The Hidden Structure of Organic Informal-like Settlements in Jogjakarta City: An Investigation of Socio-Spatial Relationship in an Urban Kampung

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Abstract. Some urban kampungs are registered as informal settlements in Indonesian cities. The existence of a kampung amidst the cities is crucial in providing an affordable access to housing for most of the city’s residents. As an integral part of the city, urban kampungs face many problems such as social segregation, low and deteriorated physical quality, and exclusion from spatial plans which may worsen the residents’ quality of life. Apart from this condition, an urban kampung is believed to have a strong social cohesion and resilient community which are able to persist and survive socially and economically. Towards the sustainability of the city, kampungs as part of the city structure need to be addressed spatially through proper plan and design strategy. In doing so, planners and architects must understand the unique characteristics of urban kampungs to appreciate their positive contribution to the cities. This paper is presented to understand the underlying information on the organic spatial layout of the informal kampung and its impact on social composition within the framework of lively, vibrant, and safe neighborhoods. We utilized Space Syntax (SSX) combined with activity snapshot to understand the socio-spatial relationship and then triangulated the results with a questionnaire on the residents’ perception. Kampung Code, located in the inner city of Yogyakarta, was selected as the case study area as it represents the informal-like settlements. This study revealed that the complex interplays of the organic spatial layout does not significantly affect the frequency of outdoor activities. However, the presence of eight popular spaces (streets, house’s terraces, local shops/taverns, small open spaces, riverbanks, guard posts, community buildings, and small mosques) distributed within Kampung Code does influence it, and it is the driving factor for the residents to engage with others in the form of social interactions. Popular places are able to accommodate residents’ need for various activities from informal business, community interaction, and hobbies. Eventually, the continuous process of interaction and encounter in the same shared public places shapes the strong social connection and conducive living situation, ensuring the kampung to be a lively, vibrant, and safe neighborhood. Reflecting from this study, where organic spatial layout has little effect on social composition and encounters, planners and architects should be aware that proper...
spatial layout design (e.g., high integration street networks in global and local scale) could generate constant flow of both locals and passersby – enhancing the vibrancy and vitality of the public realm in the kampungs.

1. Introduction
Urban kampung or kampung is a common name to address residential neighborhoods in Indonesian cities. The name “kampung” represents its unique characteristic as a traditional settlement which was built and evolved from pre-colonialization until now [1]. At the same time, rapid urbanization in the past decades led 924 million people to live in the slums or squatter settlements in the city seeking for a better life-changing opportunity [2]. This trend has a clear impact on how people sustain in the city, especially and most critically, how they reconcile the cost of living and their income at a balance. This traditional issue makes people look for both lower land value and rent housing value, yet they still expect proximity to workplaces. Hence, urban kampungs emerge as a spatial unit of human habitat which is arguably affordable for the majority of the city’s residents to access the housing market. However, the continuous growth of an urban kampung without a clear plan and direction, and the fact that they are mostly erected in unclear or disputed land tenures [3] register urban kampungs as informal settlements.

Urban kampungs have their own characteristics. Commonly, it is located whether near riverbanks, railways, traditional markets, or strategically near to city’s central business district. The built-up environment is worse, with low building material quality, inadequate open space due to overcrowding, sanitation issues, sporadic and irregular street layout, and secure tenure. These conditions apparently meet the five criteria for slums and informality set by UN-Habitat [4]. In some parts of a big city, urban kampungs also suffer from spatial and social segregation from older policies and spatial plans, leading to the deterioration and deprivation of its physical quality. However, apart from its poor physical quality, urban kampungs are believed to have a vibrant public life and strong social connection [3,5,6]. This is the key asset for people living in the kampung to sustain and satisfy their life.

The important role of an urban kampung in shaping a prosperous and livable city cannot be neglected since the urban kampung itself is an integral part of the city as a residential neighborhood. United Nation Development Group [7] stated that the post-2015 development agenda focused on the complex issue of informal settlements in urban areas which needs to be addressed through multi-stakeholder participation, building social inclusion, empowerment, and engaging in local partnerships. Urban kampungs now need to be retouched by urban planners and architects to improve their quality of life. They need to learn comprehensively from the Kampung Improvement Program (KIP) which has been established to improve and upgrade kampungs for about 36 years, but deemed as failed project [8]. Many experts indicate that after the project completed, people in the urban kampungs were not capable to maintain and conduct self-improvement in the long-term, resulting on the gradual deterioration that worsened the quality of life. Regarding this issue, livability, vibrancy, and safe neighborhood hence must be set as a goal for a new renewal and upgrading program.

Understanding the unique characteristics of kampungs can start from analyzing the underlying information from spatial layouts and the social composition to formulate the most proper design strategy for kampung improvement programs. To achieve this, typo-morphological analysis tools such as Space Syntax have been used in the various projects to investigate the physical and social qualities of urban space [9–12]. In a specific context like informal settlements, space Syntax has also been utilized to describe and evaluate the existing spatial layout and design proposal for adaptive regeneration scenarios [13,14]. From all these studies, the findings suggest that the design of the spatial layout was crucial in shaping a vibrant public life. However, what if the already saturated urban kampung with its organic spatial layout want to achieve a lively and vibrant neighborhood? Finally, this study was conducted to
reveal how the relationship between activities and organic spatial layout of informal settlements like urban kampungs work in shaping the condition that is believed to be a vibrant and lively kampung.

2. Literature review

2.1. A common space forms the social character of the kampung

Typical urban kampungs in Indonesia possess a unique spatial character as well as the community living in it. Shared spaces are an inherent spatial feature of the kampung where formal-informal interactions occur, creating a smaller degree of private space and creating more semi-public to public spaces [8,15]. For example, private spaces such as houses limit access and are strict to visitors, while public spaces such as street space, parks/fields, and community buildings give the residents equal opportunity to access and use the place. Further, semi-public spaces are generally formed by rules and the consensus of the people in perceiving the common spaces [16]. In the kampung, such places can be the taverns, terraces, yards, and local shops. This transition zone between private and public is essential to promote long duration activities and social interactions [17:p.103].

Kampungs in the heart of the city have a similar characteristic. The most common one is situated along the riverbanks where the status of the land is unclear. Kampungs also have higher building density (>85% are built up), higher population density (100,000 per km²), low housing quality with traditional and concrete structure [5]. Malek et al. [18] added that the too-high building density left a serious shortage of open space which functions as a media of social interactions. The pressure of density and the needs of interaction among neighbors create an adaptation of space into acceptable public spaces. Empirical study of kampung Rratmakan by Rahmi et al. [15] showed that communal places such as alleys/street spaces, local shops (warung/kios), community buildings (balai warga), public baths (MCK komunal), and mosques (langgar) are typical public spaces that can be found in any urban kampung. These common public places (see table 1) enable kampungs to retain continuous social activities, which later strengthen the social cohesion [16] and attachment to the place [19].

Table 1. Common Social Spaces in the Urban Kampung [15,20–22]

| Common places in the kampung | Feature and Character | Description |
|-----------------------------|-----------------------|-------------|
| Alleys and Pathways         | Organic and spontaneous, street widths vary from wide to narrow | Pathways and alleys are directly connected with house terraces. As the majority of houses have no fence or gate, pathways and alleys form the transition zone from public to semi-public space which is common for dwellers’ spontaneous social interaction. |
| Local shops and taverns (kios/warung) | Informal local economic activity, Home Base Enterprise, semi-permanent construction | Shops and taverns not only supply the basic need of dwellers but also serve as a social hub (to chat and discuss). These particular places are recognized to convey longer social interactions and building the symbolic identity of the neighborhood. [16]. |
| Public bath and toilet      | Communal use, mostly spotted in un-exposed space | Sanitary facilities such public bath and toilets are unique properties of high-density urban kampungs, as such they stimulate social relations at particular times of the day. Such a place is shared by 10 to 15 households where, for example, women use this place for washing clothes. |
### Social facilities (community building, hall, guard post, and mosque)
- Communal use, symbolic representation of the community
- Social facilities in urban kampungs obviously play an important role in accommodating social interaction as well as preserving the social system that binds the community [20]. Community buildings and halls are used for meetings among the community and other purposes. Meanwhile, guard posts are used for keeping the kampung safe.

### Field and open space
- Limited in size, part of residual space, and heterogeneous form
- Open spaces and fields are limited in the kampung with different forms and typologies, yet they still function as a prominent social medium. Open spaces are used by dwellers for diverse activities such as cooking, selling food/breakfast, drying clothes, and especially social interaction.

### Riverbank
- Linear open space
- The riverbank is the only natural feature for some kampung. This place is able to accommodate social and optional interaction ensuing to signify the place attachment of the kampung [19]

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2.2. **Space Syntax as a tool to analyze underlying spatial layouts and their implication on social phenomena**

Space syntax (SSX) is method developed from a robust theory about the topology of space networks (spatial structure) and its implication towards social composition. The key aspects of SSX are the understanding of reciprocal interaction between the configuration of space in the system and multiple variables associated with social phenomena, including pedestrian movement. [9,23]. SSX adopts a graph-theoretic method to mathematically model how urban spaces are integrated or segregated using axial maps. Continuous open spaces are represented by individual axial lines, which are the longest visible lines cutting across urban void (e.g., street networks and open spaces) [24,25]. Based on this analysis, syntactic measurement can produce connectivity, integration or depth, angular/choice, and others. Through SSX, various social data can be added to perform further correlation analysis revealing the potential use of space and its implication.

Several SSX studies revealed that there is a high correlation between spatial layout and number of movement [9,26], land use density [27,28], crime and anti-social behavior [29,30], co-presence and encounter in street space [31]. Previous SSX studies then become a postulate for this paper such as a relatively high integration in both local and global scale generates a continuous flow of people and encounters for both locals and a mixture of visitors. Secondly, borrowing from the outcome of the first postulate, a significant number of people on the street creates a natural surveillance, reducing the potential for robbery, crime, and anti-social behavior. Moreover, highly integrated and connected street space compels businesses to run as the movements are rich and continuous.

When it comes to an organic spatial structure like urban kampung, one may think that the causal correlation is slightly biased, and thus it cannot robustly interpret the social phenomenon occurring in a disorganized spatial network. A research by Hutama [19] suggests the low correlation resulting from SSX measurement between integration and outdoor activities, implying that the spatial layout of the kampung is not always significant in promoting social activities. Socio-spatial interplays thus need to be studied comprehensively involving several factors like perception and place attachment.

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2.3. **Spatial perspectives of livable, vibrant, and safe neighborhood**

To start with, livability, vibrancy, and safety is a condition wherein its establishment is partly associated with the quality and character of a space. Space with different settings produces different responses and
behaviors to adapt with it. According to Gehl [17], for example, spaces installed with lovely street furniture such as benches and fountains attract people to sit or talk. Meanwhile, disorganized or empty spaces only left people to just walk away or misappropriate activities. Van Nes & Rueb [11] said “human behavior takes place in space, and the spatial layout shapes the opportunity for people to interact and utilize the space. This perspective can argue for the establishment of those three conditions.

Reciprocal interaction of man (activities) and space prevails in different urban scales [32]. On the micro scale level, design strategies such as organizing the building facing to the road creates control over street space as an active public space [17,33]. Moreover, planning a different building use in an accessible walking distance and reshaping the ground floor as a shopping street type building generate continuous activities nearby. On the macro scale level, designing a good spatial layout promotes the constant flow of people in the space. In this regard, Gehl [17] and Jacobs [34] signified that well integrated and well connected spaces are a key element in generating and encouraging encounters. This explains to some extent that a well-connected and integrated street space was naturally more favorable for spontaneous social interactions [31]. This combination between certain design of the spatial layout and mix-use evidently shapes the livability, vibrancy, and safety of the residential neighborhood [11,13,31].

Safe neighborhoods are associated with the feeling of security from disturbances, anti-social behaviors, and loss of belongings due to thievery. In a residential neighborhood, this feeling is formed from the conducive social connection among residents which acts as social control and warns against inappropriate behaviors [35]. Recent studies also reveal that safe neighborhoods are associated with the design of the built-up environment. Dense building blocks facing the streets and active ground floors for local business are always eyes on the street [34,36]. Everyone can do activities in outdoor spaces by being watched by the others. This induces natural surveillance on street spaces, thus forming a sense of safety in the neighborhood [29,33]. As such, the degree of safety can be measured from different perspectives of social cohesion, urban layout, and constant flow of activities on the street space.

3. Identification of case study
Kampung Code is an informal settlement which administratively consists of four neighborhoods of Tukangan, Gemblakan, Cokrodirjan, and Juminahan. The kampung code is registered as a slum based on Mayor of Yogyakarta Decree 393/2014. In terms of location, Kampung Code is situated strategically in proximity to the city center and sits along Code River (see Figure 1). As an informal settlement, Kampung Code has both high population and high building density wherein 10,059 inhabitants (2596 households) are housed within 25.69 hectares. In terms of occupation, 33% of dwellers were self-employed/entrepreneurs, 32% were employed by others, 12% were retired, and others were working seasonally. In addition, dwellers in the kampung were poor with a monthly income of under IDR 2 million and only 7% made a living of above 5 million. Based on the survey, majority of the residents are working in the informal economic sector nearby the kampung, taking advantage of its strategic location near the city center of Yogyakarta.
Spatial properties of kampung Code are composed by organic spatial layout, irregular street width ranging from wide in some segments and narrow in others, and inadequate open space due to a too-high building density. Irregular building orientation and size. Some buildings’ front doors do not face the road. Kampung Code is not a solely mono-function neighborhood, but it is diverse in terms of function. Although the majority of buildings were residential, we still can find commercial and service buildings (at the left edge of the kampung), local shops/taverns, schools, craft workshops, and mosques that can be reached within walking distance.

4. Data collection and method
This paper attempted to justify the hypothesis mentioned in the introduction by understanding the socio-spatial interplays in the informal-like settlement of urban kampung. How the organization of organic space layout in kampung affects the social interaction that frame a lively, vibrant, and safe community. In order to comprehend that complex relationship, the study area (Kampung Code) should be analyzed by considering the micro (activity and use of place) and macro (configuration of space) relationship [29]. The case study was selected as a method to understand this complex relationship through empirical observation in the field [37]. We also utilize a mixed-method approach to elaborate the varied information crossing over from qualitative measurement of spatial configuration to the social life of the kampung [38]. In this study, the axial base map model of kampung code was produced to enable the identification of the configurational value of spaces. Several SSX measures are then selected to perform this analysis. Parallel with SSX, activities were observed and registered on the map. Subsequently, the values of SSX measurements of each street space in the kampung were correlated with the sum value of...
activities registered on each street space with Spearman correlation. The result is then elaborated with the interview to withdraw further findings.

4.1. Space syntax measures for analyzing the spatial layout

SSX is a method and tool which enables the analysis and interpretation of the configuration of space and social variable. The aim of SSX is to understand how the continuous urban void that are connected to each other within the system can be calculated to interpret various forms of social phenomena [31]. Syntactic measures are the core analysis tools in SSX. In this research, we use SSX variables such as connectivity, local integration, and global integration. Connectivity measures the number of street spaces that are directly connected to other street spaces within one step. The principle is, the higher the connectivity value, the higher connectivity of street space it has to access another space in the immediate locality [39]. Integration, both local and global, measure the average depth of each street space to all other street spaces in the whole network. The lower number of street spaces represented by axial lines and fewer turn changes in the network system, the more integrated (accessible) the network system becomes [9,40,41]. To measure local integration, R3 value was chosen as the street space can be assessed in three turn changes from other space.

To perform SSX analysis, an Axial map is drawn manually in GIS environment using the AXWOMAN plug-in [42] by stretching the longest visibility lines from an arbitrary start-point to end-point in street space. This can be done with the assistance of a high-resolution image superimposed in the background of the worksheet. Once the axial map was finished, AXWOMAN is then used to execute SSX analysis. The syntactic results were automatically saved in the attribute table for each street space (axial lines). Three syntax parameter values (connectivity, global, and local integration) were visualized in gradient colors (reddish to blue). The SSX results for each variable are: Connectivity (Min: 1, Mean: 3.45, Max: 23); Local integration/R3 (Min: 0.05, Mean: 2.06, Max: 5.38); Local integration/R (Min: 0.61, Mean: 0.94, Max: 1.60) (see Figure 3 for results in maps).

4.2. Activity mapping and questionnaires

Observation and activity snapshot were employed to record the activities of both individuals and groups in the kampung. Referring to Can & Heath [31], this approach is effective to document all activities through photographs in the public realm where some activities could prevail longer and others spontaneously happen in short duration. For example, people working and serving food in the tavern, children playing football/kite on the streets, and group of people mingling might prevail longer and it was easy to identify. However, activities such as men encountered on the street or open space and women chatting while doing something may only happen in a short duration in random spaces. All activities and their specific locations are then registered on the A3 map during fieldwork. Afterwards, the paper maps were digitized in ArcGIS to produce an activity mapping which is spatially informative to study the behavior of residents in the various setting of space [43].

To effectively understand the socio-spatial behavior of residents in kampung, observation and activity mapping with snapshots were conducted at three different times a day which is in the morning (07.30-08.30), midday (12.30 – 13.30), and afternoon (16.30-18.00). These activities were also conducted on one weekday (Tuesday) and one Sunday to fairly create a whole picture of the daily routine in the kampung. Due to the complexity of the built-up environment in the kampung, the researcher was assisted by several surveyors and set them in the certain places within a radius of 50 m. This observation has been conducted in two steps by paying attention to some limitations. First, observations were carried out in the determined location for about 10-20 minutes to be able to take snapshots of stationary and moving activities. The next step was, walking to nearby areas to take snapshots of the activities occurring in the remaining spaces on each zone. Second, the surveyor was directed to pay attention to peculiar
linear open spaces such as the riverbank and main streets/pathways where people did several activities individually or in a group. The limitation of this method was the possibility of an un-exposed activity that was not recorded due to the small-time gap when the surveyor walked to a nearby location [22]. Activities and SSX results were correlated to give a profound explanation on how organic spatial layout influenced outdoor activities in the kampung. Prior to doing so, activity and SSX results must be recorded in the same attributes table. “Generate near table tools” were used to associate the activities point data with the nearest axial line (new data attribute). The sum operation was used to aggregate the number of people to the nearest axial line where activities take place.

Questionnaires with closed and open of question types were addressed to the heads of households (HH) and some family members to inquire the individual’s perception towards the kampung in terms of lively, vibrant, and safe community. In the study, the researcher employed quota sampling (probability method) based on the division of four neighborhoods with different population densities. We took about 160 (about 7%) samples of HH with 2-4 family members. The questionnaire was divided into five chapters obtaining different types of information. The first and second chapter gathered information about the socio-economic characteristic of dwellers, wherein more than 70% are poor and mostly working in informal economic sectors. The third chapter explains the use of dwellers’ habit/preference to use eight popular places in the kampung. The fourth chapter depicts the livability of kampung, the social cohesion, and followed by the perception of safety and cleanliness in the kampung.

In this study, using a mixed-method approach was useful in terms of inferring the result from different perspectives of data. The correlation results of activities and SSX triangulated with residents’ perception could justify whether the spatial configuration of kampung Code impacted the lively, vibrant, and safe community or there was another reason that residents could reveal through the interview.

5. Result and discussion

5.1. Types of activities and use of informal space in urban kampung
The daily life of the urban kampung is shown in various activities. Through snapshots and observation, we found 45 varieties of activities which can be classified into necessary (38%), social (40%), optional (18%), and religious activities (4%). Necessary activities in the kampung are mainly related to make subsistence (e.g., selling daily needs in local shops, selling food/drinks in the taverns, and making handicrafts in a workshop). Spatially, work-based activities mostly happened on the streets/alleys and on the edge of study areas where passers-by travel frequently. Social activities (chatting, playing, doing sport) were diverse in terms of age and gender. With regards to Gehl [17], social activities were found in most outdoor spaces of the kampung and it can spontaneously occur in streets/alleys, semi-private spaces like terraces, taverns, riverbank, and irregular shapes of open spaces. However, there were formal-informal activities in kampung. Residents who were doing an activity related to work are usually accompanied or encountered by neighbors and they spontaneously have a conversation on the premises. Hence, this can be overlapped as social activity, explaining the nearly same frequency of social and necessary activities. Further, self-oriented or optional activities (e.g., fishing, gardening, reading, and contemplating) had a random spatial pattern as they tended to occur based on the personal sentiment on the place. Religion-related activities were counted very few and they occurred at specific places such as a small mosque (langgar).

Most of the spaces in the urban kampung are composed of intertwined irregular solid and void structure. We observed eight places in the kampung which attract activities. Those places are house terraces, streets/alleys, irregular open spaces (e.g., field), riverbank, community buildings, guard posts, and tavern or local shops, and mosque. Riverbank, house’s terraces, streets/alleys, and community buildings are the places which have a high frequency of social activities among neighbors [22].
Particularly for Kampung Code, the riverbank is a place which allows dwellers to linger with neighbors and do various activities (chatting, fishing, sitting, or sightseeing). As Hickman [16] highlighted, this type of place can be considered as a “third place” where the formal open spaces were not well designed in most kampungs. House terraces are common semi-private places in the kampung which plays the important role of contributing to good social ties among neighbors. Residents may use the terrace to interact with other neighbors even without the presence of the owner. Streets/alleys and taverns are important social features in the kampung that not only connect the places but also dwellers. Similar to Rahmi et al. [15], those places have been identified as the community’s tangible assets that serve as a social medium in the urban kampung.

![Outdoor Activities Map in Kampung Code on Sunday (Weekend)](image)

**Figure 3.** Map shows different activities and use of space through the day on the weekend. During weekend, outdoor activities appeared most compared to weekdays in eight popular places in the kampung.

5.2. **Correlation between activity and urban kampung’s spatial layout**

The spatial configuration of the kampung can be described as organic and chaotic, without a clear pattern like a grid, curve, or linear. Spatial layout of the kampung was formed spontaneously through a gradual process of residing as dwellers come and erect buildings in the remaining land. As a result, there were residual spaces in between buildings with irregular sizes and forms. The continuous residual open spaces to some extent serves as shortcuts or channels that connect one place to other. In SSX measures, connectivity value scores 3.45 (avg) and 23 (max) meaning that residents can move from one place to another with at least three different alternatives of streets/alleys. Only a few street segments (within the kampung) have a higher connectivity value, allowing to absorb potential of the social composition into those street segments. However, as it turns out, the activities are not fully attached to the higher street connectivity, instead clustered into several popular spaces in the kampung. In this case, only necessary activities took place in the higher connectivity street segments as a lot of passersby spotted.

Spatial analysis of integration shows a relatively high value at the edges of the kampung. This makes sense since the street at the edges like Jl. Mataram, Jl. Juminahan, and Jl. Mas Suharto in the middle has the higher street hierarchy in the city level, connecting the kampung directly to collector street network in the Central Business District (CBD) of Yogyakarta. Similar with Majumdat, et al., Majumdar, Sliuzas,
Munshi, & Brussel (2009), streets at the edges appeared to have more commercials and services. At the local scale (R3), highly integrated street spaces are located within the kampung showing the internal main structure of the kampung where the residents composed a mutual interaction.

Figure 4. Map showing various spatial measurement (SS) of Kampung Code combined with activities.
Table 2. Correlation of Activity Snapshot and Space Syntax Parameters

| Activity snapshots and SSX | Necessary (walking and working) | Social (interaction and playing) | Optional (relaxing and sitting/standing) |
|---------------------------|----------------------------------|----------------------------------|----------------------------------------|
|                           | R² Linear                        |                                  |                                        |
| Tuesday                   | 0.211                            | 0.221                            | 0.175                                  |
| Sunday                    | 0.193                            | 0.257                            | 0.188                                  |
|                           | 0.121                            | 0.208                            | 0.102                                  |
|                           | 0.006                            | 0.045                            | 0.006                                  |
|                           |                                   | 0.066                            | 0.027                                  |

Spatial layout of the kampung governs the number of outdoor activities, particularly on the composition of social activities. In the correlation result, social activities are more associated with local integration (R3) than other types of activities (see table 2). It means, the higher the accessibility of the street network at the local scale, the more there are social activities. Despite the lower correlation results, the survey showed the spatial layout affects the number of people encounters on the street, initiating social activities. In this study, the relationship between organic spatial layout and activities in the kampung agreed with [31,44,45].

5.3. Resident’s perception on lively, vibrant, and safety in the kampung

Activities in the kampung are diverse and continuous throughout a day (see Figure 5). On a weekday, necessary activities gradually went down from the morning to afternoon. Conversely, social activities reached its height in the afternoon as the residents returned home from work then socialized with their neighbors. During midday, outdoor activities are slightly decreased particularly for social activities due to uncomfortable heat. Dwellers tend to seek shaded space like house terraces, taverns, and guard posts (cakruk) to have social interactions. On the weekday, particularly in the morning and midday, necessary activities were spotted more frequently than that on the weekend; meanwhile, in general, social activities were spotted more frequently on the weekend (morning and afternoon). The dynamic and continuity of activities from morning to afternoon induces the sense of a vibrant place. It is similar with the study about people, space, and activity by Gehl [17], Jacobs [34], and Mehta [46] who stated that the constant flow and presence of residents from different genders and ages in public spaces throughout the day indicates a vibrant and livable neighborhood. This condition was signified by the fact that the mixture of building use like local shop/taverns, community buildings, guard posts, and mosque generate different types of activities [6,47]. The high density of buildings in the kampung and inadequate formal open spaces pushed the residents to adapt and use semi-formal and informal space, promoting a cluster of several activities near them.
Regardless of the condition of economic and physical poverty in the kampung, residents perceived that the kampung is safe in terms of criminal activity (theft/robbery) and anti-social behavior. Quoted from one of the residents, “people just park their motorcycle in the alley all day and it’s never gone – only a small thing happened such as thievery of pet birds”. This situation is apparently signified by the strong social cohesion which the community later established a social system such as patrol at every night (Ronda) and massive cleaning (kerja bakti). Residents spent at least one hour or more and have visited each other in popular spaces to have conversations. This routine social interaction and visit among neighbors play a pivotal role in promoting and strengthening social capital as an asset among other spatial entities in a kampung. As studied by Rahmi et al. [15] in locally urban kampung and Gilroy [48] in typical settlement of western society, social cohesion is apparently an image of the residential neighborhood where people can feel the existence of various activities in public realm. In this study, the kampung is empirically proven as a lively and vibrant human settlement.

5.4. Socio-spatial interplays to promote lively, vibrant, and safe community in the kampung.

We have critically described the activities and use of space in the kampung, the spatial layout, and the residents’ point of view on livability, vibrant, and safe communities. This study shows the spatial layout is not statistically significant in affecting the frequency of activities taking place in all outdoor spaces in the kampung. Particularly for social activities, the number of co-presence of residents are less counted in relatively high locally integrated spaces and become lesser in the lower locally integrated street segment. It is explained by the organic spatial layout creating some convex spaces in which one needs more turns to access this space. The more organic the spatial layout, the higher possibility of the depth of space from whole system. Hence, theoretically, based on the evidence from space SSX studies [9,11,12,49] the outcome of the spatial layout (high integration on both local and global scale) which induces the relatively high flow of movement is not really relevant with the condition where a spatial layout was organically developed like in Kampung Code. This finding was signified by Van Nes et al [33] where the pre-war neighborhood was registered to be less lively and vibrant due to the less number of residents appearing in public spaces. In that case, pre-war neighborhoods shared the same character as urban kampung with organic spatial layout resulting in relatively low integration value and high depth of space.

The eight popular spaces and mixed building use for housing and local business are the factors that promotes the livable and vibrant kampung. These places are able to accommodate dynamic of interactions through the day. Particularly for the riverbank, this place is compelling for residents to stay outside, interact with each other, and satisfy their emotion towards the daily stressor of living in an overly dense building. Socio-spatial interaction then can be seen through the clear pattern of outdoor activities which clustered nearby the popular spaces and the amenities within the kampung (see Figure 7).
Figure 7. Kernel density map of outdoor activities creates a clear pattern of socio-spatial interaction where outdoor activities tend to be spotted nearby the eight popular spaces and amenities within the kampung.

Socio-spatial interplays in terms of safety of the community in the kampung reasonably contrast with Hillier & Sahbaz [30] and Van Ness & Lopez [29] who stated that the lower degree of integration, both local and global, reduces the number of people engaging in the street that might serve as natural surveillance. The street space with low natural surveillance at the local scale tends to be affected by thievery and anti-social behavior. Empirical evidence shows the correlation between types of activities and local integration in the kampung were low (see Table 1) meaning that the poor organic spatial layout of the urban kampung generated small chances of co-presence on the street space, which can worsen the safety issue. However, the kampung is perceived as safe by the residents themselves. This apparently departed from the social trust among neighbors as they have been residing in the kampung for 43 years on average. This resulted in the knowledge and understanding between neighbors such as their occupations, spatial behavior in the kampung, and their family profile. The safety in urban kampung hence was the product of strong social cohesion and the daily routine of social interaction.

6. Conclusion
This research suggests that kampungs in the inner city of Yogyakarta are livable, vibrant, and safe. This condition is perceived by residents as the outcome of good social cohesion, continuous outdoor activities, and conducive living neighborhood from thievery and anti-social behavior from youngsters. The organic spatial layout of the kampung is not strongly associated with the frequency of various outdoor activities, but the presence of eight popular places distributed within the kampung does encourage the residents to have the opportunity to use and share it for various activities. The streets, local shops, house terraces, guard posts, community buildings, riverbanks, small open spaces, and mosques thus are the popular places in the kampung that act as the key role in binding and
accommodating social interaction. In the end, we believed that the flexibility to walk through the disorganized multi-connected street network within the kampung, the presence of humane popular places, and active ground floor for local business activities (kios or warung) has contributed to both the active use of public spaces and the strong social connection between residents.

There are key outcomes that enrich the analysis and recommendations from this research. Space Syntax (SSX) embedded with social data from activity snapshots can be used both for analysis and consultancy tools for urban planners, architects, and practitioners who are responsible for making positive changes towards informal settlements like the urban kampung. This approach is robust to understand the underlying feature of spatial layout and its impact on social phenomena like the frequency of outdoor activities. Instead of focusing on repairing the organic spatial layout of the kampung, which indeed needs much effort and cost, we can design the space and place to elevate the values and the community in the kampung. Designing some of the popular spaces especially for riverbanks, community buildings, and small open spaces with proper street furniture and little ornamental touches like wall paintings will not only attract residents but also retain them longer in the public space. These efforts are to appreciate the presence of the public realm as the common ground and lifeblood of the kampung. For further and long-term upgrading or development, let one not romanticize the condition that emerged from the scarcity of proper open public spaces and well-developed sense of community in the kampung. But, the importance of spatial layout (high integration both on the local and global scale) for generating the continuous flow of both locals and passers-by must be considered as this significantly contributes to the lively, vibrant, and safe neighborhood. Finally, the design process in every scale of the upgrading program or residential development must engage the local community to consult on what they need and what it ought to be to create positive change in their lovely kampung or neighborhood.

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