Participatory mapping of hydro-meteorological hazard-prone locations

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Abstract. Community concepts and terms often appear in policies and programs related to environmental issues and community participation. During this time, the concept of community uses the location of residence as the basis for its determination. The assumption is that those who live in these locations are the most familiar with their surroundings. The high displacement of urban residents causes some of them do not always know the place of their residence. This condition can affect the success of development programs that involve the community. To help implementing the program successfully, training on community participation-based map development is needed. The objective of this paper is to offers a way to find out people's perceptions of where they live, so that they have a collective awareness of their environment through map development. Researchers conducted training of 15 residents who were members of the Kancil community. Kancil community located in a settlement on the edge of Ci Liwung, Depok City, West Java. Data of the environment is collected by mapping the location of a settlement area by several methods. The results of the mapping with the theme of hydro-meteorological disaster sensitivity were integrated subsequently into the form collaborative mapping. This participatory mapping produced a map showing the boundaries of flooded areas, areas prone to clean water scarcity, and locations prone to landslides. Community participation-based map development shows the people's perception of their environment. Individu with high travel pattern shows knowledge and awareness on their environment. The mental map has a positive influence to their knowledge.

1. Introduction

Community concepts and terms often appear in policies and programs related to environmental issues and community participation. Currently, the concept of community uses the location of residence as the basis for its determination. However, the concept of community which is only based on the location of residence, at this time is no longer adequate. These changes occurs because of social changes and environmental conditions [1]. Some studies use place attachments and place identities as a way to compile environmental programs that require community participation. Other studies use place identity and place dependent [2,3]. Place identity and place dependent are often interpreted similarly, and the use of the terms is often exchanged. But some variables show differences in their
meanings. Some research also indicates that there is a relationship between place identity and willingness to participate in activities related to the environment [4].

The community is associated with the relationship between the individual and his community [5]. Kasarda & Janowitz [5] found that social relations that are built up between communities are far more instrumental in building place attachments, than the total population. A more recent study from Perkins [6] and Long uses social attachment and ownership of a place as a way to measure place attachments. Plunket [7] states that place attachment is a multidimensional concept of the relationship between humans and the places where they interact. People built their feelings based on their same history, interest, and concern for the environment in which they lives.

Attachment to a place to stay can occur because of good memories. Memories can be created through various activities, both individually and in groups. One way to dig memories together is to transfer them into pictures. Transferring memories into maps are carried out in addition to explore memories, also to form attachments to places, and to build togetherness. This togetherness can provide benefits in mobilizing community participation so that they care for their environment. This paper offers a way to find out people's perceptions of where they live, so that they have a collective awareness of their environment through map development.

2. Research Methods
Activities are carried out in urban community settlements that live in marginal areas and are vulnerable to the threat of hydro-meteorological disasters. This activity has unique challenges and issues need to be addressed in planning for high-risk and low income areas [15]. To meet the activities objectives, the initial step taken is to invite the community to participate in building a basic map of their environment, through focus group discussion activities. Purposive random sampling is used with several criteria of sampling such as the people who lived in that area more than two years, participate as member in Kancil community, and have interest in enhancing their knowledge on environment issue. We used purposive random samplings because only certain people that fulfill the criteria can enroll as participants.

This study was conducted on 15 people consisting of 3 women and 12 men. The fifteen participants were accompanied by five facilitators who had advanced knowledge about maps. In detail the profile of respondents is as follows

| Age (yr)   | Length of stay (yr) | Neighborhood activity |
|-----------|---------------------|-----------------------|
| ≤ 20 yrs  | > 20 yrs            | ≤ 5 yrs               |
| Men       | 8                   | 11                    | 12                     |
| Women     | 2                   | 1                     | 2                      |
|           | 1                   | 3                     |

Source: Data collection, 2017

The activities that we conduct consist of several activities, that are:
  a. Recalling memories by drawing picture of their area;
  b. Verifying the drawing picture by wandering in their area and improving their picture;
  c. Determine places that have sensitivity to hydrometeorology disaster;
  d. Briefing to be able to overcome the hydrometeorology disaster problems.

3. Result and Discussion
3.1 Recognition of a remembered place
In the initial stage, the participants were asked to draw a picture of their neighborhood, to the outermost area. This activity is an effort to recall what they know and experience in their environment
Mental maps (also called cognitive maps) are components of geographic behavior [8]. Mental map is a graphic perception of individual imagination on space. These spatial representation are nourished by mental and social representation. According to Sarre [8] the definition of a mental map is ‘a model of the environment that is built up over time in one’s brain’. Mental maps are stored in the brain, so they do not really exist. Nevertheless, we can all see the map as a mental construction that is the result of the geographical environment and human actions [9]. Everybody has his/her own mental map of the space and place around them [10]. One example of a mental map is like the image below.

![Mental Map](https://mentalcharloss.files.wordpress.com/2010/02/mental_map_cristina-ampatziidou1.jpg & https://mentalcharloss.files.wordpress.com/2010/02/mental_map_lisa-overmann1.jpg)

Participants were asked to draw anything important according to them, or have memories that reminded of certain places. Only 67% of participants showed their knowledge of the area of their residence. Mostly, they draw attributes mosque, field, and Kancil secretariat. While 33% only brings a little from their memories. They all draw road networks, although some are relatively complete and some only draw main roads. Figure 2A shows a poor picture of the area, whereas Figure 2B shows a complete picture. This finding is in line with Hidalgo’s discoveries, that the longer a person stays in that place, the higher she understand that place [11]. From these two data sources, the dominant characteristics that emerged from respondents are places that used to be a gathering place to residents, that is a mosque.

![Simple and more complete map](https://mentalcharloss.files.wordpress.com/2010/02/mental_map_lisa-overmann1.jpg)

**Figure 1. Mental Map**
Source: Data collection, 2017

**Figure 2. Simple and more complete map**
Source: Data collection, 2017
The results of making a map of each participant are then discussed in the form of a Focus Group Discussion (FGD). In this FGD activity, the participants set together, important places for their daily lives. Important places according to the participants were a meeting point, a place to carry out community activities such as mosques, homes of community leaders, and public places such as schools and offices of the heads of neighborhood (Rukun Tetangga-RT) and hamlet (Rukun Warga-RW). Of the 15 maps, five maps were made as a tool to carry out further activities.

3.2 Walking Trajectory
After the FGD phase, participants are wandering around to do their field survey. Based on the collaborative maps, participants then verified in the field. This characteristic is emphasized in the digital era, where collaborative maps become dynamic and interactive [14]. As an alternative to GISs and geovisualization systems, collaborative mapping systems can be used by a vast population of users, the community itself and people who lived in surrounding area. It does not require particular competencies and they are generally usable [14]. This activity is an activity to verify the mental map created. Using five basic maps, participants re-examine the results of their mental maps in the field. At this stage, participants placing important places by the actual location. They also encourage to draw more information to the map. Every group of participants accompanies by one facilitator. The role of the facilitator is significant. The facilitator has to guide the forging of objects at the exact point on the map. Facilitators also directing participants draw symbols precisely. The walking trajectory shows a very significant result. We could compare pictures before the field survey and after it. Figure 3 shows a map before the field survey.

![Figure 3. Before field survey](source: Data collection, 2017)

Figure 4 below is one example of the field mapping result. This picture shows participants' carefulness in looking at important objects in their environment. By conducting a field survey, participants discover objects that they did not recognize or were not considered important. The most added objects are those related to community gathering places and essential places when conducting joint activities.
The enrichment of information resulting from walking trajectory activities is in line with similar activities carried out by an association in Italy in developing their website. They found out that culture participation emerge to spread and share knowledge. This knowledge will strengthen the community concern to their environment.

3.3 Locations of hydro-meteorological disaster threat
To find out participants' knowledge of hydrometeorological disasters, the next activity was to map the local environment using a blind map. Blind map in this activity is a basic map that is equipped with river and road information that is positioned correctly. Blind map filling is done by the facilitator. Blind map example is shown by Figure 5. The purpose of environmental thematic mapping in this activity is to determine one's perception of the environment. In this activity, each group of participants is equipped with a GPS (Global Positioning System) to guide filling of the map. The use of GPS aims to provide an understanding of how to use GPS. These perceptions are manifested in plot results that can be points, lines and areas in accordance with the perceptions of map fillers, are important things.
The results of the environmental mapping show that participants set the same boundaries for areas that are threatened by flooding, water sources that can be utilized in the dry season, places that have potential for landslides, and places along stable rivers. The environmental mapping activity produced a map as listed below. Figure 6 shows the good knowledge of group members about local environmental conditions. These findings are contrary to what Tampi found in the same area [12]. Kancil community participants were not ready to involve in the activities that carried out by the organization. The main factor that discourages the participants is the lack of knowledge of the benefits of engaging the activities. The unpreparedness of the community to get involved in Kancil community activities needs to resolve immediately. Resolving this problem is important considering that communities that have knowledge and awareness about their environmental vulnerability to disasters will be the basis for building communities that are resilient to disaster threats.

![Regional Condition of Kampung Pondok Cina, Depok City Year 2017](image)

**Figure 6.** Local Environmental Conditions Map  
Source: Data collection, 2017

### 4. Conclusions

This interactive mapping activity produces a map of environmental conditions, an evacuation route map, and a map of flood prepared areas based on survey results using GPS and a blind map by each group that fills it. This method is proven to be able to provoke participants’ memories and extracted the unconscious information. The participants’ sense of belonging and togetherness is increasing. Before they participate in the community map development, most participants do not aware of the hydrometeorology threatened. By joining this activity, their awareness is better. Active community involvement is better than the interview and fills the map attributes method. Building mental maps so far can be explored and enrich information. This finding is in line with the results of research from Gueben-Venière [13], which shows that community participation-based map development activity complements the result of interviews and map making by other research groups. The result indicates that individual’s activity space is not necessarily within the individual mental maps. Both activity space and mental maps are correlated with individual’s travel pattern factors. The mental map has a positive influence on the formation of activity space.
5. References

[1] Gurneya G G, J Blythea H A, W N Adgerd, M Curnocke, L Faulknerd, T Jamesd, and N A Marshall 2017 Redefining Community Based on Place Attachment in a Connected World 114 (38) pp 10077–10082

[2] Bricker K S and Kerstetter D L 2000 Level of specialization and place attachment: An exploratory study of whitewater recreationists J. Leisure Sciences 22 p 233

[3] Kyle G T Absher J D & Graefe A R 2003 The moderating role of place attachment on the relationship between attitudes toward fees and spending preferences J. Leisure Sciences 25 p 33

[4] Stedman R 2002 Toward a social psychology of place: Predicting behavior from place-based cognitions, attitude, and identity J. Environment and Behavior 34 p 561

[5] Kasarda J and Janowitz M 1974 Community attachment in mass society. J. American Sociological Review 39 p 328

[6] Perkins D D and Long A D 2002 Neighborhood sense of community and social capital: A multi-level analysis Psychological sense of community: Research, applications and implications ed A Fisher C Sonn, & B Bishop (New York: Plenum Press) p 291-318

[7] Plunkett D R P and B Ucar Kocaogluc 2018 Place Attachment and Community Development J. Community Practice 26 p 471

[8] Graham E 1976 What is a mental map? J. Area 9 p 259

[9] Gregory D, Johnston R, Pratt G, Watts M and Whatmore S 2009 The dictionary of human geography 5th edition (United Kingdom: Wiley-Blackwell)

[10] Cloke P P C and Sadler D ed 1991 Approaching Human Geography Peopling human geography and the development of humanistic approaches (London: Chapman) chapter 3 p 57-92

[11] Hidalgo M C and Hernandez B 2001 Place Attachment: Conceptual and empirical questions. J. Environmental Psychology 21 p 273

[12] Tampi D M, W Sumadio, J Sumabratda, J Anggiat and E Suyantia 2017 Bottom up approach: KANCIL, The strive of local informal communities WIT Transactions on Ecology and The Environment 223 (United Kingdom:WIT Press)

[13] Guebben-Venière S 2011 How can mental maps, applied to the coast environment, help in collecting and analyzing spatial representations J. Echogeo p 17

[14] Fogli D 2013 Cultures of Participation in Community Informatics: A Case Study (Berlin: Springer) IS-EUD LNCS 7897 p 201-216

[15] Von Einsiedel N, Bendimerad F, Rodil A S and Deocariza M 2010 The Challenge of Urban Redevelopment in Disaster-affected Communities. J. Environment and Urbanization ASIA 1 p 27

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