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Addressing WaSH challenges in Pacific Island Countries: A participatory marketing systems mapping approach to empower informal settlement community action

Abstract

Addressing complex and challenging issues entails access to credible systems information in the form of systems maps or diagrams. The purpose of our paper is to describe a participatory action research (PAR) systems mapping activity that was undertaken by an urban informal settlement community in a small Pacific Island Country. A total of 19 households participated in a systems mapping activity to map a household-level water or sanitation system. The individual household systems maps and related data were then used to construct a de-identified aggregated water, sanitation and hygiene (WaSH) marketing systems map (and accompanying narratives) for the informal settlement. We present the marketing systems map, which delineated a series of marketing exchanges, and report on how the map assisted the community to address a number of expressed needs. We conclude by suggesting that systems mapping is a valuable activity that communities could undertake to generate credible systems information to inform and empower collective planning and actions.

Background

The delivery of water, sanitation, and hygiene (WaSH) services in Pacific Island Countries[1] (PICs) has been highly complex and challenging due to their geographical isolation, resource constraints, diverse cultural and social practices, rising sea levels, and increased frequency of extreme weather events (Hadwen et. al., 2015). Many PICs did not meet the Millennium Development Goals (MDGs) as overall WaSH conditions have not improved or have stagnated in some countries (ESCAP, ADB, UNDP Asia-Pacific Regional MDG Report, 2015). The WaSH challenges have been exacerbated by the significant growth in the number and size of informal settlements (also sometimes referred to as slum or squatter settlements), which are now a common feature within most PIC urban areas (WSP, 2015). These informal settlement communities are characterised by having no land title, social exclusion, flooding, cyclones, water supply contamination, unhealthy living conditions, and extreme poverty (UNICEF, 2013; WSP, 2015).

In most informal settlement communities in PICs there is little or no coordinated formalised provision of basic WaSH infrastructure or services (WSP, 2015). Instead WaSH services could be best described as self-built and self-managed (Scott, Cotton & Khan, 2013). There also seems to be general

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[1] The 15 Pacific Island Countries are Cook Islands, Fiji, Kiribati, Marshall Islands, Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu.

agreement amongst WaSH practitioners in the region that there is a lack of collective understanding about how these self-built and self-managed WaSH-related activities and actions interconnect or relate (WSP, 2015). Without a holistic view of how the WaSH system operates in informal settlements it is extremely difficult to identify and plan appropriate and systemic interventions to improve the delivery of WaSH services. As such, WaSH practitioners and researchers are beginning to advocate for a broader holistic systems-based approach to WaSH to identify and plan appropriate WaSH interventions (Hadwen et al. 2015; Scott, Cotton & Khan, 2013; Scott, Cotton, & Sohail, 2015; Banana, Chitekwe & Walnycki, 2015). By adopting a systems-based approach, WaSH practitioners and researchers in PICs aim to achieve better outcomes under the Sustainable Development Goals (SDGs) than was achieved under the MDGs.

When addressing complex and challenging issues, a holistic systems-based approach normally begins by selecting an appropriate method for visually mapping the system under study so that a thorough analysis of the system can then be undertaken. The choice of visual mapping procedure is guided by many factors including: who intends to use the map and for what purpose, its ease-of-use, flexibility and adaptability, and the availability of data and resources (Wood, 2010). Based on these factors, a systems map can take on many different forms, from simple two-dimensional diagrams to sophisticated computer-based Bayesian network maps (see Chan, Ross, Hoverman & Powell, 2010).

Typically, in high-income countries, WaSH authorities and planning agencies are tasked with creating formalised WaSH systems maps that can be used to inform planning and actions, and to identify appropriate interventions. These systems maps can be broadly classified as either: physical network maps where the focus is on the physical flow of water and excreta through the system, or as service network maps where the focus is on activities and actions at various points within the system (Scott, Cotton, & Sohail, 2015; Criqui, 2015). In low-income countries (such as PICs) authorities and planning agencies often lack the capacity, resources and tools to create these types of formalised WaSH systems maps. In the few cases where maps are created they often exclude important system actors such as informal settlement communities (Gloeckner et al., 2004). Similarly, the maps are often criticised for not fully capturing some of the social and cultural activities and actions that are integral to the functioning of the system as a whole (Baharoğlu & Leitmann, 1998; Akpabio & Takara, 2014; Scott, Cotton, & Sohail, 2015). To address these deficiencies, development practitioners widely recognise that those who are excluded from formalised maps can play a leading role in 'documenting' or creating maps (see generally Patel & Baptist, 2012).

The purpose of this paper is to describe a novel participatory systems mapping activity that was undertaken by an informal settlement community in Suva City, Fiji. The aim of the activity was for the community itself to generate WaSH systems maps that could be used to (1) visualise the WaSH

marketing system, (2) describe and depict the various activities, actions and exchange relationships amongst the system actors, (3) identify appropriate activities to improve the delivery of WaSH services, and (4) trigger purposeful actions. The mapping activity was grounded within participatory action research (Ison, 2013), marketing systems thinking (Layton, 2007; 2015), and participatory mapping (Perkins, 2007) research streams. We present our methodological orientation, and the participatory action research method, before providing a short exposition on some community actions and outcomes.

Methodological Orientation

For our research purposes we view a system as primarily a marketing mechanism for coordinating production, distribution and consumption activities (Layton, 2007). When viewed from this perspective, the system explicitly includes the economic, social, cultural and environmental components associated with the transfer of products, services, experiences, ideas and information (Layton, 2015). We acknowledge that systems are inherently complex (Head & Alford, 2015), and that the overall performance of the system is determined by individual and collective activities and actions. We are therefore concerned with both micro-level exchange activities and the macro-level consequences of these activities on the overall performance of the system. In addition, we argue that the performance of the system can be improved through the purposeful actions of system actors (Ison, 2013). To effectively act within the system requires having access to credible systems information, such as the system maps we discussed above. However, systems information is not always readily accessible to the most vulnerable in society (e.g., informal settlement communities). Consequently, many development scholars and practitioners advocate for participatory mapping (sometimes referred to as community-led mapping) as a way to democratise information (Parker, 2006; Perkins, 2007), and to provide 'undocumented' communities with the opportunity to generate useful systems information to empower themselves (Sanderson & Newport, 2010; Patel & Baptist, 2012; Banana, Chitekwe & Walnycki, 2015).

Perkins (2007) defines participatory maps as local maps that are produced collaboratively by local people, and which incorporate local social, cultural and economic information. The overarching ethos guiding participatory mapping is participatory action research (PAR). As Reason and Bradbury (2008, p. 1) explain, PAR is not just a methodology per se but an orientation to inquiry that seeks to create participative communities whose 'qualities of engagement, curiosity and question posing are brought to bear on significant practical issues'. Explained simply, PAR involves bringing together researchers and participants through reflection and action to tackle complex issues and problems. To ensure validity of the research process, PAR researchers use a number of evaluative criteria, including outcome validity, democratic validity, process validity, catalytic validity and dialogical validity (see

Reason & Bradbury, 2013). Regardless of the different types of validity, PAR researchers agree that PAR should bring about practical benefits for those involved. Following this ethos, PAR practices can therefore provide access for the most vulnerable in society to the powerful dynamics of systems mapping. In addition, it allows those involved in the activity the opportunity to not only name, describe, or discover systems, but to then acquire a process of systems thinking which can bring about critical reflection and purposeful actions (Ison, 2013).

Research Community

The dramatic growth in the number and size of informal settlements in urban areas in Fiji is of major concern to government planning authorities (WSP, 2015).[2] In the capital city, Suva City, it is estimated that at least one in eight persons live in an informal settlement (Health Services Department Survey Report, 2007) without access to basic WaSH services such as excreta disposal and proper drainage (Fijian Government MDG Report, 2010; WSP, 2015). Given the lack of basic WaSH services and the growing informal settlement concerns in the capital city, an informal settlement in Suva City, Fiji was chosen as the research site. The settlement was illegally constructed on government land, starting 14 years ago, when migrants began arriving from rural villages in search of better employment and educational opportunities (Health Services Department Survey Report, 2007). The settlement is located two kilometres from the city centre along the Suva-Nausori corridor, and is approximately 5.5 acres in size (see Figure 1)

Figure 1: Suva City, Fiji

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[2] Section 35 of the 2013 Fijian Government Constitution highlights the 'Right to housing and sanitation', which states '(1) the state must take reasonable measures within its available resources to achieve the progressive realisation of the right of every person to accessible and adequate housing and sanitation'.
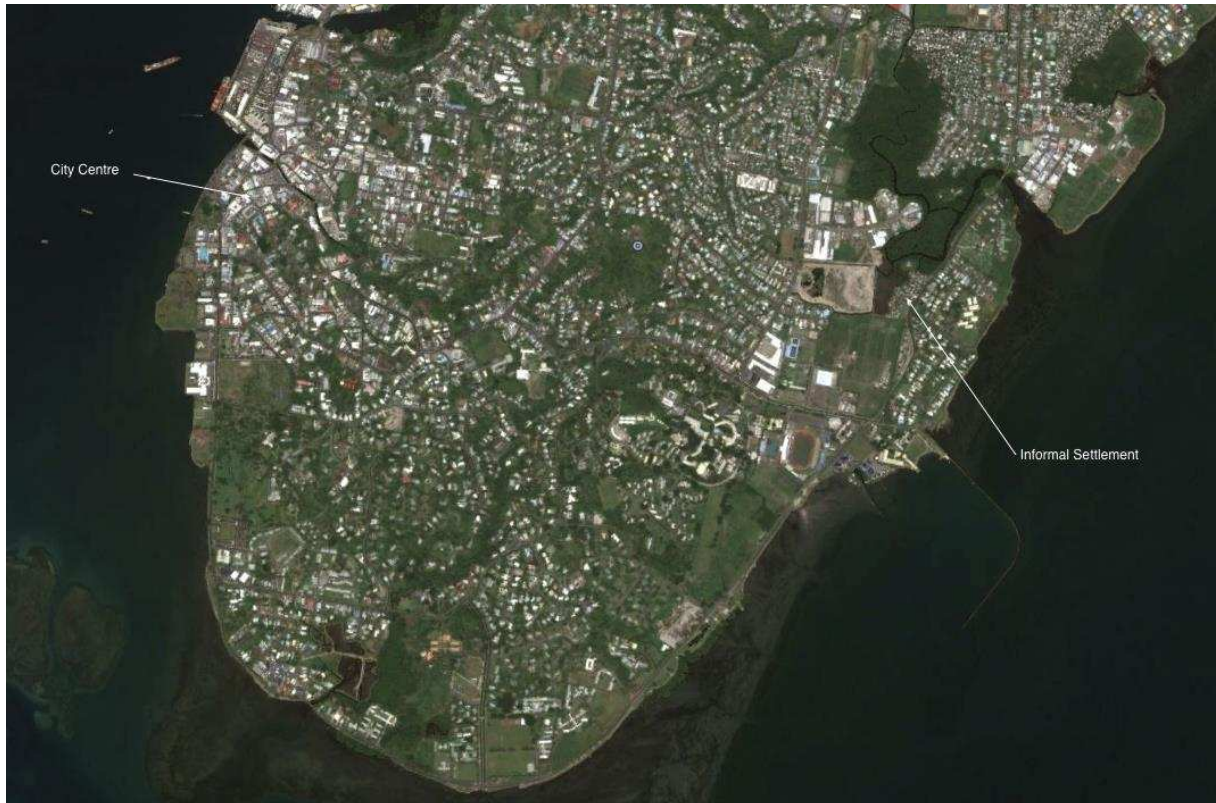
Source: Google Earth 2014, CNES/Astrium

On 31 March 2011 the Fijian government endorsed a National Housing Policy to achieve 'Affordable and Decent Housing for All by 2020'. Under the new policy the government embarked on a national Squatter Upgrade Project to provide sealed roads, water and sewer reticulation, and the issuance of residential leases for 10 informal settlements across Fiji. However, the research community was not included in the project, which effectively meant that it was highly unlikely that it would receive any government-funded basic WaSH infrastructure or services in the foreseeable future.

As there is no recent census data for the informal settlement, the researchers and the community estimate that there are between 90-100 housing structures and between 400-500 community members living at any one time in the informal settlement. It is also estimated that at least half of these community members are under 18 years old; and that the ethnic profile is approximately 80% ethnic Fijian, 18% Indo-Fijian, and 2% non-Fijian Pacific Islanders. Living conditions vary dramatically across the informal settlement from well-constructed three bedroomed houses (with indoor kitchens, showers and toilets, furnishings and modern appliances) to very poorly constructed corrugated lean-to type 'sheds' (with no piped water, no utilities and few furnishings). The WaSH infrastructure in the informal settlement is also built and maintained by individual households. Although community members occupy the land illegally, a few households have been given consent by the government to access piped water by purchasing a water meter connection. The water meter connection point is

located outside the settlement next to the main road, and residents are required to install their own water piping to their house. Only residents relatively close to the main road have purchased water meter connections.

Research Method

As part of a larger research project, some members of the research team first met with the community in November 2013. The team consisted of both practitioners and researchers, and came from diverse professions (i.e., water and sanitation engineers, public health, marketers, economists and environmentalists). Between them they spoke the local languages (i.e., English, Fijian, and Hindi). The purpose of the initial engagement was to develop trust and build rapport, and to ensure that the team had a good working relationship with the community. It was also an opportunity to become familiar with the research site, and to gain a better understanding of the complex issues and problems facing the community. The initial engagement phase culminated in a weeklong set of activities in August 2014, which included:

1. Welcome and traditional protocol ceremonies
2. Community transect walks to identify and record important landmarks and physical locations in the informal settlement
3. In-depth interviews with community leaders
4. Workshop sessions with community interest groups (e.g., church groups, women's groups, and other local committees)

One of the workshop sessions most related to the systems mapping activity involved the sharing of Google Earth images of the informal settlement (Ward & Peters, 2007; Archer, Luansang, & Boonmahathanakorn, 20012). The purpose of the activity was to identify and share community knowledge about significant features and landmarks. During the activity the participants created an overlay map, which highlighted important features and landmarks.

During the initial engagement with the community, the chairman of the informal settlement invited the research team to visit the community over a two-week period to specifically undertake the systems mapping activities. Households were invited to participate in an individual household-level systems mapping (HSM) activity through a referral sampling strategy (Abdul-Quader et al., 2006). In accordance with traditional protocol, the chairman of the informal settlement informed all households about the research, and asked for any interested participants to identify themselves. Interested participants from the households comprised the initial sample. These participants were then asked to refer the researchers to other households in the informal settlement who were then invited to

participate. The referral sample was saturated after 19 households (see Table 1). All 19 households were geo-referenced on a Google Earth image to verify that the sample was geographically dispersed across the settlement.

Once the household had been identified, the researchers then chose the two-person research team who would facilitate the HSM. For instance, if the household were Indo-Fijian, a researcher who spoke Hindi would be chosen as part of the research team. At each household, the researcher began by sharing a Google Earth image of the informal settlement, and by asking the household to identify their house. If the house did not appear on the image, the participants were asked to add it on the map. The researchers then followed an open-ended informal conversational technique (Turner, 2010) to broadly inquire about the household's background and life experiences before narrowing the focus on the household's WaSH situation. After the initial inquiry, the researchers then asked the participants to identify, and then choose a particular WaSH device (e.g., tap, shower, toilet, pipe, washing machine) in their home that was of importance to them. Once identified, the participants were asked why they selected the device, and then asked to write or depict it on a large piece of paper. The participants were then asked to separately identify and list any inputs and outputs to the device, and to draw these on the paper. It is important to note that the participants were encouraged to not only list physical or service inputs and outputs, but were also encouraged to list any social, cultural, economic, environmental, and even psychological inputs and outputs. All household members present were encouraged to participate. During the activity the researcher asked permission to audio record the household discussions and intra-household decision-making processes. The researcher also asked permission to photograph the WaSH device.

Table 1: Sample Profile

No.	Gender (Age Category)	Other participants	Job (Spouse Job)	WaSH Device
1	Female (20-24)	Male Housemates	Student (No spouse)	Toilet
2	Female (25-29)	Mother, Son	Unemployed (Casual Labourer)	Toilet
3	Female (55-59)	Husband	Unemployed (Unemployed)	Toilet
4	Male (35-39)	Wife	Casual Labourer (Housewife)	Bucket
5	Male (60-64)	Wife, Son	Retired/Self Employed (Housewife)	Tap
6	Male (50-54)	Wife, Son	Unemployed (Unemployed)	Shower Tap
7	Female (35-39)	None	Unemployed (No spouse)	Multi-purpose Basin
8	Female (35-39)	None	Unemployed (No spouse)	Tap
9	Female (30-34)	Daughters	Housewife (Fulltime Employed)	WaSH Basin
10	Female (No data)	Children	No data (No spouse)	Bucket
11	Male (50-54)	Wife	Casual Labourer (Housewife)	Multi-purpose Basin
12	Female (35-39)	None	Informal Stall (Unemployed)	Tap
13	Female (25-29)	None	Fulltime Employment (No spouse)	Bathroom
14	Female (35-39)	None	Unemployed (Unemployed)	Bathroom
15	Male (No data)	Wife	No Data (No data)	Tap
16	Male (No data)	Wife	No Data (No data)	Tap
17	Female (30-34)	Female Neighbour	Casual Employment (No Data)	Toothbrush
18	Female (40-44)	Husband	Unemployed (Taxi driver)	Toothbrush
19	Male (45-40)	None	Voluntary work (No data)	Tap

Once the household participants had indicated that the systems map was finished, the researcher asked if they were satisfied that the map was complete or whether they would like to make any changes. The

researchers then asked the participants to explain the HSM. Before leaving the household the researchers photographed it, unless otherwise instructed.

After the HSM activity was completed, the researchers imported the translated/transcribed audio-files, the researcher's notes, HSM maps and photographs into a central electronic repository - NVivo 10 - for the purposes of constructing a de-identified WaSH systems map for the informal settlement as a whole.

Figure 2: Community Water and Sanitation Systems Map
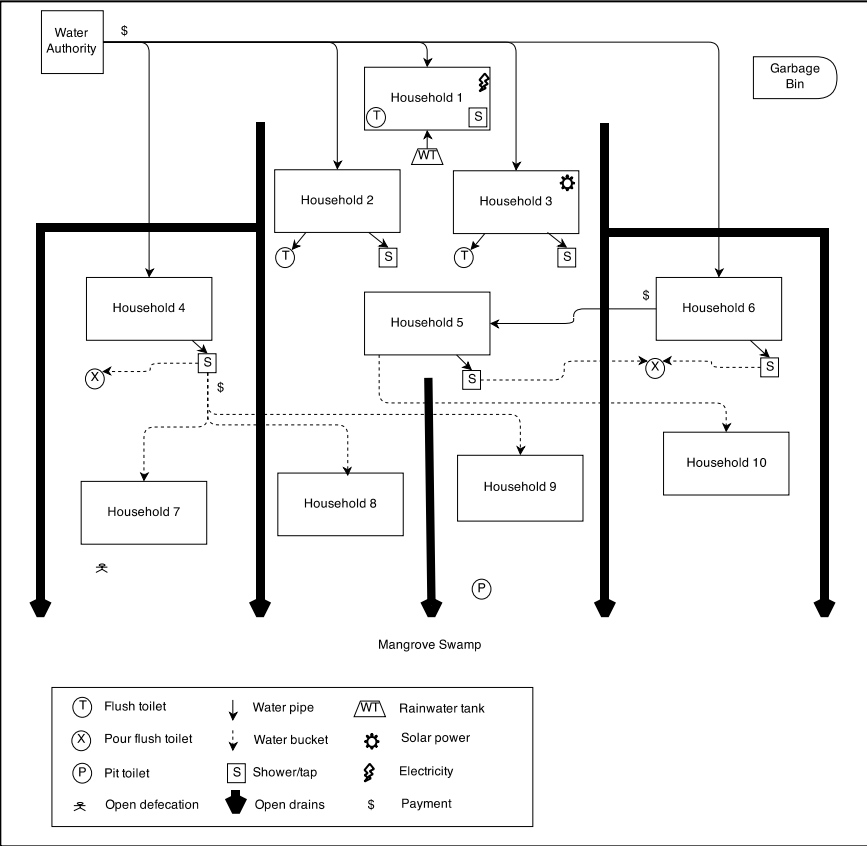
While it would have been entirely possible for a community group to construct the overall systems map from the HSMs (by way of a facilitated workshop), the researchers undertook the role so that any private or confidential information depicted on the HSM could be removed. While the map was being constructed, the researchers also transcribed summarized narratives for all 10 representative households shown in the map (see Box 1). The purpose of the narratives was to capture a description of each representative sub-system in the form of natural language (Polkinghorne, 1988) so that the community could form their own overarching 'WaSH systems narrative' to empower action (Williams, Labonte & O'Brien, 2003).

The map and accompanying narratives were shared with the community during a community meeting. At the meeting the community members were also given the opportunity to discuss the maps amongst themselves, and to make any amendments or changes to the maps. The amended maps were then printed, and given back to the community members (see Figure 2). Some examples of the system map narratives are shown in Box 1.

Box 1: Examples of the Systems Map Narratives

Household 1 Narrative: Mr B lives with his wife and two children in a three bedroomed house, located on the main road of the informal settlement. Together with all the other residents he is unsure if his family will be relocated to another site by the government – something he doesn't want to do. The informal settlement is his 'home'. He shares the house, which he describes as 'decent', with his brother and sister-in-law, who pay him a monthly rent. He operates a small business that employs four other people. The house has a separate inside bathroom (with shower) and flush toilet (connected to a septic drum). He is able to afford most WaSH-related products that are needed in the house, including washing powder, washing soap, body soap, shampoo, beauty products, toothpaste, toothbrush, sanitary pads, disinfectants, deodorises, razors, and shaving cream. He prefers branded products, except for toilet paper, which he prefers the cheaper thinner toilet paper as it does not block the toilet. He owns an electric washing machine. He had a small problem with the washing machine, but had not completed the warranty card, so he was unable to take the machine back to the store to get it fixed. His house has a rainwater tank for community use, which was installed by a charity organisation. He would prefer that the tank were not connected to his house, as it means that anyone could come into his yard. However, the tank's tap mechanism had been 'taken' so it does not work anymore. The house is above the floodline so it never floods. All the wastewater from the bathroom flows into the open informal drainage system.

Household 4 Narrative: Mr N lives with his wife, son, daughter-in-law, and grandchildren in a one-roomed corrugated iron 'shed', which he built from materials he found at various building sites. His family members occasionally get casual work in the city. A couple of years ago he managed to buy a water meter connection from a neighbour when the neighbour left the settlement. He connected the water from the main road to an outside shower, via the house. He 'shares' the shower with 10 other families who pay him a fixed monthly fee to use the shower, and fill buckets to take home. Some of the families are in arrears. He has a water valve ('key') inside the shack, which allows him to switch the water on and off. He normally has the water turned on between 6:00am and 9:00pm. Occasionally he turns it off during the day when people are taking the water without paying. He keeps spare piping and parts in the roof of his house so that he can fix any problems immediately. He is sometimes asked to repair a neighbours shower or toilet as he has plumbing tools. He asks the neighbours to buy the parts at the hardware store when they have the money. In return for his services he is sometimes paid

cash, provided a meal, or simply thanked. Any payment he receives is deposited into his account at the local water authority. As he has no bank account, he feels that this account is the safest place to keep his money. The account is normally in credit.

Household 7 Narrative: Mrs P is a widow who lives with her daughter-in-law and grandchildren. Her late husband had a casual job before he passed away. She rents a partitioned section of a one-roomed shack that is located next to the mangroves. She 'shares' a shower with 10 other families, and pays a fixed monthly fee to the provider. She is in arrears. She owns two mats and some bedding. She is a skilled mat weaver, however she is now very old, and so is only able to make about four mats a year. She cannot afford WaSH-related products such as newspaper, and relies on charitable neighbours to provide her with soap. She lives below the floodline on the mud flats. The mud flats below her shack were previously covered with mangrove trees, but a building developer on the other side of the swamp had cleared the trees when they built a retaining wall to protect the new development. As a result, the summer flooding is much worse and prevents her from accessing the shared pit latrine, which is located lower down. Open defecation occurs near to where she lives. She is grateful that the mud crabs act as 'little graders' to clean up the mess. All the wastewater from her buckets flows directly into the mangrove swamp.

Household 10 Narrative: Mrs O is a widow who lives alone. She has no steady income, and relies on the goodwill of her neighbours and relatives. She lives in a one-roomed shack with a mattress and two mats that is located below the floodline and next to the border fence. She has a wooden footstand next to the open drain where she cleans her teeth and disposes of wastewater. She shares a pit latrine toilet with her neighbours. The only WaSH-related product that she can regularly buy is all-purpose soap, and occasionally newspaper. She always keeps the plastic wrappers from the WaSH-related products so that she can use them to light the fire. When she cannot afford to buy soap she uses ash to clean her dishes. She showers at her relative's house, which is 2 minutes walk away across the open informal drains. She also fills her buckets there, and carries them back to her house. She has sometimes fallen into the drain and hurt her ankles when carrying the heavy buckets. She now uses a PVC pipe as a walking stick. She owns a large collection of buckets, including biscuit buckets, ice-cream buckets, and water bottles, which she found down by the beach and in the city. She would like to own a hosepipe one day, however she knows that she will probably never be able to afford it. The summer rains regularly flood her house and the pit latrine. Her neighbour is also a widow who lives in a very similar situation.

Community Needs, Actions and Outcomes

Even though the systems mapping activity aimed to trigger purposeful community actions, it would be misguided to claim that a single mapping activity (amongst many other activities) undertaken by some people in the community could lead to specific community actions and outcomes in any cause and

effect way (Ison, 2013). Instead, it is possible to underline some of the community-expressed needs that came about during the systems mapping activity, and to show how the activity enabled suitable conditions to address these needs. Evidence of these expressed needs and subsequent actions were recorded in the form of meeting records, action plans, photographs and videos, letters and correspondence, maps, applications, and media communications (e.g., newspaper articles).

Community Identified Need 1: The need for a WaSH sub-committee to oversee the entire WaSH system

During the systems mapping activity the participants expressed a felt need for the community itself to oversee the WaSH system within the informal settlement. At a later joint workshop arranged by research team, the community established a specific WaSH sub-committee. The WaSH sub-committee initially consisted of five office bearers and ten additional members who were to co-ordinate a number of actions with the community to improve the overall performance of the WaSH system. The WaSH sub-committee was then later officially instituted under an existing Community Development Committee during a community meeting. Some of the actions that the WaSH sub-committee co-ordinated included: regular cleaning of drains, building of footpaths, installing household garbage bins, attending free small-enterprise training workshops, and formally requesting a new pedestrian crossing for the main road.

Community Identified Need 2: The need to articulate and share their WaSH systems maps with other WaSH system actors

During the systems mapping activity the participants expressed a need to articulate and share their WaSH situation with other WaSH system actors. An opportunity came about to share their WaSH systems map at a joint workshop arranged by research team. The aim of the workshop was to bring together the informal settlement community and other WaSH system actors (i.e., city council, water authorities, housing and health authorities, various NGOs) to seek ways to address some of their most urgent WaSH problems. At the meeting there were numerous occasions when the community participants articulated and shared their WaSH systems map. For example, the community participants used the systems maps to explain to the water authorities how water is on-sold in the informal settlement through a complex set of cultural, social and economic exchange relationships. The system maps were also used to explain to the city council how illegal dumping of solid waste outside the informal settlement was blocking the drains and so negatively impacting their WaSH system. In addition, the system maps were used to point out that many basic services were not in place in the informal settlement. During the workshop, the community were also given the opportunity to take the other systems actors on a guided tour of the informal settlement to 'bring to life' some of the WaSH problems shared during the workshop, and to show what actions they were undertaking to address these. For many of the WaSH system actors this was their first time 'inside' the informal settlement. By the end of the workshop, the participants agreed on a number of small actionable steps. For

instance, the city council promised (and later provide) simplified process diagrams, specifically designed to help the community report illegal dumping. The city council also promised (and later provided) additional information on how to formally apply and pay for new water main connections.

Community Identified Need 3: The need to include other WaSH system actors in a community WaSH Forum.

During the systems mapping activity the participants expressed the need to involve other WaSH systems actors to address their most urgent WaSH problems. Similarly, during separate meetings, the other systems actors also expressed a desire to support the community WaSH committee. An important initiative of the joint workshop was the establishment of a joint WaSH Forum that consisted of both the community WaSH sub-committee and other systems actors (including WaSH-related NGOs, government departments, and public utility company representatives). The WaSH Forum agreed to meet once every two months to provide technical advice to improve community actions, set objectives, assign tasks and monitor progress. Some of the initial actions undertaken by the WaSH Forum included building a Facebook site to share community specific WaSH-related information, advising the community on national policies and standards, clarifying information on water access and garbage collection, cleaning the 'outside' drains, and improving administration and management of the other sub-committees. Another important outcome of the joint WaSH Forum was the extension of the water supply mains along the main road by the water authority to a section of the informal settlement that had been identified as a priority area during the systems mapping activity. At a later WaSH Forum meeting the community was also advised by a government representative that the informal settlement would for the first time form part of the National Development Public Consultations to formulate the country's 5-year and 20-year plan. The public consultations were then held at the informal settlement. During the consultations the community chairman and other community representatives were given the opportunity to once again articulate and share their WaSH system 'story' and to raise some of the issues identified during the systems mapping activity. The public consultation attracted media attention.

Discussion and Conclusion

Improving WaSH services in PICs is certainly very complex and challenging, particularly in informal settlements that have received very little or no support from other systems actors in the past. Given these complexities and challenges, we advocate for a broad systems-based approach to generate credible systems information in the form of marketing systems maps, which can be used to inform planning and actions. Hence, our paper described a PAR mapping activity that was undertaken by an urban informal settlement community to create reliable systems maps. We showed that an extremely marginalised community, with facilitated support from the research team, were able to competently

name, describe, and depict their WaSH systems, and were then able to use these maps (and accompanying narratives) to inform their own planning, bridge communication gaps, and build action networks with other relevant systems actors.

Significantly, the mapping activity acted as a catalyst for communication and knowledge sharing both within the community and with other systems actors. This new and more informed dialogue then directly led to the formation of collectives (i.e., committees and forums), which were able to drive discussions and prioritise responses to the issues brought to the surface during the mapping activity. Through building consensus and establishing a WaSH sub-committee with a single unified voice, the systems mapping undertaken in this project has helped empower the local community in a number of ways. First, the mapping activity helped organise and develop the community's capacity to adopt a systems-based approach to name, describe and discover WaSH systems information for the purpose of identifying and planning appropriate WaSH interventions. Thus, the activity was able to expose aspects of the WaSH system that otherwise may have gone unexplored (and unmapped). Second, the mapping activity gave voice to the informal settlements WaSH narratives that could be articulated and shared in the form of natural language, particularly when negotiating and finding common ground with other systems actors. The systems mapping also provided a medium in which the community could begin to explore and explain their own collective WaSH aspirations as a direct outcome of the PAR process. Third, the systems mapping allowed the community to describe and depict the many social, cultural and economic activities and actions that are integral to the functioning of the system as a whole. This greatly assisted both the community and the other WaSH systems actors to understand the broader social complexities of the WaSH system; and to negotiate possible solutions.

Of course, there was no guarantee that the mapping activity would necessarily improve WaSH system outcomes or performance. However, we have demonstrated that the mapping activity empowered the community to themselves initiate a course of actions to address WaSH-related issues, even if these actions did not necessarily solve the issue in its entirety. Similarly, we do not suggest that participatory systems mapping was straightforward or easy. It required careful facilitation that took time and resources to develop; and there was always the possibility that the various actors could use it to further their own self-interests or even use the information contained in the maps to disempower others (Patel & Baptist, 2012). Similarly, because of the limitations of relying on a referral sample strategy there was always the possibility that the mapping activity would fail to capture important system components. Nevertheless, we have shown that systems mapping provides a medium of communication and dialogue that increases the likelihood of all systems actors achieving small actionable outcomes, which typically required system actors to reveal information about the workings of the system as a whole.

In terms of future PAR activities, we encourage researchers to further refine our systems mapping procedures for other contexts and communities, particularly amongst the most vulnerable in society; and to develop additional ways of monitoring and evaluating the effectiveness of community systems mapping to ensure that the activity remains reflexive and responsive to community needs. Urban planning researchers could consider using our systems mapping procedures to seek community insights and participation in the areas of transportation, education, energy, telecommunications, and other urban marketing systems of interest. Similarly, systems mapping could be integrated into urban policy planning activities to better achieve a more inclusive, representative, and effective decision-making process. In doing so, we believe that engaging in mapping as a supplementary systems-based activity can create a richer pool of systems knowledge and contribute to the overarching PAR ethos of creating "circumstances in which people can search together collaboratively for more comprehensible, true, authentic, and morally right and appropriate ways of understanding and acting in the world" (Kemmis & McTaggart, 2005, p. 578).

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