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The Implementation of Bicycle Lanes in Pekanbaru City

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Abstract

The concept of fostering environmentally conscious urban environments has emerged as a pivotal strategy in mitigating the escalating pace of developmental endeavors. A prominent approach entails the adoption of eco-friendly transportation modalities, prominently featuring non-motorized conveyance options. A tangible stride towards the realization of eco-centric urban landscapes lies in the alteration of societal lifestyles, thereby cultivating heightened environmental consciousness. Across various locales in Indonesia, the prevalent trajectory towards eco-friendly living is epitomized by the widespread embrace of bicycling as a quintessential means to augment communal mobility. This burgeoning proclivity has engendered the establishment of dedicated bicycle infrastructure within urban landscapes, exemplified by communal cycling initiatives and the institution of "*Car Free Day*" initiatives. Moreover, Pekanbaru City—characterized by its distinctive topography, climate dynamics, and idiosyncratic urban features—presents a distinct milieu that accentuates the complexities entailed in orchestrating widespread bicycle utilization. Therefore, the objective of this study is to explore how the deployment of bicycle lanes can be tailored to accommodate the community's demands for bicycle usage, the demographics of bicycle users, and the appropriateness of bicycle lane integration.

Keywords: requirements for implementing, bicycle lanes, characteristics, bicycle users

Introduction

The emergence of environmentally conscious urban planning has become essential to counterbalance the escalating pace of urban development. One approach is the promotion of eco-friendly transportation options, particularly non-motorized vehicles. Across various cities in Indonesia, the adoption of bicycles as a sustainable mode of transportation is increasingly prevalent, contributing to community mobility (Martínez et al., 2024). However, the feasibility of bicycles as a sustainable mode of transportation is contingent upon the accessibility of urban public transportation. In Pekanbaru City, the integration of bicycles into the transportation network is closely linked with the availability of public transit options. Presently, Pekanbaru grapples with a significant volume of motorized vehicles, primarily comprising private automobiles (Wijaya et al., 2023). For this reason, effective implementation of bicycle lanes necessitates concerted efforts to curtail private vehicle usage.

Numerous inhabitants of Pekanbaru have actively engaged in cycling communities, signaling a notable enthusiasm for such initiatives. These community involvements serve as catalysts for a transformative shift towards fostering an environmentally conscious urban lifestyle (Romadhon & Murwadi, 2023). Additionally, governmental support has been instrumental, with initiatives like the establishment of bicycle lanes on designated holidays, often coupled with environmental campaigns such as "*Car Free Day*" along Dipenegoro, Gajah Mada, and Sudirman Streets.

The introduction of bicycle lanes in Pekanbaru stands to capitalize on the nascent stages of the city's eco-conscious endeavors, exemplified by initiatives like pedestrian-friendly thoroughfares (Fosgerau et al., 2023). Here, the implementation of bicycle lanes signifies a commitment to fostering sustainable transportation practices within a culturally rich and environmentally aware community. Central to this study is the inquiry into the opportunities for implementing bicycle lanes in Pekanbaru, taking into account the specific needs and criteria.

Objectives and Targets

This research endeavors to broadly explore the feasibility of introducing bicycle lanes in Pekanbaru City, aligning with the city's aspirations to embody a cultured and environmentally conscious urban environment. Specific objectives include identifying the community's demand for bicycle infrastructure, delineating criteria for the implementation of bicycle lanes, elucidating patterns of bicycle usage, assessing factors influencing the establishment of bicycle lanes, and strategizing for the integration of bicycle lanes into Pekanbaru City's urban landscape.

Literature Review

Bicycles form an integral part of road networks, delineated by marked or unmarked lanes wide enough for a single bicycle to pass alongside the road separator. Roads serve as vital transportation infrastructure, playing a pivotal role in the transportation sector, particularly in fostering economic growth and harnessing regional development potential (Rivera Olsson & Elldér, 2023). Bicycle lanes, commonly known as bike lanes, represent designated pathways exclusively for cyclists and non-motorized vehicles. Typically, these dedicated lanes are segregated from motorized traffic to bolster safety, complemented by associated facilities (Enrico & Silitonga, 2021). Nurfahmi (2018) highlights that the absence of bicycle lanes instills a sense of insecurity among cyclists navigating roads, given the need to share space with motor vehicles. The distinct physical attributes of bicycles compared to motor vehicles demand different safety standards for cyclists, highlighting a discrepancy in the right-of-way. Devin *et al*. (2021), backed by the American Association of State Highway and Transportation Officials (AASHTO), delineate bike lanes as purpose-built road segments catering to cyclists, typically delineated by pavement markings and signage, generally allocated for a single lane in alignment with traffic flow, unless configured for dual carriageways. Priambodo *et al*. (2015) introduce three methodologies for bicycle lane design, outlined as follows.

a. Bike Path

A bike path is a specialized lane exclusively designated for bicycles, physically segregated from motor vehicle traffic. Typically, this separation is achieved through the use of fences or additional median strips (Hsu et al., 2023). The design of such lanes necessitates a separate pathway from vehicles, with a width of 1 meter, providing ample space for a single bicycle to pass with clearance on both sides. The primary advantage of this lane is the enhanced safety it offers to cyclists, who are not required to share the road with motor vehicles.

Figure 1. Bike Path Design

b. Bike Lane

A bike lane is a segment of the roadway specifically allocated for bicycles, often distinguished solely by road markings or distinct pavement colors. This design is widely implemented in multiple regions across Indonesia, including Jakarta, Bandung, Semarang, and Yogyakarta. Unlike other bicycle lane configurations, bike lane designs do not necessitate the allocation of new land; instead, they utilize existing space within motor vehicle lanes (Dalla Chiara et al., 2023), demarcated solely by road markings or signage, such as lane markings designated for cyclists.

Figure 2. Bike Lane Design

c. Bike Route

A bike route is a designated part of the traffic lane for bicycles that is integrated into the main road without physical separation.

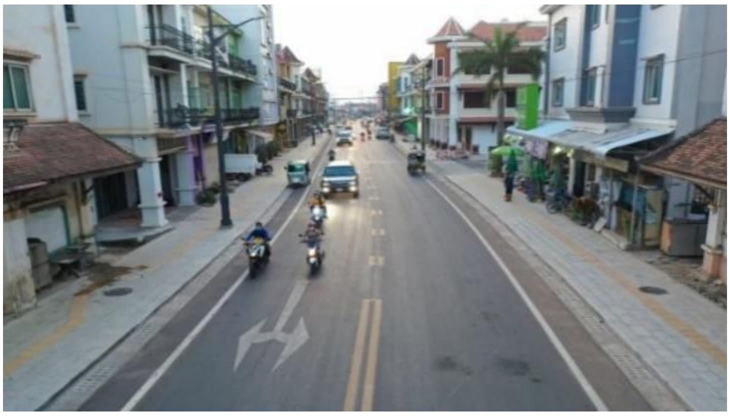


Figure 3. Bike Route Design

Bicycle Lane Facilities

Several criteria must be fulfilled for bicycle lanes, encompassing safety, comfort, freedom from motorized vehicles, and the presence of signs, markings, or curbs (concrete road dividers). Physical protection serves as a key facility within bicycle lanes (Widyaningrum et al., 2023), aiming to establish motor vehicle-free zones, with designs tailored to the specific roadside conditions of each area. Moreover, meticulous planning of surface materials is crucial, as it contributes to cyclist safety. For instance, strategically placing manhole covers perpendicular to the bicycle lane is one such measure (Devin *et al*., 2021). Furthermore, the painting and marking of bicycle lanes must be clear and comprehensive, with their placement tailored to their intended purpose. Uniform coloring of lane markings is essential to enhance cyclists' comprehension. Signs should be prominently displayed and fully informative following their designated function and providing guidance, warnings, commands, or prohibitions to road users. Additional indispensable amenities include supplementary facilities like shading crucial for providing relief from intense heat or rain, thereby ensuring cyclists' comfort and safety during biking endeavors (Zhao & Manaugh, 2023). Another vital complementary feature is lighting, serving to illuminate pathways and enhance cyclists' safety during nighttime activities (Devin *et al*., 2021).

Figure 4. Bicycle Lane Marking Coloration

In situations of high pedestrian volume, it becomes imperative to establish dedicated bicycle lanes by extending the sidewalk up to 2 meters to delineate the bicycle lane from adjacent traffic lanes. Typically, cycling speeds range from 10 to 20 km/h. However, under the following conditions, adjustments can be made accordingly.

a. If the spatial configuration allows for adaptation to cycling speeds of 30 km/h, integration can proceed seamlessly without the need for significant alterations.

b. If the desired minimum speed exceeds 20 km/h, an increase in the width of the bicycle lane by 0.6 to 1 meter is warranted (Anshori, 2018).

Green Transportation

The proliferation of vehicles not only amplifies oil consumption but also exacerbates air pollution in Indonesia. Presently, the country hosts over 20 million motorized vehicles, with motorcycles constituting 60% of this figure. Additionally, car ownership is growing at a rate of approximately 3–4% annually, while motorcycles exhibit an even higher growth rate of over 4% per year. To mitigate the adverse impacts of escalating vehicle numbers in urban areas, the development of sustainable transportation strategies is imperative. Sustainable transportation serves as a countermeasure to the shortcomings of transportation policies, practices, and systems established over the past half-century (Primastuti & Puspitasari, 2021). Aligned with initiatives outlined by Indonesia's Ministry of Public Works and Housing in 2017, green transportation encompasses endeavors to design pathways and amenities that seamlessly connect the following:

a. Public transportation hubs to pedestrian walkways, and
b. Public transportation hubs to bicycle lanes.

Additionally, the adoption of green transportation constitutes one aspect of utilizing eco-friendly fuels, to minimize gas emissions and mitigate adverse environmental effects. Below are examples of environmentally friendly fuel options:

a. Electricity
b. Biofuels
c. Natural gas

Bicycle Lane Placement

The positioning of bicycle lanes significantly influences the comfort of cyclists. When these lanes intersect with other traffic paths like bus lanes and pedestrian walkways, it becomes imperative to guarantee appropriate placement to ensure the safety and convenience of cyclists. This may entail the installation of barriers or separators from other traffic lanes. Afida (2015) delineates several design approaches for bicycle lanes, as follows.

a. Dedicated Bicycle Lanes

   These lanes physically segregate bicycle traffic from motor vehicle lanes using safety barriers or by being situated separately from the roadway.

b. Bicycle Lanes Integrated with Traffic Lanes

   These lanes are delineated solely by road markings or different pavement colors, integrated within traffic lanes.

Ichda (2016) elaborates on the selection of bicycle lanes based on the function and road class in urban areas, as presented in Table 1 below.

Table 1. Selection of Bicycle Lanes on Roadways and Sidewalks Based on Function and Road Class in Urban Areas

Road Class	Main Road	Secondary Road	Tertiary Road
Primary Artery	A	A	A
Primary Collector	A	A	A
Primary Local	C	C	C
Primary Environment	C	C	C
Secondary Artery	A/B	A/B	A/B
Secondary Collector	B/C	B/C	B/C
Secondary Local	B/C	B/C	B/C
Secondary Environment	B/C	B/C	B/C

Source: Ichda (2016)

Notes:

A : Protected bicycle lane type (on or off the road)

B : Bicycle lane type on sidewalks

C : Bicycle lane type on roadways

The Concept of Bicycle Lanes

The concept of bicycle lanes, as outlined in the Standard Geometric Design for Urban Roads in 1992, specifies the minimum widths for bicycle lanes as follows:

a. A bicycle lane should have a minimum width of 2.0 meters;

b. For Type II, Class I, and Class II roads, the minimum width for a combined bicycle and pedestrian lane is 3.5 meters, whereas for Type II and Class III roads, it is 2.50 meters;
c. The minimum width for a combined bicycle and pedestrian lane may be reduced by 0.5 meters under conditions of low traffic volume or along bridges exceeding 50 meters in length;
d. The minimum width for the horizontal clearance between bicycle lanes and traffic lanes is 1 meter (Afida, 2015).

Bicycle lane placement on roadways should not compromise the width of motor vehicle lanes, as outlined by Indonesia's Directorate General of Highways in 2021 concerning the Design of Cyclist Facilities. The dimensions of bicycle lanes are depicted in Figure 5 below.

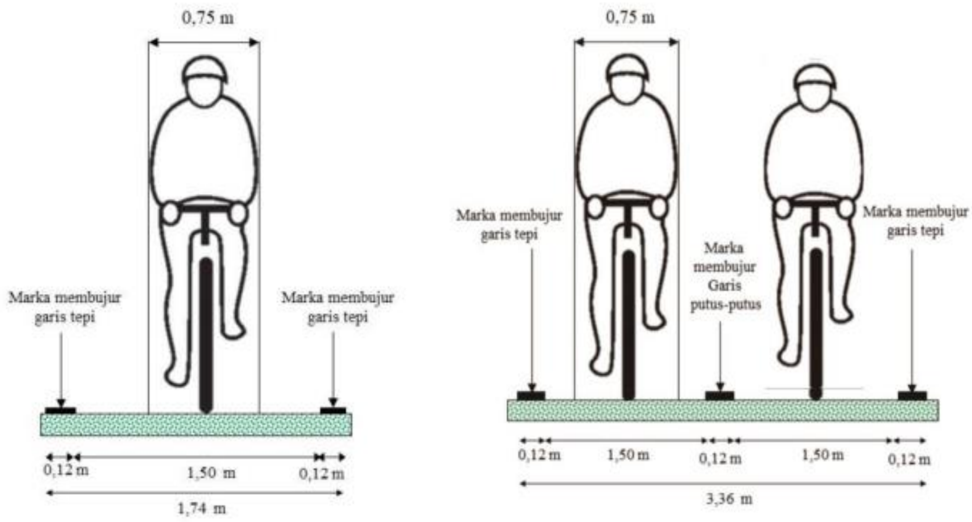


Figure 5. Width of Single Direction Bicycle Lanes (1a) and Width of Two-Way Bicycle Lanes (1b) (Source: Indonesia's Directorate General of Highways in 2021 on Cyclist Facility Design)

The allocation of bicycle lane width on roadways maintains the width of motor vehicle lanes. Main and secondary roads feature motor vehicle lane widths of 3.5 meters, while tertiary roads have widths of 2.75 meters. The road width configurations after the installation of bicycle lanes are illustrated in Figures 6 and 7 below.

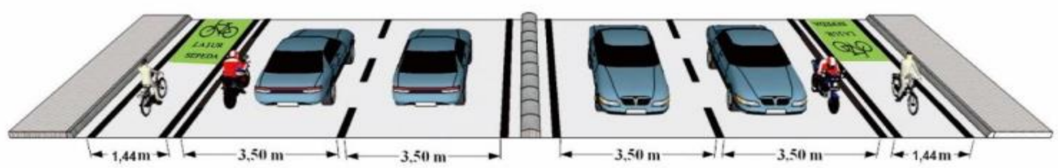


Figure 6. Width Conditions for Secondary Roads (Source: Indonesia's Directorate General of Highways in 2021 on Cyclist Facility Design)

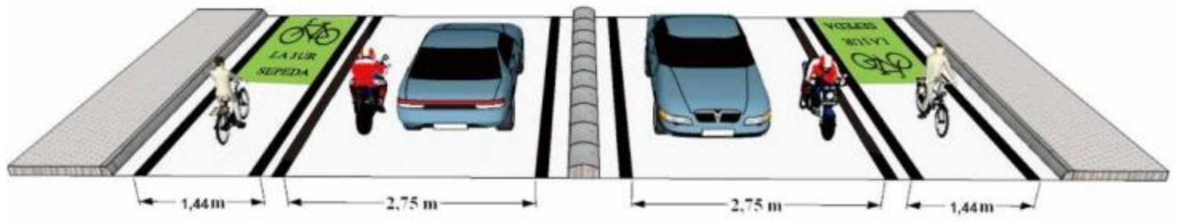


Figure 7. Width Conditions for Tertiary Roads (Source: Indonesia's Directorate General of Highways in 2021 on Cyclist Facility Design)

Principles of Bicycle Network Planning

According to Mungkasa (2021), there are several principles governing the planning of bicycle networks, as follows.

a. Establishing networks that link starting points to destinations, catering to primary destinations and transit routes. Encompassing the entire area yields greater benefits than partial coverage.
b. Planning for diverse users, taking into account their physical capabilities, safety perceptions, trip types, and travel requirements.
c. Designing bicycle networks with facilities that serve various functions and cater to a wide range of users.
d. Minimizing travel outside designated lanes.
e. Ensuring the safety of cyclists.
f. Providing rest areas at regular intervals.
g. Striking a balance between current and future needs, improving existing conditions, and considering areas with the potential to be integrated into the bicycle network.

Research Method

This study is driven by the aspiration to foster a cultured society and cultivate an environmentally conscious urban environment. Addressing the use of bicycles to mitigate motor vehicle dependency necessitates the implementation of bicycle lanes tailored to the needs and appropriate criteria of the city of Pekanbaru. The criteria for establishing bicycle lanes are derived from an extensive literature review, providing insights into the methodologies of their implementation. From this review, various aspects such as the types of bicycle lanes, associated infrastructure, and integration with public transportation systems can be discerned.

The criteria formulated from the literature review are intricately linked to the current circumstances in the city of Pekanbaru. Consequently, observations and surveys are conducted to ascertain the criteria, requirements, and usage patterns of bicycles. The research required a sample of 80 individuals, comprising respondents from the cycling community. Additionally, interviews were conducted with pertinent government agencies in Pekanbaru, including the Department of Transportation, the Department of Public Works, the Environmental Agency, and the Regional Development Planning Agency, to gain insights into policies regarding bicycle lanes.

The method employed in this research was quantitative, utilizing analytical tools. The selection of this method and analytical tools was driven by the objective of elucidating the relationships among several variables that influenced the feasibility of implementing bicycle lanes. These variables served as indicators in this study. The relationships among these variables were analyzed using ordinal scale data. This analysis aimed to uncover correlations, particularly between the characteristics of cyclists and the criteria for implementing bicycle lanes, as well as the community's cycling needs.

The findings of the analysis were combined with the results of the analysis of community needs in bicycle usage and criteria for implementing bicycle lanes. This combined outcome was utilized to address the feasibility of implementing bicycle lanes.

Research Location and Time

The research took place in the city of Pekanbaru, Riau Province. Pekanbaru was intentionally selected for its rapid transportation infrastructure development but relatively low bicycle usage. The study was conducted from October to November 2022.

Figure 8. Map of Gajah Mada Street

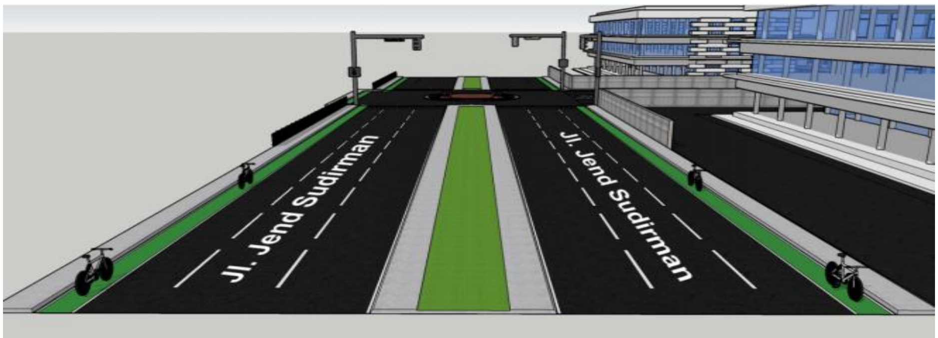


Figure 9. Map of Sudirman Street

Figure 10. Map of Dipenegoro Street

Research and Discussion

Discussion of Survey Data Analysis Results

Based on the findings of the field survey, the sample size from a population of 97 individuals was determined. The researcher applied the Slovin formula with a confidence level of 95% and a margin of error of 5%, resulting in a sample size of 80 individuals. The Slovin formula is applicable for determining sample sizes when the study aims to estimate population proportions accurately.

Three cycling communities participated in the questionnaire survey for this study. These communities include Tambusai Cycling Club (TCC) with 32 members, Komunitas Ontel Pekanbaru (KOPA) with 31 members, and Tampan Gowes Community (TGC) with 34 members. Thus, the total population obtained from the field survey is 97 individuals.

Upon analysis using the Slovin formula, the sample sizes obtained are as follows: Tambusai Cycling Club (TCC) with 26 individuals, Komunitas Ontel Pekanbaru (KOPA) with 26 individuals, and Tampan Gowes Community (TGC) with 28 individuals, resulting in a total sample size of 80 individuals used in this study.

1. Characteristics of the Questionnaire Data

The following section provides an overview of the respondents to the questionnaire, elucidating various characteristics of the research participants who contributed responses to the survey. The respondents' profiles are categorized as follows.

a. Profile of Respondents by Gender

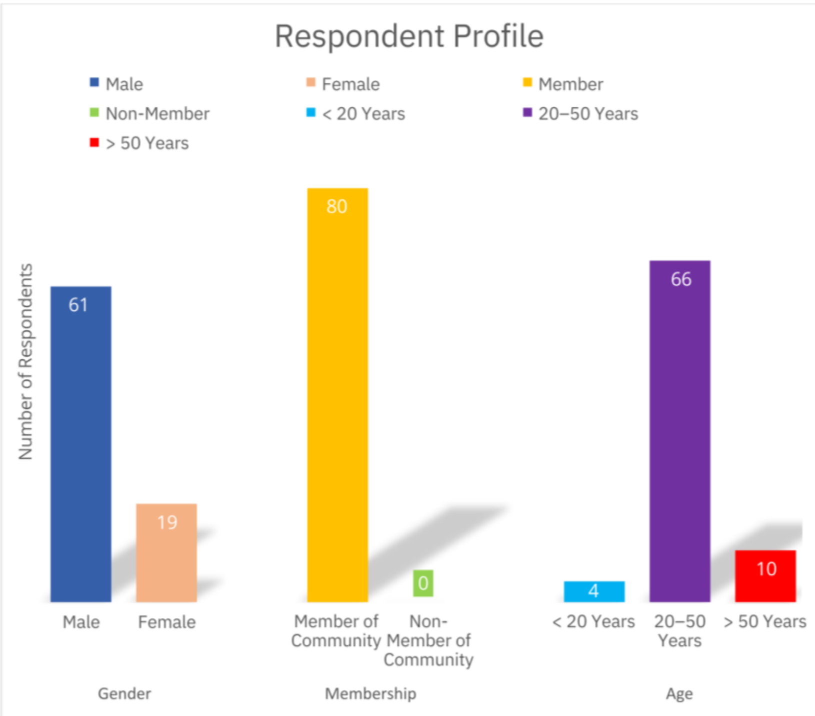
An analysis of the gender distribution among bicycle users is essential in this study to ascertain the proportion of male and female cyclists in the city of Pekanbaru. Upon scrutinizing the questionnaire data, it was found that out of the 80 respondents, 76% or 61 individuals were male, while 24% or 19 respondents were female. These findings suggest a predominant representation of male respondents in the questionnaire. The detailed questionnaire results table generated using SPSS is provided in the appendix.

b. Profile of Respondents by Age

The age distribution of bicycle users in Pekanbaru is a key factor to understand. Analysis of the questionnaire data from 80 respondents reveals that 5% or 4 respondents are under 20 years old, 82% or 66 respondents fall within the age range of 20–50 years old, and 13% or 10 respondents are over 50 years old. These findings indicate that the majority of questionnaire respondents are in the age group of 20–50 years old, highlighting the demographic profile of bicycle users in the city. The detailed results table generated using SPSS is provided in the appendix.

c. Profile of Respondents by Membership

Upon analyzing the questionnaire data, it was found that all 80 respondents who completed the questionnaire were members of cycling communities, while none were non-members. These results suggest that the respondents who participated in the questionnaire are predominantly affiliated with cycling communities.



2. Questionnaire Data Analysis

Following the explanation of the questionnaire data characteristics, the subsequent step involves testing the validity of the questionnaire data. This is crucial to ensure the obtained data maintains a high level of accuracy and consistency. Hence, in this study, it is imperative to conduct a validity test of the research instrument.

Validity Test

Validity testing assesses the reliability level of the measuring instrument employed. An instrument is deemed valid if it demonstrates that the measuring tool used to gather the data is reliable. In essence, validity testing involves examining the content of an instrument to ascertain its accuracy in a study.

Validity testing reveals the extent to which the questionnaire can effectively measure variables in this study. It also indicates the consistency of a measuring instrument when used repeatedly. To conduct validity testing, the questionnaire instrument is considered valid if the r_{count} is > the r_{table}.

Based on the validity testing results, with a significance level of 0.05 or 5%, the critical r_{table} is 0.2199. Meanwhile, the r_{count} value in the validity test represents Pearson's correlation between statement items and the total score of the variable. Consequently, it is evident that the calculated r_{count} is greater than 0.2199 (> r_{table}). Hence, all statement items related to the variable are considered valid and meet the criteria as a measuring tool in this study.

To determine the r_{count} value (r_{xy}), the employed validity test formula was Pearson's product-moment correlation coefficient. The analysis result obtained using the validity test formula is as follows.

$$r_{xy}(r_{count}) = \frac{N\sum xy - (\sum x)\ (\sum y)}{\sqrt{(N\sum x^2 - (\sum x)^2) \times (N\sum y^2 - (\sum y)^2)}}$$

Based on the questionnaire result for question 1, the obtained value is as follows.

n = 80

$\sum x$ = 255

$\sum x^2$ = 881

$\sum y$ = 3980

$\sum y^2$ = 199970

$\sum x \times y$ = 12774

$$r_{xy} = \frac{(1021920) - (1014900)}{\sqrt{(70480) - (65025) \times (15997600) - (15840400)}}$$
$$= \frac{7020}{29283.54}$$
$$= 0.239725 \approx \mathbf{0.240}$$

Furthermore, the r_{table} value was determined as follows

$r_{table} = n - 2$

$= 80 - 2$

$= 78$

Based on the calculation above, the obtained result was 78. This value was then converted to the two-tailed significance level table at 5%, resulting in a r_{table} value of 0.2199.

Table 2. Validity Test Results for Questionnaire Respondents

No.	Items	r_{count}	r_{table}	Result
1.	I use a bicycle for daily activities.	0.240	0.2199	Valid
2.	I use a bicycle for exercise or recreation.	0.536	0.2199	Valid
3.	I use a bicycle only on weekends or after busy hours.	0.583	0.2199	Valid
4.	I do not use a bicycle for daily activities because the destination is far.	0.550	0.2199	Valid
5.	I use a bicycle individually.	0.374	0.2199	Valid
6.	I feel less confident cycling in heavy traffic conditions.	0.457	0.2199	Valid
7.	I agree with the reinstatement of bicycle lanes along Gajah Mada, Diponegoro, and Sudirman Streets.	0.457	0.2199	Valid
8.	I need a bicycle lane when cycling.	0.466	0.2199	Valid
9.	I would be enthusiastic about bicycle lane implementation in urban areas.	0.550	0.2199	Valid
10.	Cycling can reduce the fuel subsidy burden.	0.659	0.2199	Valid
11.	Cycling can reduce congestion levels in Pekanbaru.	0.515	0.2199	Valid
12.	Cycling can reduce traffic accident rates in Pekanbaru.	0.652	0.2199	Valid
13.	Cycling can reduce air pollution levels in Pekanbaru.	0.583	0.2199	Valid

Source: Research Results (2022)

Following the completion of descriptive statistical analysis, the intensity of responses was gauged employing the Likert scale. The outcomes are delineated below.

a. Bicycle Usage Time
   1) 43 respondents, or 53.8%, reported using bicycles for daily activities.
   2) 75 respondents, or 93.8%, stated they use bicycles for exercise or recreation.
   3) 68 respondents, or 85.1%, mentioned using bicycles only on weekends or after busy hours.
   4) 45 respondents, or 56.3%, do not use bicycles for daily activities due to distant destinations.

b. Cycling Habit
   1) Regarding cycling habits, 48 respondents, or 60.1%, indicated using bicycles individually.

c. Confidence Level

1) In terms of confidence while cycling, 42 respondents, or 52.6%, expressed feeling less confident in heavy traffic conditions.

d. Bicycle Lane Needs
   1) 74 respondents, or 92.5%, agreed with reinstating bicycle lanes along Gajah Mada, Diponegoro, and Sudirman Streets.
   2) 78 respondents, or 97.6%, expressed the need for bicycle lanes when cycling.
   3) 75 respondents, or 93.8%, expressed enthusiasm for having bicycle lanes in urban areas.

e. Public Opinion on Bicycle Usage
   1) 75 respondents, or 93.8%, agreed that cycling can reduce the burden of fuel subsidies.
   2) 76 respondents, or 95.1%, agreed that cycling can reduce congestion levels in Pekanbaru.
   3) 65 respondents, or 81.3%, agreed that cycling can reduce traffic accident rates in Pekanbaru.
   4) 75 respondents, or 93.8%, agreed that cycling can reduce air pollution levels in Pekanbaru.

3. Factors Influencing the Desire to Cycle

Road segments allocated for bicycle lanes are distinctly separated from lanes for motor vehicle traffic, demarcated by road markings or signs. Roads witnessing moderate to high bicycle usage warrant the allocation of bicycle lanes, distinctly segregated from lanes designated for motor vehicles. Ensuring the safety and comfort of cyclists is imperative for facilitating enjoyable cycling experiences; thus, meticulous attention should be paid to the placement of bicycle lanes (Devin *et al*., 2021).

a. Aspect of Safety and Security

In this aspect, the safety of the designated bicycle lane must be carefully considered to ensure that cyclists using it feel safe and are free from threats posed by other road users. This can be achieved through the following criteria.

   1) Availability of boundary lines for the bicycle lane. Respondent W7S7P4 mentioned the presence of boundary lines or road markings.
   2) Compliance of other vehicle users with road section regulations. Respondent W3S3P4 highlighted the non-compliance of other vehicle users with traffic rules.
   3) Orderliness of road users in parking their vehicles. Respondent W1S1P4 expressed concerns about the lack of orderliness among other vehicle users when parking their vehicles.

Figure 11. Orderliness of road users in parking vehicles
(Source: Research Results, 2022)

Furthermore, lighting systems play a vital role in aiding cyclists during nighttime or in dark conditions, significantly reducing the risks associated with obstacles like potholes, temporary barriers, sudden oncoming vehicles, and others. The existence of proper lighting is also essential to mitigate the potential for criminal incidents.

This assertion is in line with Mungkasa (2021). The inclination towards cycling is primarily rooted not only in the desire for protection against criminal activities but also in the necessity for safety from the dangers posed by high-speed vehicles on the road and their disregard for traffic regulations.

b. Aspect of Comfort

In assessing comfort levels, the higher the quality is, the better the comfort level of a road segment will be, making it suitable as a bicycle lane route.

a. The availability of adequate traffic lights on the bicycle lane. Respondent W10S10P4 emphasized the necessity for cycling facilities.
b. The presence of dedicated bicycle parking spaces on the bicycle lane. Respondent W1S1P4 underscored the importance of dedicated bicycle parking.
c. The presence of markings to delineate the bicycle lane. Respondents W2S2P4 and W7W7P4 highlighted the need for road markings.
d. The presence of bicycle crossing lanes for cyclists to cross the road. Respondent W10S10P4 emphasized the necessity of cycling facilities.

This is consistent with Mungkasa (2021), where comfort is understood differently by cyclists, including having comprehensive facilities and infrastructure for cycling.

c. Aspect of Attraction

When evaluating the appeal of dedicated bicycle lanes, one crucial aspect to consider is the presence of shade along the road, such as the availability of trees lining the bicycle lane route. This feature enhances the comfort of cyclists traversing routes within the study area.

Figure 12. The availability of trees around the bicycle lane

(Source: Research Results, 2022)

During the implementation of Car Free Day (CFD) by the Pekanbaru government, held every Sunday morning on Sudirman Street in front of the governor's office, various communities gather, including cycling communities. This initiative aims to alleviate congestion, reduce pollution, and promote healthy living. The location serves as a focal point for cyclists in Pekanbaru, attracting many enthusiasts for both recreational and social purposes. Research findings indicate that the area's appeal is bolstered by the presence of streetlights, strategic placement of vegetation along the roadside, and favorable road conditions, all contributing to the comfort of cyclists traveling through the area.

d. Aspect of Important Reasons

Clear and significant reasons are crucial to stimulate pedestrians' interest in walking. Respondent W1S1P7 articulated that cycling can alleviate the burden of fuel subsidies. In addition, respondent W2S2P8 stated that cycling can mitigate congestion in the city of Pekanbaru. Furthermore, respondent W5S5P10 emphasized that cycling can reduce air pollution when the community is united.

This finding is consistent with Mungkasa (2021), suggesting that a variety of reasons lead to a stronger inclination to cycle.

Public Perception Regarding the Implementation of Bicycle Lanes

While there is a significant number of cyclists in Pekanbaru, the city lacks a comprehensive network of dedicated bike lanes, with only a few existing in certain areas. This is supported by the fact that over 50% of cyclists agree or strongly agree with the reinstatement of bike lanes along Sudirman, Gajah Mada, and Diponegoro Streets.

Moreover, cyclists show great enthusiasm for the provision of bicycle lanes. Many of them support this initiative as it enhances safety while cycling. This is evidenced by over 50% of respondents agreeing or strongly agreeing with this notion. The presence of bicycle lanes alleviates cyclists from the hazards posed by undisciplined motor vehicle users on the road.

However, as residential areas continue to grow and expand towards the outskirts of the city, cyclists face longer distances to reach their daily destinations. Nevertheless, bicycles offer an affordable and environmentally friendly mode of transportation that complements travel needs. Therefore, the development of existing infrastructure is crucial to enhance it, encouraging bicycle usage and ensuring safety, comfort, and smooth traffic flow for both motor vehicle users and cyclists.

Moreover, cycling contributes to reducing the burden of fuel subsidies. This is evidenced by the agreement of over 50% of cyclists with this statement. Transitioning to cycling implies a reduction in fuel consumption, as bicycles are eco-friendly vehicles that align with "*Green Transportation*" initiatives.

The level of congestion in the city of Pekanbaru is significant. One proposed solution is the utilization of bicycles. More than 50% of cyclists either agree or strongly agree that cycling can mitigate congestion in Pekanbaru. The community's adherence to road regulations further bolsters this assertion. The lack of discipline among the community is a contributing factor to accidents in Pekanbaru. The adoption of bicycles for daily activities can also diminish the rate of traffic accidents in the city. This is supported by the agreement or strong agreement of over 50% of respondents with this statement. The presence of a substantial number of cyclists holds the potential to lower motor vehicle speeds, thereby reducing the occurrence of traffic accidents.

Motor vehicles not only precipitate traffic accidents but also exacerbate air pollution. The utilization of bicycles presents a solution to curtail air pollution and greenhouse gas emissions. This is corroborated by the agreement or strong agreement of more than 50% of respondents. According to the Centers for Disease Control and Prevention (CDC) in the United States, motor vehicles and cars contribute to over 50% of asthma cases triggered by urban air pollution (Source: U.S. Department of Housing and Urban Development).

Challenges in Implementing Bicycle Lanes

The challenges associated with implementing bicycle lanes in the city of Pekanbaru are multifaceted, particularly due to the prevalence of congested roads. Over 52.6% of respondents express a lack of confidence when cycling in heavy traffic conditions, leading to feelings of insecurity and discomfort. This finding is consistent with Mungkasa (2021), highlighting busy roads as a primary obstacle to implementing bicycle lanes.

Another significant hurdle is the presence of street vendors and vehicles parked along the roadside. Respondent W1S1P4 emphasized the necessity for designated bicycle parking areas, aligning with the observations made by Mungkasa (2021). Common impediments to the establishment of bicycle lanes include steep inclines, speed bumps, roadside parking, the presence of street vendors, and traffic signals.

Efforts to integrate cycling into the transportation network, alongside recreational and sporting activities, have been ongoing for decades. While progress has been made in certain regions, in others, the realization of such initiatives remains distant from expectations.

Numerous valuable lessons—encompassing both positive and negative aspects, along with exemplary practices—can be gleaned from the successful endeavors of other cities to date. Consequently, endeavors to expedite walking and cycling as modes of transportation can be rendered more efficient and effective.

A notably effective approach, dubbed "*seeing is believing*," allows stakeholders (including governmental and non-governmental entities) to witness the outcomes before fully embracing the implementation. Conducting small-scale or even city-wide pilot projects is one avenue to pursue (Mungkasa, 2021).

Efforts to map stakeholders are imperative to ensure that all parties contribute to the process of formulating vision, planning, executing, monitoring, and evaluating. In other words, no one should be left behind (Mungkasa, 2021).

Conclusion

Following the completion of the research and the comprehensive explanation of the results and discussions, several conclusions come to light.

1. The profile of bicycle users in Pekanbaru predominantly comprises males, aged between 20 and 50 years. Their primary motivation for cycling is exercise, and they often prefer group cycling activities.
2. Analysis reveals that 92.5% of respondents support or strongly support the reinstatement of dedicated bicycle lanes in Pekanbaru, while 93.8% express enthusiasm for the establishment of such lanes in urban areas.
3. However, numerous obstacles hinder the widespread adoption of cycling in Pekanbaru, including the lack of bicycle lanes in certain areas, on-road parking, the presence of street vendors, and insufficient cyclist-specific facilities. Establishing adequate bicycle lane infrastructure, including lanes free from motor vehicle traffic, has the potential to bolster public interest in cycling, providing cyclists with safe, comfortable environments to congregate and express their passion for cycling. To realize this vision, collaboration, and coordination between governmental and non-governmental entities are imperative for the successful implementation of bicycle lanes following the proposed plan.

Recommendations

In considering the implications of the study findings, the following recommendations are put forth.

1) In light of the characteristics of bicycle lanes, the government must ensure the provision of adequate bicycle lanes to enhance the safety and comfort of cyclists.
2) A close collaboration between governmental and non-governmental entities is crucial for the effective implementation of the bicycle lane plan within the study area.
3) The government should formulate policies, plans, and strategies with clearly defined and regularly reviewed targets for bicycle lane planning in the study area.
4) The public should prioritize the use of environmentally friendly transportation and uphold the maintenance of bicycle lane facilities once they are established.
5) For future research endeavors, researchers should incorporate and expand questionnaire variables to yield more specific outcomes.

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