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Wetland Conversion into Residential Areas and Associated Environmental Conditions: A Qualitative Study in Kampar, Riau

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Abstract: Wetland conversion into residential areas may alter land-surface characteristics, water retention, and local hydrological conditions. Limited site-specific qualitative assessments have documented these environmental conditions in residential developments on former wetlands. **Objective:** This study aimed to examine wetland conversion and associated environmental conditions at Payung Sekaki Housing Complex, Kampar, Riau, Indonesia. **Method:** A qualitative descriptive approach was employed using interviews, field observations, and available documentation. Data were analyzed descriptively and organized into themes concerning residential development and environmental conditions. **Findings:** Landfilling transformed former wetlands into residential areas with supporting facilities. Observations identified uneven ground surfaces and turbid, rust-colored, odorous household water. Surface runoff was particularly noticeable in Blocks H, G, and F during heavy rainfall. Residents reported flooding in 2015 and 2024, with inundation in some areas lasting approximately one week during the 2015 event. **Implications:** These findings support the consideration of land suitability, drainage management, and water-quality assessment in residential planning. **Originality:** This study integrates land-use transformation, observable environmental conditions, and residents' historical flooding experiences within a single qualitative assessment of a former wetland settlement in Kampar.
Keywords: environmental conditions; flooding; land-use conversion; residential development; surface runoff; wetlands

INTRODUCTION

Land-use conversion from wetlands into residential areas represents an increasingly important environmental issue associated with urban expansion and the growing demand for housing. Although residential development contributes to the provision of housing and supporting infrastructure, the transformation of wetlands may alter natural water-storage functions, vegetation cover, soil conditions, and local hydrological processes. Wetlands provide important ecosystem services, including water retention and flood regulation, while the expansion of built-up surfaces can modify infiltration opportunities and surface runoff patterns (Mitsch & Gosselink, 2015; Rajib et al., 2020; Fletcher et al., 2024). In Indonesia, changes in land cover and the development of flood-prone areas have raised concerns regarding the environmental sustainability of residential settlements (Tarigan, 2016; Martono et al., 2022; Rahayu et al., 2023; Giofandi et al., 2024). These concerns are relevant to Payung Sekaki Housing Complex, Kualu Village, Kampar Regency, Riau Province, where an area previously characterized by wetlands and vegetation has been converted into residential land through landfilling activities. Preliminary observations and residents' accounts indicate uneven ground-surface conditions, turbid and rust-colored household water, noticeable surface runoff during heavy rainfall, and flooding events in 2015 and 2024. These conditions highlight the importance of examining residential development in relation to the environmental characteristics of former wetlands.

Previous studies have examined the relationships among land-use conversion, wetland functions, hydrological processes, and environmental conditions in residential areas. McHarg (1969) and Rossiter

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(1996) established the importance of considering natural land characteristics and land suitability in spatial planning, while Chow et al. (1988) and Butler et al. (2018) provided fundamental frameworks for understanding runoff generation and urban drainage management. More recent studies have demonstrated that land-cover changes, wetland degradation, and increasing impervious surfaces can influence runoff and flood susceptibility (Rajib et al., 2020; Rojas et al., 2022; Banjara et al., 2024; Fletcher et al., 2024). Research in Indonesia has also addressed wetland conversion and flood hazards in residential settlements, including studies conducted by Heldayani (2016), Tarigan (2016), Putri (2024), and Eraku et al. (2025). Furthermore, Rahayu et al. (2023) examined the influence of land cover, rainfall, and topography on flood risk, while Giofandi et al. (2024) reviewed the importance of land-use change in urban flood susceptibility assessment. Other investigations have highlighted the relevance of groundwater characteristics, water-quality monitoring, and environmental conditions in residential areas (Ikonen et al., 2013; Fahimah et al., 2023; Syafrizal et al., 2024). Collectively, these studies provide an interdisciplinary foundation for understanding environmental conditions associated with land-use transformation.

Despite the substantial literature addressing land-use change and environmental impacts, the relationship between wetland conversion and residential environmental conditions remains highly dependent on local physical and hydrological characteristics. Previous investigations have frequently emphasized land-cover classification, flood susceptibility, hydrological modeling, or specific environmental indicators, whereas site-specific qualitative descriptions can provide complementary information regarding residents' experiences and observable environmental conditions (Martono et al., 2022; Rojas et al., 2022; Banjara et al., 2024; Fletcher et al., 2024). Although Heldayani (2016) examined wetland conversion and flood hazards in a residential context, the geographical and environmental characteristics of that study cannot be assumed to represent conditions in Kampar Regency. Similarly, research concerning wetland suitability and land-use conversion has demonstrated the importance of local environmental characteristics without establishing that the same environmental processes occur uniformly across different residential developments (Putri, 2024; Eraku et al., 2025). Within the literature considered in this study, an integrated qualitative account of wetland conversion, household water conditions, surface runoff, ground-surface characteristics, and residents' historical flooding experiences at Payung Sekaki Housing Complex has not been identified. Therefore, the contribution of the present study lies in providing a location-specific qualitative description that brings together these environmental dimensions. Rather than establishing quantitative causal relationships, the study offers contextual evidence that may support preliminary environmental assessment and identify priorities for subsequent technical investigations.

Based on the identified environmental concerns and research gap, this study aims to describe the conversion of wetlands into residential land at Payung Sekaki Housing Complex, Kualu Village, Kampar Regency, Riau Province, and examine the environmental conditions associated with this transformation. Specifically, the study seeks to identify the characteristics of land-use conversion and residential development, describe observable ground-surface and household water conditions, examine reported surface runoff patterns during rainfall, and document residents' experiences of flooding events in 2015 and 2024. A qualitative descriptive approach is employed using interviews, field observations, and available documentation to develop a contextual understanding of the study area. The findings are expected to contribute site-specific information relevant to environmental management, residential land-use planning, and the identification of issues requiring further hydrological, geotechnical, and water-quality assessment.

RESEARCH METHOD

Research Design and Study Area

This study employed a qualitative descriptive approach to examine wetland conversion into residential land and its associated environmental conditions at Payung Sekaki Housing Complex, Kualu Village, Kampar Regency, Riau Province, Indonesia. The qualitative descriptive approach was selected to provide a contextual understanding of land-use transformation and environmental conditions based on field observations, interviews, and available documentation. The investigation focused on the development of residential areas on former wetlands and the environmental conditions associated with this transformation, particularly ground-surface characteristics, household water conditions, surface runoff, and historical flooding events. This approach enabled the study to describe observable environmental phenomena and residents' experiences without assuming direct causal relationships between land-use conversion and environmental changes.

Data Collection

Data were collected through interviews, field observations, and available documentation. Interviews provided information regarding previous land-use conditions, residential development, household water utilization, surface runoff, and residents' experiences of flooding in 2015 and 2024. Field observations were used to examine the physical characteristics of the residential area, including the distribution of built-up surfaces, visible ground-surface conditions, household water characteristics, and locations where surface runoff was identified. Particular attention was given to the rear sections of the housing complex and Blocks H, G, and F, where environmental conditions were described in the research findings. Available documentation was used as supplementary information to support the description of the study area and its environmental context. The collected information was interpreted according to its source, distinguishing direct field observations from residents' accounts and documentary information.

Data Analysis

The collected data were analyzed using a qualitative descriptive procedure. Information obtained from interviews, observations, and available documentation was organized into two principal themes: (1) wetland conversion and residential development, and (2) environmental conditions associated with land-use conversion, including household water characteristics, surface runoff, and flooding. Within these themes, the findings were examined to identify recurring descriptions, observable environmental characteristics, and differences in conditions across the residential area. The results were subsequently interpreted in relation to established concepts of land suitability, wetland functions, runoff generation, and urban drainage. Relevant literature was used to provide a theoretical context for the interpretation of the findings, particularly the hydrological principles described by Chow et al. (1988), wetland characteristics discussed by Mitsch and Gosselink (2015), and urban drainage considerations presented by Butler et al. (2018). The analysis emphasized the distinction between empirical observations, residents' reported experiences, and theoretical explanations.

Scope and Methodological Limitations

The study was limited to a qualitative description of environmental conditions within Payung Sekaki Housing Complex. Observations of household water characteristics were based on visible conditions and reported domestic use rather than laboratory measurements of physical, chemical, or microbiological parameters. Similarly, indications of uneven ground-surface conditions were not supported by repeated elevation measurements or geotechnical investigations. Information concerning historical flooding events was obtained from residents' accounts and available documentation rather than continuous hydrological monitoring. Consequently, the findings were interpreted as descriptive evidence of local environmental conditions and potential associations with residential development, rather than quantitative confirmation of environmental impacts or causal relationships. Further investigations involving topographical surveys, soil testing, water-quality analysis, rainfall measurements, and drainage assessments would be necessary to evaluate these relationships more comprehensively.

RESULT AND DISCUSSION

Wetland Conversion and Residential Development

The findings indicate that Payung Sekaki Housing Complex, located in Kualu Village, Kampar Regency, Riau Province, has undergone land-use transformation from an area previously characterized by wetlands and vegetation into a developed residential environment. Based on field observations and information obtained through interviews, the development process involved landfilling activities to prepare the ground surface for residential construction. The area subsequently developed into a settlement comprising residential buildings, educational facilities, roads, and shop-houses.

This transformation illustrates changes in both land utilization and surface characteristics. Areas previously occupied by vegetation and wetland surfaces have been converted into built-up spaces. Such changes are environmentally relevant because wetlands contribute to water retention and regulate local hydrological processes. Mitsch and Gosselink (2015) emphasize the ecological importance of wetlands, particularly their role in water storage and hydrological regulation.

The observed changes in land cover may influence the movement and accumulation of rainwater within the residential area. Vegetated surfaces and exposed soil can provide opportunities for infiltration and temporary water retention, whereas compacted and built-up surfaces may restrict these processes. However, the extent of these changes in Payung Sekaki Housing Complex cannot be quantified from the available qualitative observations.

The findings also indicate differences in ground-surface conditions across the residential area. Several houses located in the rear blocks exhibited visible indications of uneven ground conditions and possible surface settlement. The rear section was also observed to be relatively lower than other parts of the housing complex.

These observations require careful interpretation. Differences in ground elevation do not necessarily demonstrate progressive land subsidence. Establishing land subsidence would require measurements of ground elevation over time. Nevertheless, the observed conditions highlight the importance of considering soil characteristics, landfilling materials, and ground stability in residential development on former wetlands.

Rossiter (1996) explains that land suitability evaluation should consider the physical characteristics of land in relation to its intended utilization. Similarly, McHarg (1969) emphasizes the importance of incorporating environmental characteristics into spatial planning. These perspectives provide a conceptual basis for understanding the relevance of land conditions to residential development at the study site.

Overall, the findings demonstrate that wetland conversion in Payung Sekaki Housing Complex has altered the physical characteristics and utilization of the area. The environmental implications of these changes should be considered in relation to local soil conditions, surface elevation, drainage infrastructure, and the hydrological characteristics of the surrounding environment.

Environmental Implications of Land-Use Conversion

Household Water Conditions

Field observations and interview findings indicate that household water in several parts of Payung Sekaki Housing Complex exhibited noticeable physical characteristics, including turbidity, rust-like coloration, and an unpleasant odor.

According to the information obtained during the study, residents generally used this water for domestic activities such as bathing and washing rather than for drinking. These findings describe the physical characteristics and reported utilization of household water within the observed residential area.

Water color, turbidity, and odor are observable characteristics that may indicate changes in water conditions. However, these characteristics alone cannot establish the presence of specific contaminants or determine whether the water meets applicable quality standards.

Fahimah et al. (2023) discuss groundwater turbidity as an important characteristic in community-based water-quality monitoring. Similarly, Ikonen et al. (2013) demonstrate the relevance of physical and chemical measurements for identifying changes in drinking-water quality.

In the present study, the observed water conditions cannot be attributed directly to wetland conversion because the available evidence does not include laboratory analyses, measurements of groundwater characteristics, or comparisons with conditions before residential development.

Potential contributing factors may include the characteristics of the water source, naturally occurring minerals, soil conditions, household distribution systems, and other environmental influences.

Therefore, the findings should be interpreted as qualitative evidence of household water conditions rather than confirmation of water contamination caused by land-use conversion. Further examination involving physical, chemical, and microbiological testing would be necessary to establish the characteristics and suitability of the water for different domestic purposes.

Surface Runoff and Rainfall Conditions

The findings indicate that surface runoff within Payung Sekaki Housing Complex varied according to rainfall conditions and location.

Based on field observations and information obtained from residents, runoff was relatively limited during periods of low- to moderate-intensity rainfall. In contrast, more noticeable surface-water movement was reported during high-intensity rainfall, particularly in Blocks H, G, and F.

These findings suggest that surface-water accumulation and movement were not distributed uniformly throughout the residential area. Differences in surface elevation, land cover, soil conditions, and drainage characteristics may contribute to variations in runoff behavior.

Chow et al. (1988) explain that runoff generation is influenced by interactions among rainfall characteristics, soil properties, land cover, and watershed conditions. This framework is relevant to understanding the environmental conditions observed at Payung Sekaki Housing Complex.

The conversion of wetlands into residential areas may alter surface-water retention and infiltration opportunities through vegetation removal, landfilling, soil compaction, and construction activities. Rajib et al. (2020) highlight the importance of wetlands and surface depressions in hydrological storage processes. Nevertheless, the present findings do not establish the magnitude of runoff changes resulting from residential development. No quantitative measurements of rainfall intensity, infiltration rates, runoff discharge, or drainage capacity were presented in the study.

Consequently, the relationship between land-use conversion and surface runoff should be interpreted as a potential hydrological association supported by the observed environmental conditions and relevant literature.

From a practical perspective, the identification of Blocks H, G, and F as locations where runoff was more noticeable provides useful preliminary information for environmental management. These locations may warrant further assessment of surface gradients, drainage connectivity, and water-conveyance conditions. Butler et al. (2018) emphasize the importance of considering local characteristics and drainage-system performance in urban stormwater management. Accordingly, future evaluations of the residential area could include drainage inspections, surface-elevation mapping, and documentation of runoff pathways during rainfall events.

Flooding Events and Local Environmental Conditions
Interview findings indicate that Payung Sekaki Housing Complex experienced flooding in 2015 and 2024. According to residents' accounts, the flooding event in 2015 was more severe than the event in 2024. In several parts of the residential area, reported inundation depths ranged approximately from adult waist level to neck level. Residents also indicated that floodwater in the rear section of the housing complex required approximately one week to recede.

These descriptions represent reported experiences of flooding rather than results obtained through direct hydrological measurements.

The variation in reported inundation conditions suggests that flooding impacts differed across the residential area. Lower-lying sections may have been more susceptible to prolonged water accumulation, particularly where drainage or water discharge was restricted.

However, determining the factors responsible for differences in inundation depth and duration would require additional information regarding ground elevation, drainage capacity, rainfall conditions, and surrounding water levels.

The reported flooding events were also associated by residents with periods of intense rainfall and water releases from a hydropower facility connected to the Kampar River. Residents indicated that information received before the 2024 flooding event enabled them to undertake preparations.

Although these accounts provide important contextual information, the relationship between hydropower operations and flooding at the residential site cannot be independently established from the available qualitative evidence. Confirmation would require operational records, river-water-level observations, and relevant hydrological data.

The findings are consistent with the general understanding that flooding results from interactions among rainfall, land-surface characteristics, drainage systems, and surrounding hydrological conditions.

Fletcher et al. (2024) discuss the complexity of urban hydrological processes and the importance of considering multiple interacting factors when examining changes in water movement and accumulation. Therefore, flooding at Payung Sekaki Housing Complex should not be attributed exclusively to wetland conversion. Rather, the observed and reported conditions indicate the need to consider land-use characteristics together with rainfall, local topography, drainage infrastructure, and the influence of the Kampar River.

Discussion of Environmental Management Implications

The findings demonstrate several environmental conditions associated with residential development on former wetland areas, including changes in land cover, uneven ground-surface conditions, observable household water-quality problems, surface runoff during intense rainfall, and historical flooding events.

Although the qualitative findings do not establish direct causal relationships among these conditions, they provide a contextual description of environmental issues relevant to residential land-use planning.

The results also share conceptual similarities with the study conducted by Heldayani (2016), which examined the conversion of lowland swamp areas into residential settlements and its implications for flood hazards in Gandus Subdistrict, Palembang City. Both studies highlight the relevance of wetland characteristics when evaluating residential development.

However, differences in geographical conditions, drainage networks, and local hydrological systems mean that findings from one location cannot be directly generalized to another.

In the context of Payung Sekaki Housing Complex, the findings suggest several considerations for environmental management. These include evaluating the suitability of former wetland areas for residential construction, examining drainage conditions in locations where runoff is frequently reported, assessing household water sources, and improving community preparedness for flooding.

The reported experiences during the 2015 and 2024 flooding events also highlight the relevance of communication and preparedness measures. Information concerning rainfall, river conditions, and potential flooding may assist residents in preparing for environmental hazards when communicated accurately and in a timely manner.

Nevertheless, recommendations for specific engineering interventions should be supported by additional technical assessments, including topographical surveys, drainage-system evaluations, soil investigations, and water-quality testing.

The principal limitation of the present study is its reliance on qualitative observations, interviews, and available documentation. The study does not include quantitative measurements of land-cover change, runoff discharge, soil settlement, or water-quality parameters. Historical flooding information also relies substantially on residents' accounts.

These limitations do not diminish the descriptive value of the findings but restrict the extent to which causal relationships and the magnitude of environmental impacts can be established.

Overall, the study provides a site-specific description of environmental conditions in a residential area developed on former wetlands. The findings underline the importance of integrating land characteristics, water management, and local environmental observations into residential planning and future environmental assessments.

CONCLUSION

This study examined the conversion of wetlands into residential areas and its associated environmental conditions at Payung Sekaki Housing Complex, Kampar Regency, Riau Province. The findings indicate that landfilling and residential development have transformed the former wetland area into a built-up environment comprising houses, roads, educational facilities, and shop-houses. Field observations identified uneven ground-surface conditions in several rear sections of the housing complex, while household water was reported to be turbid, rust-colored, and odorous. Surface runoff was more noticeable in Blocks H, G, and F during high-intensity rainfall. Residents also reported flooding events in 2015 and

2024, with the 2015 event described as more severe and inundation in some rear sections lasting approximately one week.

The study contributes a site-specific qualitative description of environmental conditions associated with residential development on former wetlands. Although the findings suggest potential relationships among land-use conversion, surface characteristics, water conditions, and flooding, direct causal relationships cannot be established from the available qualitative evidence. These findings highlight the importance of considering land suitability, drainage conditions, and water management in residential planning. Further assessments of soil stability, household water quality, surface elevation, and drainage performance are recommended to support evidence-based environmental management and sustainable residential development.

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