Chapter 9
Participatory Action Research for WASH by Children and Youth in Peri-Urban Communities

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Abstract In the study of water, sanitation, and hygiene (WASH) and its related health impact, it is imperative to understand the people and their respective environments to ensure lasting improvements in their quality of life. To explore this theme, this chapter provides details of a Participatory action research (PAR) conducted with members of Dziko Langa, a children and youth club, based in two peri-urban settlements in Lusaka, Zambia. The study was aimed at collaborative examination and intervention alongside club members, focusing on health and sociocultural aspects relating to WASH within their communities. The chapter is divided into three parts: (1) peri-urban WASH assessment and intervention through participatory approaches, (2) development of a quantitative self-assessment methodology for fecal contamination in their living environment, and (3) visualization approaches for community and stakeholder engagement. Through collaborative studies such as these, we can further explore the abilities of local communities to independently measure the health levels of their environment, identify WASH priorities, engage with stakeholders and policymakers, and share their findings for the betterment of the broader community.

Keywords Participatory action research · Peri-urban · Water, sanitation, and hygiene · Visualization · Fecal contamination · Diarrhea risk

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9.1 Health, Social Culture, and Participatory Action Research

A key component of scientific exploration on subjects such as water, sanitation, and hygiene (WASH) and health is the individual—the core recipient of the knowledge and intervention, whose quality of life we are seeking to improve. Failure to recognize the individual and the sociocultural ecosystems that define their way of life has, at times, led to the rejection of inventions and public distrust, even when faced with grave health risks or much needed intervention (Pugliese-Garcia et al. 2018). With regard to personal matters such as health and WASH preferences, the active participation of local people in exploration, discussion, and decision-making offers the possibilities of culturally appropriate, well-rounded, and sustainable input (Jacquez et al. 2013).

Participatory action research (PAR) is a research method that allows stakeholders to determine, assess, evaluate, and address a problem. In PAR, there is exchange of resources and ideas between researchers and participants that is guided by the needs of the participants rather than the researcher (Jason et al. 2019). A consistently developing research method, the process involves repeated cycles of planning, observing, and reflecting, in which individuals and groups engaged in PAR can implement changes required for social improvement. In the recent past, children and young people have been involved in this research method not merely as research subjects, but as active participants and even researchers in their own right (Foster-Fishman et al. 2010; Kim 2016). PAR has thus become more common with regard to such studies because researchers identify children and youth as resources for participatory action and research, gaining ground on preventive and positive developmental movements.

In this chapter, we provide details and findings of PAR conducted with children and youth residents of two peri-urban settlements in Lusaka, Zambia. PAR was conducted through the Dziko Langa Club, which acted as the main vehicle for community engagement with the aim of bottom-up and collaborator approaches. The chapter is divided into three parts: (1) peri-urban WASH assessment and intervention through participatory approaches, (2) development of a quantitative self-assessment methodology for fecal contamination in their living environment, and (3) visualization approaches for community and stakeholder engagement.

9.1.1 Peri-Urban WASH

Globally, over one billion people live in slums (including peri-urban settlements), with poor access to municipal services such as adequate health care and quality WASH facilities. Unfortunately, the number of slum residents continues to rise, particularly in low- and middle-income countries. In Sub-Saharan Africa, peri-urban dwellers account for 59% of the urban population; this is estimated to increase to

1.2 billion people by 2050 (UN Habitat 2016). Very few national surveys on WASH routinely distinguish between slum settlements in rural and urban areas (WHO and UNICEF 2019), making information on peri-urban WASH more often scant and creating a gap in the urban WASH story. WHO and UNICEF (2019) have thus partly credited this gap for uneven peri-urban WASH achievement on a global scale.

9.1.2 The Case of Lusaka, Zambia

Zambia is a low-middle-income nation in Sub-Saharan Africa with a population of approximately 15.5 million, 65% being under the age of 25 years. Only 67.7% and 40% of the population have access to improved drinking water and sanitation, respectively (Central Statistical Office 2016). In comparison to national statistics, peri-urban figures reveal that approximately 56% and as much as 90% of the peri-urban population lack access to safe water and sanitation facilities, respectively (Republic of Zambia 2006). Poor WASH has also been linked to Zambia's annual cholera outbreaks, usually emanating from rural and peri-urban settlements (WHO 2011). In the capital city of Lusaka, 70% of the residents are peri-urban dwellers (Central Statistical Office 2012) distributed across 37 peri-urban settlements (Central Statistical Office 2016). Consequently, Lusaka has experienced regular disease outbreaks due to fecal contamination of food and water caused by poor WASH (Kapata et al. 2018).

Most of Lusaka's unplanned settlements were created during colonial times as "early self-help housing" and "unauthorized housing" as a consequence of the colonial government's African urban employment policies and the rural–urban migration that ensued (Mulenga 2003; Yasini 2007). As of 1974, however, the Zambian government reclassified several illegal settlements to "improvement areas," providing legal settlement status, government municipal provisions, and resident title deeds. Improvement in area development has been slow (Mulenga 2003). Our preliminary research in nine Lusaka peri-urban settlements from August to October 2016 revealed minimal municipal provisions in the upgraded reclassified sites; of the nine assessed settlements, two were selected as research sites (Nyambe et al. 2018).

9.1.3 Dziko Langa Club

In 2017, *Dziko Langa* (DL), meaning "My Community/Country" in the local lingua (Nyanja language), was conceptualized as a suitable, engaging means to include and empower children and youth from our two Lusaka research sites (designated sites A and B) in WASH PAR. Three points should be made at this juncture: (1) children are active participants in WASH, particularly at the household level due to their engagement in domestic chores (Hemson 2007); (2) children are, and can be accurate and

valuable communicators of their experiences, particularly when the right approach/methodology is utilized (Driessnack and Furukawa 2011); and (3) the age group of 18–29 constitutes the largest household head bracket in the country (Central Statistical Office 2016). With the study aimed at participants' peri-urban WASH assessment and intervention as co-researchers and frontrunners rather than mere participants, facilitating their incorporation in WASH research was essential.

The Club, officially registered under the Zambia National Youth Development Council as of December 2019, initially had an age cap of 10–14 years for children and 18–24 years for youth for logistical and planning reasons. Child members were recruited in their fifth grade from two local public schools, while youth participants were recruited through youth centers and vocational schools as students, workers, or unemployed. For research and sustainability purposes, however, older members have been allowed to stay on despite surpassing the age limits in their respective categories, while new members under 25 years of age continue to be added. During the 3 years of study, approximately 80 children and 40 youths were active members of DL.

While children and youth primarily constitute the membership and the executive board of DL, the communal nature of the club requires collaboration and links to WASH and local community stakeholders. In summary, the key actors in the DL story are: (1) DL members who were the main participants as co-researchers and community leaders; (2) peri-urban residents and/or the general public who benefit from DL activities; (3) the research team as aids and co-researchers with DL; and (4) local institutions (e.g., schools, youth centers, health centers) that provide infrastructure, mentorship, and support to DL members and for DL interventions.

9.2 Participatory Approaches: Photovoice and Arts-Informed Research

The initial objective of DL research was for DL members, that is, participating children and youth, to critically assess and find means to intervene in peri-urban WASH. The study used photovoice for youth and arts-informed research for children as participatory approaches, which afforded participants the opportunity to engage in research procedures such as data collection and analysis. DL members were informed of the upcoming activities, and participation was open to DL members who were available at the time of the activities. The entire process for both approaches, including data analysis and the subsequent Sanitation Exhibitions, took place from December 2017 to March 2018. Photovoice, art, and the exhibits worked as a means of community engagement, participant empowerment, information dissemination, and education to both participants and the broader community on peri-urban WASH (Franz 2010; Wang and Burris 1997).

9.2.1 Data Collection

9.2.1.1 Photovoice (Youth)

Photovoice is a visual, participatory method in which cameras are provided to persons often excluded from decision-making processes to capture their perspective of their lives and their community through photographs and accompanying narratives (Wang 2006). Relatively cost-effective and simple to use, photovoice was deemed suitable for data collection for the youth demographic. Moreover, this methodology has been found useful for identifying new, unique priorities in WASH and encouraging community participation in project planning and engagement (Davis et al. 2018). While official research data collection and analysis was only done with the photographs of 12 youths (male = 7, female = 5; age = 17–24) who were available for the initial photovoice exercise (Nyambe and Yamauchi 2021), approximately 30 youths participated in the exercise at both sites. In both cases, prior to data collection, the participants underwent training using digital cameras and research ethics. Thereafter, each of them was given 4 days to take 2–5 pictures in response to the framing question: "What is WASH in your community?" To moderate the number of photographs, each participant was requested to select two pictures for analysis. However, 150 photographs were obtained in total.

9.2.1.2 Arts-Informed Research (Children)

Art is a useful and acceptable tool in health-related research involving children as it helps them to sense, organize, and share their thoughts (Driessnack and Furukawa 2011; Franz 2010). As art is an expressive, thought-provoking, and emotive medium for both the artist and the viewer, its methodology allows for groundbreaking, progressive research that is both socially responsible and useful in addressing social inequalities (Franz 2010). Thus, similar to photovoice, the researchers used art as a means for children to draw their experiences and share them through narration. The arts-informed research was conducted with 50 fifth-grade students (male = 21, female = 29) from two government schools. To ease children's understanding of the framing question, we explained it in both English and Nyanja. Children's framing questions required them to draw "What they wanted to see and what they did not want to see in their communities in relation to WASH." Before answering the framing question, children were provided opportunities to draw, scribble, and familiarize themselves with the art activity. After three free-flow sessions, children were given 15–20 min to draw their answers in response to the WASH framing question. Researchers stressed that the children's artwork would not be assessed based on artistic skills, and that there were no right or wrong answers.

9.2.1.3 Contextualization and Codifying

Contextualization involved participant group discussions centered on the sharing of images and their accompanying stories. This was followed by codifying, which facilitated the placement of key variables into themes (Wang and Burris 1997). The contextualization processes for photovoice and art were similar and first involved the owner of the photograph/artwork: (1) sharing their images and narratives; (2) explaining why photographs were taken or pictures were drawn, citing locations where possible; and (3) highlighting key variables to be noted in the storyline. Participant discussions helped to clarify (1) if participants agreed with the presented subject, (2) why it was a challenge/good thing, and (3) factors responsible for or linked to the aforementioned finding. Additionally, participants were requested to recommend solutions for cited challenges and/or means of sustaining positive behaviors. While codifying was not conducted by children, some basic codifying was done by youth participants. This facilitated their identification of WASH priorities, undergoing further analysis post-exhibition.

9.2.2 Photovoice and Art Results

The results depict the nature of peri-urban WASH in sites A and B as experienced by participants, indicated under the subthemes of peri-urban water, sanitation, hygiene, and WASH confounders. A sample of the results is provided in Fig. 9.1 and Table 9.1 for youth's photovoice, and Fig. 9.2 and Table 9.2 for children's art. Note that narratives have been edited purely for grammatical purposes. Overall, images and narratives depicted open defecation, links between fecal management and water contamination, food management, hand hygiene, WASH facility structures and maintenance, and waste management practices, among other challenges.

Fig. 9.1 Youth photovoice images

Table 9.1 Summary of photovoice narratives (refer to Fig. 9.1)

No.	Narrative
1	The man is living in the dump site as he is trying to make it better. The land was dormant and people began dumping on it
2	The child was defecating outside on a chamber pot [potty] with the mother nearby. There are some fecal remains on the ground
3	This area is not OK. There are a lot of bins around. There is a drainage which goes to the bin when a lot of flooding occurs. The child outside can easily get sick playing there
4	This is an old toilet which collapsed. They do not have a new one. They tried to cover it. It's on a road. They throw their chambers pots [makeshift toilets/potties] in there
5	The road is flooded. They throw garbage here. It is near a number of shops. The child is playing on the wall fence
6	The fresh food is being sold along the roadside. There is garbage along the streets and people are buying the food. There are flies on the fish
7	During the rainy season, residents transform dump sites into gardens
8	These people fetch water from this tap every time. The area around the water source area is unclean and it is not closed. Cleaning the buckets without soap. We do not know if the water is safe or not. It is an old water kiosk. Lusaka Water and Sewerage Company collect money from those who buy water here
9	From the outside, the toilet looks up to standard. Ventilated, clean, tiled. But inside, it was not that clean. The hole is not covered. It can be locked from the inside. No provision is available for handwashing within the toilet, no toilet utensils (tissue, toilet cover)
10	By the dam and the road. This is the industrial area. People use the same water for washing, dumping garbage, urinating, and children swim and play there too

Fig. 9.2 Children's artwork

Table 9.2 Summary of children's art narratives (refer to Fig. 9.2)

No.	Art narrative
1	This house here has no toilet [leading to open defecation; Note: Person on left of the house]
2	This toilet has no door, or cover for the toilet hole, so flies will move from the toilet into the food
3	People are pouring water for each other as they wash hands. This is what I want to see particularly at my house
4	This person came out from the toilet and is washing his hands. The toilet is behind the house and it is clean. The water [tap] is far away from the toilet down there
5	This house is doing very well. The surrounding is clean
6	This is a toilet [black roof], these are flies [left of the toilet] and these are bins [right of the toilet]. The flies are moving from the toilet and the garbage to the house [far left, blue roof]
7	This child here has a mango and she is eating it without washing it; she is eating it near the toilet. The toilet is not clean, flies are flying all over, but the child is still eating
8	Where they draw water from is clean, and the buckets are clean too
9	They are greeting each other [with a fist bump] not knowing whether the friend is from the toilet, or if he washed his hands or not
10	This house has no tap and when they draw [collect] water, they do not add chlorine or boil it. They use the same water to wash dishes, bath, and they still drink from the same water

9.2.2.1 Peri-Urban Water, Sanitation, and Hygiene

Results representing peri-urban water focused on behavioral tendencies related to water sources, and the collection, usage, storage, and treatment of water (particularly treatment of drinking water). Several narratives also incorporated the theme of contamination routes, with fecal disposal, poor waste management, and faulty infrastructure being termed as water pollutants. Refer to Fig. 9.1, Table 9.1 (3, 8, 10), and Fig. 9.2, Table 9.2 (4, 8, 10). Open defecation and public urination were commonly expressed by child participants under the theme of peri-urban sanitation. The results also showcased toilet quality, structure, maintenance, and child fecal management. The condition of public toilet facilities was highlighted by youth participants, and contamination of water and food due to proximity to the toilet was cited by several child participants. Refer to Fig. 9.1, Table 9.1 (2, 4, 9, 10), and Fig. 9.2, Table 9.2 (1, 2, 6, 7). Following the WHO-UNICEF WASH definitions (WHO and UNICEF 2017), hygiene is focused on handwashing. The results indicated important times for handwashing and a close link between handwashing, toilet use, and food consumption. Children's results also highlighted handwashing methods and hand hygiene strategies linked to cultural practices, that is, communal handwashing before a meal, and conservative greeting styles to avoid handshakes [Fig. 9.2, Table 9.2 (3, 9), respectively]. Refer to Fig. 9.1, Table 9.1 (9); and Fig. 9.2, Table 9.2 (3, 4, 5, 9).

9.2.2.2 Peri-Urban WASH Confounders

The results highlighted several often-overlooked factors that, though not covered by formal WASH definitions, play an active role in peri-urban WASH. Poor waste management [see Fig. 9.1, Table 9.1 (1, 3, 5, 6, 7, 8, 10); and Fig. 9.2, Table 9.2 (5, 6, 8)] was indicated as a causal factor for water contamination through flooding due to blocked drainage and pit latrines [Fig. 9.1, Table 9.1 (3, 8)]. It was also cited as a source of food contamination and disease [Fig. 9.1, Table 9.1 (5, 6); and Fig. 9.2, Table 9.2 (6)], canceling out the benefits of water and sanitation access as it attracts flies and microorganisms. Child insights further highlighted the importance of WASH in food hygiene, that is, the washing of fruits and vegetables before consumption [Fig. 9.2, Table 9.2 (7)]. Both child and youth results noted the health implications related to WASH practices and children's play practices [Fig. 9.1, Table 9.1 (3, 5)]. Refer to Fig. 9.1, Table 9.1 (1, 2, 6, 9, 10, 12, 15, 16), and Fig. 9.2, Table 9.2 (3, 4, 9).

9.2.3 A Summary of Peri-Urban WASH

Children and youth alluded to both good and poor knowledge, attitudes, and practices that impacted local WASH. Open defecation and public urination, improper waste disposal, poor food management, and unsafe hygiene practices were attributed to ignorance, force of habit, and a lack of proper facilities (Bhatt et al. 2019; Satterthwaite et al. 2015). Children provided insight into cultural beliefs relating to mothers' management of child feces; that is, that child feces were not harmful and were good for growing vegetables, particularly cabbage. They also provided a few examples of how various habits had changed to accommodate hygiene improvements, such as greeting by fist bumps rather than handshakes, pouring of water rather than communal use of basin water for handwashing, and growing of crops at dumpsites to reduce poor waste disposal practices. The youth, in particular, stressed on household habits and behaviors, and the responsibility of residents to ensure proper WASH (Nyambe and Yamauchi 2021). The need for WASH education was expressed by all participants, with children citing examples of adults who willfully practiced poor WASH despite being informed. This highlighted poor attitudes and behaviors toward new knowledge, particularly when shared by children, emphasizing their marginalized position.

Besides the need for WASH education, local government suppliers were castigated for poor WASH management, ranging from inadequate and delayed service delivery, malpractice, and poor policy implementation. While the cost of WASH facility installation and upgrades should be recognized as impacting governments' ability to facilitate WASH improvements (Satterthwaite et al. 2015), there was a call from participants that authorities should be held accountable for poor service delivery. Participants also lobbied for the incorporation of more public–private

partnerships and/or community-based organizations in local WASH activities. Previous studies have shown how participatory strategies incorporating individual, organizational, and community-level players were used to create awareness and intervention reaching policy levels (Laverack 2017; Postma and Ramon 2016). Children lamented school closures during disease outbreaks and their willingness to participate in preventing such reoccurrences despite lacking the platform. Both children and youth thus mentioned the need for local empowerment and cooperation with other WASH stakeholders for real, consistent improvements in WASH.

9.2.4 Sanitation Exhibition

As a culmination of the photovoice and art exercises, participants held Sanitation Exhibitions at the research sites. The exhibitions were held during the 2017/2018 cholera outbreak that had hit both research sites and required permissions from the local health facilities and police departments to hold the events. The exhibits were open to the public, and a local government representative attended each exhibition as a guest of honor. Media houses were also invited. A total of 223 persons attended the event at both the sites. All DL members' art and photographs were showcased, with the creators giving the narrative of their work to the attendees. The venues for sites A and B were a local school and a local government office, respectively. The venues were designed by children and youth, who also took it upon themselves to incorporate poetry, drama, and song into their WASH information dissemination. Additionally, focus group discussions with community residents in attendance were conducted by the youth at site A (see Fig. 9.3).

The Guest of Honors made a pledge to support DL's work in their communities, citing DL as a proactive group working for disease prevention. Through these events, community residents in attendance sought government assistance and

Fig. 9.3 Sanitation exhibit: (**a**) exhibit setup; (**b**) focus group discussion by youth; (**c**) exhibition hall; (**d**) information dissemination (drama by children)

recognized the need for regular public action through education to help change behavior. There was also recognition of the importance of children and youth involvement in playing an active role in sustainability and change in peri-urban WASH.

9.2.5 Dziko Langa Post-Exhibit

DL members have conducted and/or participated in several community-based interventions. An executive meeting with DL youths registered a total of 22 interventions and training conducted from August 2017 to October 2019, excluding biweekly meetings and/or occasional in-house training. Post-exhibit, DL members held a Sanitation Festival that saw the participation of children and youth from schools and churches alongside local government in community cleanups, waste management, and WASH information dissemination.

Having developed a business idea based on their findings, DL youths through the researchers participated in the 2019 Hult Prize Competition themed "For Us By Us, Youth Unemployment: Can you build the foundations of a venture that will provide meaningful work for 10,000 youth within the next decade?" Their business idea won first place at the Hokkaido University On-Campus competition and reached the semifinals of the regional competition held in Ho Chi Minh City, Vietnam. Examples such as these showcase the possibilities and opportunities offered to communities through the incorporation of local knowledge and collaboration with multidimensional partners.

9.3 An Early Trial of Self-Assessment of Health Risk in WASH

9.3.1 Motivation of Self-Assessment of Health Risk in WASH

PAR is a promising approach to enhance people's motivation to improve WASH, and DL has been effectively exploring and intervening in WASH through PAR, as mentioned above. Still, in many cases WASH interventions such as the introduction of toilets and the treatment and disposal of excrement have not taken root. One of the reasons for this failure is that the health effects of WASH interventions (e.g., reduction in diarrhea frequency) are not apparent in the short term.

As mentioned in Chap. 8, WASH is a system that reduces the likelihood of exposure to pathogens, especially from human excreta, by reducing fecal contamination and exposure in the living environment (Cairncross and Feachem 1993; Wagner and Lanoix 1958). However, fecal contamination is invisible to the naked eye, except in cases of extreme fecal pollution, which is often accidental, complex,

and context-specific (Julian 2016; Julian et al. 2018). While clean water and hand hygiene apparently and immediately contribute to health improvement, the impact of improved sanitation is not quickly realized. Sanitation helps in making the living environment free from fecal contamination (Fig. 9.1 of Chap. 9). Therefore, proper sanitation indirectly improves human health through an improved living environment. Furthermore, although a person may practice proper sanitation, the surrounding living environment cannot be improved if their neighbor still follows improper sanitation. Cronin et al. (2017) indicated that health improvement will occur with at least 60% coverage of sanitation or higher, although the proportion varies in each case. This invisibility, complexity, context-specificity, and indirectness can lead to people's failure to realize the impact on health improvement derived from sanitation.

To tackle this challenge, we conducted a case study to show context-specific quantitative data of fecal contamination, exposure, and health risk to the residents of an urban slum in Bangladesh. It was shown that the residents' interest in WASH could be enhanced, and their behavior partly changed (Goto et al. 2015). If we can take this idea a step further and instead of the external data being given by the outsider, the community quantitatively investigates fecal contamination, exposure, and health risk in WASH by themselves as PAR, they may realize the impact of fecal contamination and exposure in their living environment and the role of WASH. Through this experience, they may become proactive and effective in managing their WASH, which may form the basis for WASH behavior change and improvement. To unify PAR and a quantitative survey on contamination, exposure, and health risk in WASH, we designed a PAR framework for the quantitative self-assessment of fecal contamination, exposure, and health risk in WASH, and conducted a preliminary part of the framework with local DL youth members.

9.3.2 Outline of the Self-Assessment Workshop

In a peri-urban settlement of Lusaka, Zambia, where cholera is sporadic, we implemented an initial workshop model on the quantitative self-assessment of fecal contamination for DL youth members in collaboration with the authors. Exposure and health risk assessment was excluded from the initial trial and the total coliform concentration was used as an indicator of fecal contamination levels. The workshop was held for 2 days (October 26–27, 2019), with five youths aged 17–22 years participating on the first day (approximately 2 h) and seven youths from the same age bracket on the second day (approximately 1 h).

The outline of the 2-day workshop activities is shown in Fig. 9.4. On the first day, the authors gave an overview of WASH and the diverse forms of fecal contamination and exposure to the participants. The participants then listed what they considered important causes of diarrhea and ranked them in order of importance. The participants were divided into two groups: after the instruction on how to collect samples by facilitators, each group moved out to a community and collected samples from six different media types (Fig. 9.5), two were fixed by facilitators, and the remaining

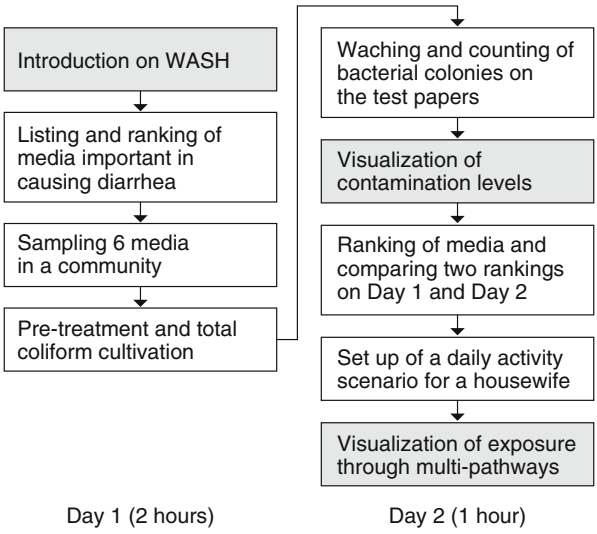

Fig. 9.4 An outline of the 2-day workshop activities. Gray background and white background boxes indicate the processes implemented by facilitators and participants, respectively

Fig. 9.5 Sampling by the workshop participants. (Photo by Kataoka)

four were selected by the participants. After a simple pretreatment, fecal contamination of each sample was tested using the test paper for total coliform (maker of test paper: Shibata, Tokyo). On the second day, after incubating the test papers at 37 °C for approximately 15 h, the participants watched and counted bacterial colonies of total coliforms formed on the test papers with the help of facilitators (Fig. 9.6). After they submitted the colony count data to the facilitators, the data were processed and illustrated as fecal contamination levels of each medium. Participants again ranked the media in a similar manner as on the first day, but this time reflected their own obtained results of fecal contamination levels. They then compared the rankings of the first and the second day with discussions on the differences between the two rankings, and what media they think needs to be tackled to improve their health.

Fig. 9.6 Counting the colony number of total coliforms by the workshop participants. (Photo by Kataoka)

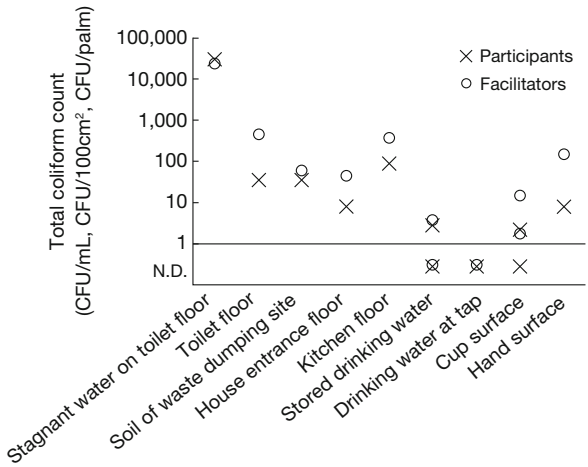

Fig. 9.7 Contamination levels of nine types of media measured by participants and facilitators

Based on a housewife's daily activity scenario, the fecal exposure for each pathway was estimated from the results of the contamination level. However, it was difficult to establish appropriate exposure factors to calculate the exposure for some activities and organize the relationship between contamination and exposure for the participants to understand on site. Therefore, as an initial trial, we limited this methodology to fecal contamination, excluding exposure and health risk aspects.

9.3.3 Learning and Implication from the Early Trial

Comparing the fecal contamination results of the authors' parallel measurements with those of the participants (Fig. 9.7), the correlation between the two

Table 9.3 Media ranking by importance on causing diarrhea (day 1: before fecal contamination survey; day 2: after fecal contamination survey)

Day 1		Day 2	
1st	Drinking water	1st	Kitchen floor
2nd	Uncovered food	2nd	Toilet floor
3rd	Unwashed hand	3rd	Waste dumping site soil
4th	Toilet floor	4th	House entrance floor
5th	Kitchen floor	5th	Cup surface
6th	Domestic water	6th	Hand surface
7th	Waste dumping site soil	7th	Stagnant water on toilet floor

concentrations was moderate ($R^2 = 0.62$), indicating that the measurements by participants were reasonably valid despite their lack of technical knowledge, having merely received brief instructions through the workshop. No total coliform was detected from the source of drinking water, whereas one sample of point-of-use drinking water (stored in a jelly can) was contaminated; this trend of greater contamination of point-of-use drinking water was in line with Harada et al. (2018). Furthermore, the wide contamination of their living environment was indicated in the contamination of various media such as a toilet floor, kitchen, waste dumping site, house entrance, hand and cup surface, and stagnant water on the toilet floor.

Of the 12 types of fecal exposure media listed by participants, the top seven ranked by importance on days 1 and 2 are shown in Table 9.3. On day 1, before the fecal contamination survey, drinking water and uncovered food were ranked as the first and second most important media causing diarrhea, which are typical media directly ingested and apparently associated with exposure. In contrast, on day 2 after the fecal contamination survey, the kitchen floor and toilet floor were listed as the two most important media, which were not directly ingested but indirectly caused fecal exposure through the contamination of the living environment. During the discussion at the end of day 2, the participants highlighted the importance of the media associated with indirect fecal exposure through the contamination of the living environment. This indicates that through the workshop they were able to realize the importance of cleanliness of the living environment rather than the media of direct ingestion, such as drinking and eating.

This early trial showed the potential effectiveness of the individual's quantitative self-assessment of fecal contamination in WASH. Throughout the workshop, participants' enthusiasm was evident through their active participation and dedication. In particular, the change in the ranking of importance of contaminating media, observation of coliform colonies, and knowledge of the extensive contamination of their own community may have led to an improved sense of the role of WASH in controlling fecal contamination in the community living environment and through it, exposure, and health risk potentially. The quantitative self-assessment would therefore help participants understand the importance of sanitation in preventing unhygienic excreta discharge and controlling fecal contamination in the living environment.

However, significant work remains to complete the quantitative self-assessment of fecal contamination, exposure, and health risk in WASH. Due to differences in the types of media, it is not rational to simply compare the contamination levels of all media, such as floor contamination (concentration per area) and water contamination (concentration per volume). To examine the effects of contamination in various media, besides being aware of the contamination level of the media, it is also vital to know the exposure from multiple media and pathways, and the health risks from these exposures with an acceptable level of accuracy to be quantitative for communities' self-learning. This will help participants design countermeasures based on their own measurement of results, taking into account the contamination and exposure trends in the contexts of their community. Due to resource limitation and methodology complexity, this early trial could not cover the exposure and health risk assessment. To achieve these goals, the authors are currently developing a methodology that easily enables the quantitative self-assessment of fecal contamination, exposure, and health risk in WASH using digital software to facilitate its implementation. It is expected that the self-assessment of fecal contamination, exposure, and health risk in WASH through PAR would allow people to realize the effect of WASH, contributing to more effective and sustainable WASH intervention.

9.4 Visualization

9.4.1 Communication in Participatory Action Research

Target 6.2 of the United Nations Sustainable Development Goals, which reads, "By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations (SDGs)," was launched in 2016. However, it is increasingly believed that a top-down approach involving "material and financial assistance" alone may not achieve this goal. Our PAR as described above is practiced with children in the community, in which they themselves conduct research on sanitation issues. It is a practical research method in which community members, consumers, and researchers collaborate to develop specific methods for solving issues and improving the community. We conducted meta-studies to investigate children's research activities with the hope of children identifying problems on their own, changing their attitudes and behaviors through discussions with other children, and having a spillover effect on adults in the community. However, the continuation of activities in the community has been very difficult, especially due to generational change in children and youth groups.

Therefore, it became necessary to focus on "science communication" rather than "education," which is a one-way delivery of knowledge. Science communication is the practice of two-way dialogue that overcomes the differences in science literacy. In many of the children's activities, dialogue among children and between children

and adults brings them into contact with the collective memory of the community and evokes empathy. It also discusses the importance of clarifying how knowledge and skills are exchanged between experts and nonexperts and among nonexperts. This not only encompasses specialized knowledge understood through literacy, but also "indigenous knowledge systems," which are the kind of life knowledge and skills that people transmit from one generation to the next in the community when tackling complex issues of the society (Hoppers 2002). Focusing on the characteristic of "living knowledge" in such dialogues, we attempted to utilize "visual materials" as a tool for PAR, which can directly express emotions and time-related changes that cannot be textually expressed.

9.4.2 What Emerged from the Introduction of Video into PAR

As stated above, DL has been utilizing photovoice and art as part of their regular activities. Typically, participants use these participatory methods to investigate the state of community WASH, demonstrating their findings through photographs, art, and accompanying stories. They also express their findings and messages through theater, poetry, and dance, which they also showcase at public exhibitions held to present their research results. Previous research on children's participation in solving community problems has shown that the easiest way for children to communicate with each other and with adults is through the spoken word, and it is important to create an open space in which children of different ages and abilities can freely express their ideas (Hart 1997). Previous research has also reported on the transformation of WASH-related behavior through photo-based action research and photovoice (Bisung et al. 2015).

We have been collaborating with a video artist in Lusaka with the expectation that the videos created as part of our PAR will be more familiar to the locals and more widely used. As shown in Table 9.4, an introductory video was created from recordings of several activities and interviews with research participants to introduce the activities of March 2018. Afterward, a 30-min documentary video was produced that recorded the 2-month preparatory period (August to September 2018) for the Sanitation Festival that DL held for the local community. Additionally, a workshop

Table 9.4 List of activities related to visualization for March 2018–February 2019

Implementation period	Activity
March 2018	Video production in collaboration with a local video artist 1 (activity video of DL)
August/September 2018	Video production in collaboration with a local video artist 2 (close-up video of the public event)
February 17, 2019	Workshop for information transmission using video (classroom lecture + information transmission group work using SNS)

was held to help DL members use the videos produced for their own publicity and activities and to disseminate information through the videos.

Thus, the PAR activities have been archived on video, and a new look at DL's work reveals that they are constantly creating an "image" of their community's issues and what they have learned through their activities through various visualization methods such as photovoice and art. Both in the place where the "image" is created and in the place where the "image" is exhibited, the research subjects talk about the "image." Moreover, they speak of a single "image" in different words, depending on the occasion. We organized a media team for the members of DL who were particularly keen on communicating their activities to not only the adults in the community, but also persons outside the community through social networking services (SNS), among others, holding workshops to deepen the conversation about the "image" of the team.

9.4.3 Digital Storytelling: Talking About the Image

In collaboration with DL youth members and a local video artist, we held a workshop to experiment with digital storytelling methodology to reflect on past activities while making images. Digital storytelling is a way for ordinary, nonprofessional filmmakers to create short video works by creating "stories" about their own lives and everyday events through dialogue with others in workshops. Alongside the creation of the video, a variety of social activities were organized that encouraged participants' reflection through dialogues and collaboration during the workshop process.

The workshop had five participants aged 18–23 years old, consisting mainly of members of the DL media team who were in charge of dissemination of club activities through social networking, among others. They had participated in almost all DL activities since their inception and were thus also core members of the club. The workshop was held on October 27, 2020, on the campus of the University of

Table 9.5 Structure of the digital storytelling workshop

	Contents	Time	Topic providers/group work
1	Opening	5 min	From researcher
2	Introduction to digital storytelling	10 min	From researcher
3	Discussion to wrap up DL activities (step 1 of the six steps)	40 min	Group work
4	Tips for making video	20 min	From local video artist
5	Digital storytelling from photovoice (steps 2–5 of the six steps)	60 min	Group work
6	Reviewing the video and closing (step 6 of the six steps)	30 min	Group work

Note: The structure of the workshop was based on Hartley and McWilliam (2009)

Fig. 9.8 Selected 13 photos and stories

Table 9.6 The six steps to digital storytelling group work

Step 1	Story circle	Discussing the topic
Step 2	Making story	Writing it as a video script
Step 3	Recording narration	Recorded voiceover
Step 4	Selecting images	Selecting photos for video
Step 5	Editing using PC	Editing video on PC
Step 6	Sharing	Sharing outcomes

Zambia in Lusaka and lasted about 3 h. The structure of the workshop is presented in Table 9.5.

The structure of the workshop consisted of a combination of topic presentations and group work, as shown in Fig. 9.8. The digital storytelling part of the workshop was structured with reference to six standard steps (see Table 9.6) (Hartley and McWilliam 2009). In this trial, workshop time was limited and could, therefore, only be conducted up to step 4. The video was edited by a filmmaker to produce the final product. In terms of the flow of the workshop, we revisited the activities through story circles, summarized them in chronological order, and then selected 13 activities (plus introspection and endings) that made a strong impression on the participants. For each of these, they chose a photo they took and wrote a script. Finally, the order of the scenes was structured as a story in a nonchronological order. The digital storytelling broke down the timeline, and through introspection of the activities, the participants shared the issues they were concerned with in their PAR through story circles. The issues were placed at the beginning of the video, and 5 of the 13 photos selected were about community "issues."

9.4.4 What Visualization Can Bring to PAR

One of the characteristics of PAR is that it is a collaborative practice involving research subjects and researchers who share a target state (Yamori 2018). Yamori states that the research subject and the researcher are "co-participants" in PAR who can both benefit from the process. For the research subjects, visualizing changes during PAR using video allows them to share the changes in the community's perception toward the target state and facilitate the understanding of PAR activities with the community. For the researcher, it is possible to analyze changes in the research subjects that are difficult to observe using conventional methods. Scientific knowledge learned during PAR is connected to local life knowledge through videos produced as part of the research; and by communicating the internalized knowledge, awareness, and understanding of the club members as "stories."

In the early stages of our research, we thought that visualization could help us package and communicate situations and problems that are difficult to be expressed verbally. Digital storytelling was originally approached as a method that emphasized individual narratives, and it was common for each participant to create his or her own story (Ogawa 2016). However, in this trial, all participants created a single story as an exercise of storytelling. Creating "our" story was not intended to be desirable, but as a result, the workshop became a place where the participants were able to see the problem as their own through reflection on the activity, and to share the issue collectively through the process of visualization. Although the visual images themselves are not a short-term solution to change individual behaviors and attitudes, visualization has the potential to become one of the methods to build a common awareness and sustainably tackle various issues in the community.

9.5 Conclusions

This chapter outlines a collaborative research conducted with local children and youth aimed at assessing and improving WASH and health within their households and broader communities. Through PAR, researchers and participants were able to assess the status of their physical environment (ecosystem), understand more precisely, the pathways for fecal contamination within their immediate environment, and visually reflect on, express, and share their findings with the broader community.

Through photovoice and arts-informed research, a full PAR cycle was achieved, moving from data collection to analysis that highlighted participants' recommendations and efforts toward WASH education, community action through exhibitions and public clean-ups, and increased engagement for children and youth as local WASH stakeholders. The sanitation exhibitions, festival, and formal registration of DL were notable, and successful PAR outcomes that were implemented by identifying and acknowledging participants' WASH priorities. They also helped to reveal areas of needed improvement in the current DL model, which we hope to address in

future research: creation of formal long-term WASH partnerships, a narrowed down and simplified peri-urban WASH action plan, and a benefit and continuity plan for the DL club and its members.

Regarding fecal pathways, the methodology of quantitative self-assessment of fecal contamination, exposure, and health risk in WASH was in early-stage development. However, observation of fecal bacteria as a part of PAR made local youth aware of fecal pollution. The initial results, including the ranking of media causing diarrhea, showed a change in their recognition of fecal contamination in their living environment, leading to an improved sense of the role of WASH. However, a significant amount of work remains to complete the quantitative self-assessment of fecal contamination, exposure, and health risk in WASH. An improved methodology with the help of digital software to facilitate workshop implementation and the quantification of fecal contamination, exposure, and health risk is currently under development.

Finally, visualization focused on video, which expresses the spoken language of the participants as it is. With a media group within DL to play a central role in the dissemination of information using the images produced, a system has been established in which club members can be more proactively involved in the visualization. As for the practical results that videos could bring, we expect it would be a tool to promote information dissemination to the local residents and surrounding communities, and that the communication in the process of video production would help DL members reflect on their past activities, deepening their understanding. In addition, the video analysis of the video production to information dissemination process may enable us to examine the function of DL within the local community through its activities from the perspective of science communication.

In all three studies, individual participation aided in a deeper understanding of personal and communal points of view, WASH priorities, and the tools available to the participants. Thus, collaborating with locals through existing community-based organizations such as schools and youth centers may be the first step toward upscaling the activities mentioned in this chapter. As PAR is about partnership and co-research, a successful model should be able to scale-up through participating communities partnering with similar neighboring community organizations in order to interact with locals as co-researchers at an interpersonal level. This requires an environment that bridges the gap between government policies and best practice in WASH, and the individual and their household. It also means ensuring that the local community has a sustainable means of progressing the intervention even after the research is completed, which can be achieved through taking advantage of local resources. While the enforcement of various government policies could benefit successful upscaling and cementing of activities, focus on Dziko Langa as a club in which participatory research methods, fecal contamination measurement, and visualization activities can be conducted within existing community organizations and shared with others offers greater opportunity for sustainability, upscaling, and practical intervention capable of impacting the individual and broader community.

References

Bhatt N, Budhathoki SS, Lucero-Prisno DEI et al (2019) What motivates open defecation?: a qualitative study from a rural setting in Nepal. PLoS One 14(7):e0219246. https://doi.org/10.1371/journal.pone.0219246

Bisung E, Elliott SJ, Abudho B et al (2015) Using photovoice as a community based participatory research tool for changing water, sanitation, and hygiene behaviours in Usoma, Kenya. BioMed Res Int 2015:903025. https://doi.org/10.1155/2015/903025

Cairncross S, Feachem R (1993) Environmental health engineering in the tropics, 2nd edn. Wiley, Chichester

Central Statistical Office (2012) Zambia 2010 census of population and housing: population summary report. Central Statistical Office, Lusaka

Central Statistical Office (2016) Living conditions monitoring survey report. Living Conditions Monitoring Branch, Central Statistical Office, Lusaka

Cronin AA, Gnilo ME, Odagiri M, Wijesekera S (2017) Equity implications for sanitation from recent health and nutrition evidence. Int J Equity Health 16(1):211. https://doi.org/10.1186/s12939-017-0709-5

Davis A, Javernick-Will A, Cook SM (2018) A comparison of interviews, focus groups, and photovoice to identify sanitation priorities and increase success of community-based sanitation systems. Environ Sci Water Res Technol 4(10):1451–1463. https://doi.org/10.1039/c8ew00391b

Driessnack M, Furukawa R (2011) Arts-based data collection techniques used in child research. J Spec Pediatr Nurs 17(1):3–9. https://doi.org/10.1111/j.1744-6155.2011.00304.x

Foster-Fishman PG, Law KM, Lichty LF, Aoun C (2010) Youth ReACT for social change: a method for youth participatory action research. Am J Community Psychol 46:67–83. https://doi.org/10.1007/s10464-010-9316-y

Franz JM (2010) Arts-based research for teachers, researchers and supervisors. In: Higgs J, Cherry N, Macklin R et al (eds) Researching practice: a discourse on qualitative methodologies, vol 2. Sense Publishers, Rotterdam, pp 217–226

Goto S, Harada H, Sakai A et al (2015) Workshop for sanitary improvement using diarrhea risk information in an urban slum in Bangladesh. In: Proceedings of 13th JADE's conference, Tokyo, pp 7–12

Harada H, Fujimori Y, Gomi R et al (2018) Pathotyping of Escherichia coli isolated from community toilet wastewater and stored drinking water in a slum in Bangladesh. Lett Appl Microbiol 66(6):542–548. https://doi.org/10.1111/lam.12878

Hart RA (1997) Children's participation: the theory and practice of involving young citizens in community development and environmental care, 1st edn. Routledge, London

Hartley J, McWilliam K (2009) Computational power meets human contact. In: Hartley J, McWilliam K (eds) Story circle: digital storytelling around the world. Wiley-Blackwell, Malden, MA, pp 3–15

Hemson D (2007) 'The toughest of chores': policy and practice in children collecting water in South Africa. Policy Futures Educ 5(3):315–326. https://doi.org/10.2304/pfie.2007.5.3.315

Hoppers O (2002) Culture, indigenous knowledge and development: the role of universities. Centre for Education Policy Development, Pretoria

Jacquez F, Vaughn LM, Wagner E (2013) Youth as partners, participants or passive recipients: a review of children and adolescents in community-based participatory research (CBPR). Am J Community Psychol 51(1–2):176–189. https://doi.org/10.1007/s10464-012-9533-7

Jason LA, Glantsman O, O'Brien JF et al (2019) Introduction to community psychology. Rebus Community

Julian TR (2016) Environmental transmission of diarrheal pathogens in low and middle income countries. Environ Sci Process Impacts 18(8):944–955. https://doi.org/10.1039/C6EM00222F

Julian TR, Vithanage HS, Chua ML et al (2018) High time-resolution simulation of E. coli on hands reveals large variation in microbial exposures amongst Vietnamese farmers using human excreta for agriculture. Sci Total Environ 635:120–131. https://doi.org/10.1016/j.scitotenv.2018.04.100

Kapata N, Sinyange N, Mazaba ML et al (2018) A multisectoral emergency response approach to a cholera outbreak in Zambia: October 2017–February 2018. J Infect Dis 218(Suppl_3):S181–S183. https://doi.org/10.1093/infdis/jiy490

Kim J (2016) Youth involvement in participatory action research (PAR): challenges and barriers. Crit Soc Work 17:38–53. https://doi.org/10.22329/csw.v17i1.5891

Laverack G (2017) The challenge of behaviour change and health promotion. Challenges 8:25. https://doi.org/10.3390/challe8020025

Mulenga CL (2003) Urban slums reports: the case of Lusaka, Zambia. Institute of Economic and Social Research University of Zambia, Lusaka. https://www.ucl.ac.uk/dpu-projects/Global_Report/pdfs/Lusaka.pdf. Accessed 30 June 2018

Nyambe S, Yamauchi T (2021) Peri-urban water, sanitation and hygiene in Lusaka, Zambia: photovoice empowering local assessment via ecological theory. Glob Health Promot. https://doi.org/10.1177/1757975921995713

Nyambe S, Hayashi K, Zulu J et al (2018) Water, sanitation, hygiene, health and civic participation of children and youth in peri-urban communities: an overview of Lusaka, Zambia. Sanitation Value Chain 2(1):39–054. https://doi.org/10.34416/svc.00010

Ogawa A (2016) Dejitaru Sutoriiteringu: Koenaki omoi ni monogatari wo (Digital storytelling: making stories for unvoiced voices). Liberuta Shuppan, Tokyo

Postma J, Ramon C (2016) Strengthening community capacity for environmental health promotion through photovoice. Public Health Nurs 33(4):316–324. https://doi.org/10.1111/phn.12243

Pugliese-Garcia M, Heyerdahl LW, Mwamba C et al (2018) Factors influencing vaccine acceptance and hesitancy in three informal settlements in Lusaka, Zambia. Vaccine 36(37):5617–5624. https://doi.org/10.1016/j.vaccine

Republic of Zambia (2006) Fifth national development plan 2006–2010. Republic of Zambia, Lusaka

Satterthwaite D, Mitlin D, Bartlett S (2015) Is it possible to reach low-income urban dwellers with good-quality sanitation? Environ Urban 27(1):3–18. https://doi.org/10.1177/0956247815576286

UN Habitat (2016) Slum almanac 2015/2016: tracking improvement in the lives of slum dwellers. UN Habitat. https://unhabitat.org/slum-almanac-2015-2016. Accessed 30 Jan 2020

Wagner EG, Lanoix JN (1958) Excreta disposal for rural areas and small communities. WHO, Geneva

Wang CC (2006) Youth participation in photovoice as a strategy for community change. J Community Pract 14(1–2):147–161. https://doi.org/10.1300/J125v14n01_09

Wang C, Burris MA (1997) Photovoice: concept, methodology, and use for participatory needs assessment. Health Educ Behav 24(3):369–387. https://doi.org/10.1177/109019819702400309

WHO Global Task Force on Cholera Control (2011) Cholera country profile: Zambia. WHO. https://www.who.int/cholera/countries/ZambiaCountryProfile2011.pdf. Accessed 30 Mar 2018

WHO, UNICEF (2017) Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines. WHO and UNICEF, Geneva. https://data.unicef.org/wp-content/uploads/2017/07/JMP-2017-report-launch-version_0.pdf. Accessed 26 Apr 2018

WHO, UNICEF (2019) Progress on household drinking water, sanitation and hygiene 2000–2017. UNICEF and WHO, New York. https://washdata.org/sites/default/files/documents/reports/2019-07/jmp-2019-wash-households.pdf. Accessed 27 May 2020

Yamori K (2018) Action research in action: kyodo-tohjisya, jikan, data (Action research in action: co-parties, time, data). Shinyosha, Tokyo

Yasini M (2007) A profile of unplanned settlements in Lusaka. Lusaka City Council Research Unit, Lusaka