Co-producing healthy communities

A methodological approach to prevent arbovirus epidemics in a Brazilian social housing neighbourhood

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ABSTRACT: Dengue, Zyka and Chikungunya are dangerous arboviruses transmitted by the Aedes aegypti mosquito. In 2019, 1.4 million people were infected, causing 414 deaths. Studies show that the proliferation of the mosquito is correlated to the accumulation of waste and other water-retaining elements in private backyards. Most cases occur in social housing developments, especially in the 'Minha Casa Minha Vida' Programme (PMCMV) for 4.4. Million homes. In Uberlândia, these cases represent 78% of the 38,000 people infected in 2019. The MORA group, from the Federal University of Uberlândia and the group People, environments and performance, from the University of Sheffield faced this situation with the project, affectionately nicknamed as "My House Without Dengue Fever", financed by the Global Challenges Research Fund between 2020 and 2021. Given the UN Sustainable Development Goals 3, 11 and 15, this project has developed an effective approach to co-produce strategies to eliminate the dengue mosquito from communities in a lasting way. This work discusses the importance of community engagement in containing the contamination by the dengue virus, describing the methodological toolkit developed to understand risk situations and behaviours. Are also described the artifacts developed in order to guide the resilient community fight against the disease – namely, a web app and a digital guidebook.
KEYWORDS: Coproduction, Social housing, Post occupancy evaluation, resilience, Arbovirus epidemics.

1. INTRODUCTION

The repetition of poor planning and construction models in the national 'Minha Casa Minha Vida' Programme (PMCMV) for 4.4 million homes – Brazilian Social Housing Federal Programme - continues to have a negative impact [1, 2]. Developing resilient housing communities that can respond to climate change requires a rapid action to address increasing short-term environmental and health shocks and long-term environmental change in such housing. This article investigates the resilience of the PMCMV housing model in reality through a case study of a typical PMCMV social housing neighbourhood in the city of Uberlândia, Brazil, in this significant national housing programme.

Previous Post-occupancy evaluation (POE) studies of PMCMV in the area encompassing 4,000 semi-detached houses identified three significant issues impacting residents' health and well-being: (i) poor acoustics; (ii) poor thermal comfort and (iii) backyard breeding grounds for Dengue, Zika and Chikungunya diseases significantly affecting social housing communities. In 2019, the disease affected 1.4 million people in Brazil and killed 419 [3]. Considering that the intensity of the disease symptoms debilitates the patient for up to 7 days, an estimated total of 9.8 million work days were lost in 2016 [4, 5]. In the city of Uberlândia mapping of Dengue shows that viruses mainly affect the social housing communities which are located in peripheral areas [5].

Despite local authority efforts to control the spread of the epidemic, solutions remain challenging because: the vaccine isn't safe and efficient enough to be used; the Aedes Aegypit mosquito proliferates in urban areas; accumulated waste and sealed soil areas are the favourite places for mosquitoes to lay eggs; private backyards with these conditions are difficult to access by the health agents; the major of mosquito breeding grounds are in the backyards; and low-income people are less aware of the measures needed to keep houses free of mosquitoes. Previous research in social housing communities [6,7,20] indicated that some practices could contribute to the establishment of grounding breeds in the houses. This paper considers the following research questions arising from the consideration of housing resilience to these key diseases and their sources: Are there shared practices in terms of how PMCMV backyards are used? What practices can reduce mosquito

breeding grounds? Are residents able to positively change their practices?

To answer these questions, this study aims to assess the Shopping Park Neighbourhood, a typical PMCMV enterprise and to develop a retrofit toolkit to help to reduce arboviruses infections. POE and co-production methods and techniques are used, aiming to involve the community and develop a long-lasting toolkit, which can engage the entire neighbourhood through promotion by the residents themselves.

Based on this single case study, the findings of this study show that the developed retrofit toolkit is successful in reducing the number of possible breeding grounds, changing residents 'practices, being long-lasting and engaging the community in the face of mosquitoes.

2. DENGUE IN SOCIAL HOUSING: ENVIRONMENTAL CONDITIONS AND VULNERABILITY

Dengue Fever is currently the most important among the arboviruses that affect man and is a serious public health problem in the world. Its proliferation is related to the presence of objects that accumulate water in backyards long enough to attract the female Aedes aegypti mosquito [8, 9].

According to the rapid survey of infestation by Aedes aegypti carried out in the city of Uberlândia in 2019, 84% of positive breeding sites for Aedes aegypti are inside homes, with 17% inside homes and 83% in backyards [10, 20]. Private backyards with these conditions are difficult to access by the health agents.

Dengue needs to be combated by stopping the mosquito life cycle, preventing it from being born in the vicinity and inside homes. For this, the good management of backyards must be constant. This research assumes that lasting solutions demand continuous intervention, especially with most vulnerable audiences, as those living in SH [8, 9].

3. CO-PRODUCING RESILIENCE: METHODOLOGICAL APPROACH TO CHANGING PRACTISES

People naturally reproduce practises that directly affect the organization and characteristics of the environment in which they live most of their lives (indoors). These practises may often lead to environmental conditions potentially favourable to dengue proliferation.

To help eliminate dengue-favourable environments, a solid methodology is developed as a solution space capable of helping the community to avoid the dissemination of dengue.

This consists of a 3 stages´ toolkit that enable the understanding of the socioeconomic and environmental context, the recognition of home management practices, residents´ profiles, in addition to providing opportunities for reflection and intervention on the built environment.

The work stages are outlined seeking to: raise evidence on the relationship between mosquito proliferation and socioeconomic, environmental, behavioural and morphological conditions of the set, and engage residents in the co-production of strategies.

The methodology comprises 3 main stages as follows:

1) Pre-study assessment

These studies seek to understand a) Residents' demographic profile; b) Mapping of the conditions of the built environment favourable to the proliferation of the Aedes Aegypit mosquito; c) Occurrence of dengue in the neighbourhood; d) amount of mosquito eggs present in houses; e) Number of possible mosquito breeding sites in backyards; f) Identification of practices favourable to the proliferation of mosquitoes. The objective of this pre-study phase is to establish a general understanding of the factors that leads to the proliferation of dengue in the neighbourhood; to know the practices and profiles of the residents to better select the methods for the elaboration of the toolkit; in addition to establishing an initial framework for comparison after studies and actions. This stage combines post-occupancy assessment methods (walkthrough and questionnaires), spatial mapping (drone flight and morphological mapping), and monitoring of the presence of mosquitoes (installation of eggtraps). For this phase, based on the morphological mapping that identifies areas most conducive to the proliferation of mosquitoes, it is decided to sample 32 questionnaires evenly distributed throughout the neighbourhood, of which 11 residents are selected for further studies with walkthrough and installation of eggtraps[1] that are monitored for 6 weeks each time.

2) Toolkit development

This stage involves working with the community to develop a toolkit, capable of helping residents to identify and eliminate possible mosquito outbreaks from their homes. To this end, 7 residences are selected among the 11 participants of the previous study from the identification of their greater

[1] An Eggtrap is a very simple device consisting of a small plastic vase and a wooden strip. The vase is filled with water to 3/4 and the wooden strip is inserted into the vase leaving 1/4 of its length out of the water. The device is then placed in a quiet place in the house. Mosquitoes will lay their eggs on the dry part of the strip expecting them to fall into the water after a week. Before that, however, the researchers collect the wooden strip and with the aid of a microscope they count the number of eggs deposited. This is a very efficient method to check for mosquito infestation in certain places.

engagement. Starting from the pre-study results, co-production workshop sessions are held (4 face to face and 2 online, across 5 months) [11, 12]. A toolkit is developed to help the community recognize and remove breeding grounds, as the most effective way to stop the Dengue disease spreading. These activities are based on the Practice Theory methodology [13] covering the socioeconomic and environmental context, home management practices and residents´ practises [13, 14, 15]. They contained different co-production exercises to address the following objectives: a) Knowing and understanding the relationship between practices and the occurrence of dengue; b) deepening knowledge and ways to avoid it; c) Change in practices and automation of the response to the problem; d) engagement and assimilation of the toolkit in the community. The assimilation indicators are measured at the last workshop, when participants are asked to find potential mosquito breeding grounds in neighbours' houses, that is, in uncharted territory.

3) Post-study assessment

This stage comprised the assessment of project impacts in terms of the effectiveness of changes in practices and persistence over time of these changes. Thus, 6 months after the last workshop, eggtraps were installed to measure the presence of mosquitoes in 11 houses, of which 7 participated in the two previous stages and another 4 that participated only in the first stage. Through a walkthrough, the possible breeding grounds of mosquitoes in the backyards were quantified. This evaluation allowed us to compare results before and after the toolkit, as well as between participants and non-participants, enabling us to obtain performance indicators.

Table 1:
Stages, methods and actions.

Stage	Methods	Actions
Pre-study assessment	Post-Ocupancy Evaluation Geoferrence. Mosquito infestation test	Questionnaire. Walkthrough. Spatialization from drone images using diverse softwares. Eggtraps monitoring.
Toolkit development	Theory of Change. Practise theory. Co-production exercises	Workshop 1 - Assessing previous knowledge of residents regarding dengue fever. Workshop 2 - Raising awareness about the mosquito, how it is behaving and the risks it offers. Workshop 3 - Identifying the critical points of the backyard. Workshop 4 - Empowering resident-yard relationship. Impact questionnaire.
Post-study assessment	Mosquito infestation test Post-Occupancy Evaluation	Eggtraps monitoring Walkthrough – number of breeding grounds

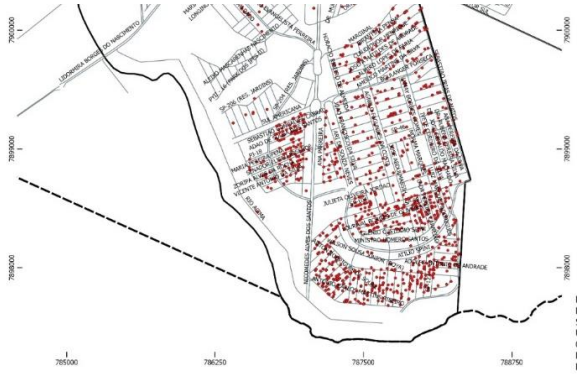
Note: (2020), Authors

4. RESULTS AND DISCUSSION

4.1 Pre-study stage

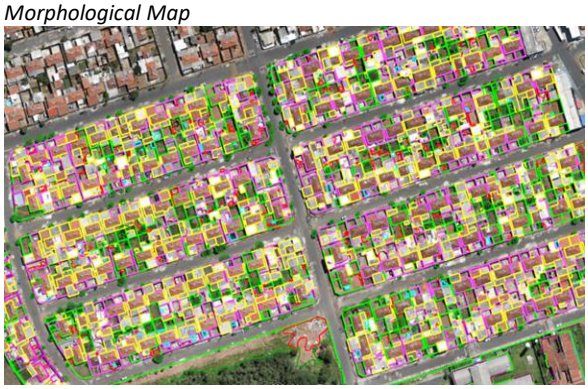
The pre-study stage indicated a high incidence of dengue in the neighbourhood in 2019. Shopping Park recorded 1225 cases of dengue, approximately one case every 3 homes (Fig. 1) [3]. Geographical distribution of cases was homogeneous, indicating that the presence of mosquitoes was not prevalent in a specific location. The morphological mapping (Fig. 1) showed a high incidence of paved areas and soil waterproofing interventions (91%), which favour the accumulation of water and possible breeding sites (Fig.2). The accumulation of material for recycling or future use by residents in the backyards in all 10 sampled houses was also recorded through the walkthrough. These materials become possible mosquito breeding grounds. The questionnaire results showed that the residents did not see materials as garbage, but as resources. Although they had no intention or planning for the use of certain materials, they stored them for some possible use in an indefinite period. Residents also showed reasonable awareness of dengue prevention measures (60% knew how Dengue was transmitted). However, about 80% said they did not take any action, a fact also observed by the researchers during the walkthroughs. The installation of eggtraps indicated that there were eggs in all participating houses, with small variations between them (27 eggs in average). The scenario, therefore, was largely favourable to an uncontrolled proliferation of mosquitoes and an increase in the incidence of the disease.

Figure 1:
Dengue fever incidence in the Shopping Park Neighbourhood



Note: Uberlandia's Zoonosis Control Centre (2019) – Adapted by the authors.

Figure 2:
Morphological Map



Note: Google Earth Pro (2020), Maxar Technologies (2020), Authors.

Figure 3:
Typical backyards – All sort of material stored

Note: (2020), Authors

4.2 Toolkit development

The workshops developed interest and engagement by residents. The degree of knowledge about dengue increased considerably and there were indications of its persistence over time, as demonstrated in impact questionnaires applied in each workshop. There were expected variations depending on the higher or lower level of schooling of each family. An average accuracy level of 80% was observed in the questions related to dengue applied to residents in the first two workshops. Among participants there was already some prior knowledge from previous government campaigns, but in all cases positive change in practices were observed, which were verified in the post-study stage. The following questions were progressively addressed in 4 workshops as follows: a) what do you have in your backyard? b) What would you like to have in your backyard? c) Where is the mosquito in your backyard? d) On-site backyard inventory; e) Mosquito hunt in participants and neighbour's hoses. The assimilation indicators were measured at the last workshop, when participants were asked to find potential mosquito breeding grounds in neighbours' houses, thus, in uncharted territory. In this dynamic, everyone got a 100% hit level. In the qualitative analysis the researchers noticed the increase of interest and absorption of information along the workshops. All these positive results are strong indicators that the toolkit is effective in promoting persistent practices change.

Figure 4:
Interacting with the residents

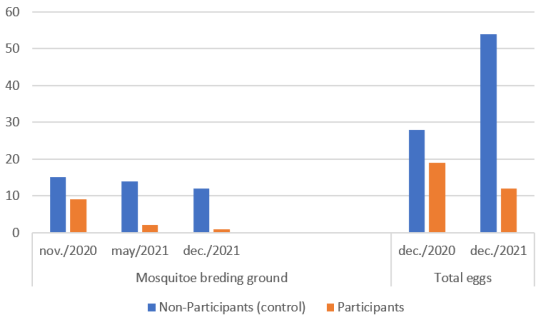
Note: (2020), Authors

4.3 Post-Study assessment

The post-study assessment was carried out 1 year after the conclusion of the workshops, during which time the residents had no contact with the researchers. After this time lapse, it was possible to assess the effectiveness of the toolkit on a daily basis and the level of assimilation of the residents. The results of this stage demonstrated the success of the methodology used. The comparisons made it possible to doubly monitor the situation in the participating houses in relation to the pre-study indicators, as well as in relation to their neighbours who had not completed stage 2. The results were encouraging and show that among the participants there was a significant 90% reduction in possible mosquitoes breeding grounds in backyards while the egg number reduced by 38%. In relation to those who participated only in the first stage (Pre-study stage) the number eggs grew by 112% while the breeding grounds decreased in 10%, however remaining in a higher level (11 in average) when

compared to the participants` (1 in average) (Chart 1). The samples were taken at the same time of the year corresponding to the wet season, which is the peak of the mosquitoes' proliferation.

Chart 1:
Eggs and breeding grounds



Note: (2022) authors

As an outcome from the development and successful performance of the study, two main digital tools were designed: 1. Guidebook; and 2. Web App [11, 12, 16, 17, 18, 19]. Their main purpose is to influence the broader context, replicating the experience of the workshops, expanding knowledge/action on fighting dengue in social housing neighbourhoods

5. CONCLUSION

The findings of this study show that the toolkit and methodology developed provides a successful solution space capable of helping the community to avoid the dissemination of arboviruses. The results also indicate that all participants changed their practises to avoid mosquitoes proliferating, and the results, as seen 1 year after the end of the workshops, shows that they had changed their practises effectively. Despite performing the activities directly with only 7 families, hundreds of people in the community were informed of the methods including: 325 students from the Shopping Park Secondary School, 168 families from the NGO Estação Vida and 23 neighbours of the 11 sampled families.

The methodology as developed also proved to be quite resilient to COVID-19 challenges. Due to the pandemic contingencies, the team turned the methods into digital ones, developing tools that will be a legacy for future projects.

The project provided intense training for students at different levels from undergraduate to doctorate. All 11 students participated and actively contribute to their studies. This methodology was put into practice at the Research Group MORA and is an example of vertical integration between different levels of skills.

ACKNOWLEDGEMENTS

The authors would like to thank the following institutions for supporting and funding this research: Federal University of Uberlândia; University of Sheffield; National Council for Scientific and Technological Development (CNPq); Research Support Foundation of the State of Minas Gerais (FAPEMIG) and; Global Challenges Research Fund (GCRF).

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