



Participatory Modeling With QUICKScan to Shape Sustainable Urban Development

Peter Verweij^{1*}, Anouk Cormont¹, Michiel van Eupen¹, Manuel Winograd¹ and Jorgelina Hardoy²

¹ Wageningen Environmental Research, Wageningen, Netherlands, ² International Institute for Environment and Development, Buenos Aires, Argentina

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*Correspondence:

Peter Verweij
peter.verweij@wur.nl

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Current spatial planning methods are often technocratic, slow, fail to use the right kind of evidence or do not involve (all) the actors needed to create support and consensus. We present a method that facilitates the use of evidence (data) in participatory spatial planning processes, resulting in a joint understanding of the most important causalities, as a means to build capacity across actors. QUICKScan is a participatory modeling method that links stakeholder- and decision maker knowledge and preferences to available spatial and spatio-statistical data, and is designed for group use in a multi-stakeholder workshop setting. We describe four urban QUICKScan applications, that vary in objective, scale and institutional setting. The most critical in organizing a QUICKScan session is to: (i) include crucial participants in a single plenary workshop (decision maker, local data expert, and local thematic experts), (ii) create an open atmosphere in which each and everyone's opinion is treated equally, (iii) dialogue is more important than an abundance of detailed spatial data, and (iv) start with simple modeling rules and iterate often while expanding the set of rules and trying out alternatives.

Keywords: urban, stakeholder involvement, spatial planning, decision making, agenda setting

INTRODUCTION

The world's population is urbanizing at a rapid pace. In 2050, 68% of the world's population is projected to reside in cities (United Nations, 2019). Currently, 72% of Europeans already live in urban areas. Cities are increasingly confronted with the task to climate-proof sustainable urbanization while maintaining or improving quality of life. This relates to issues like the use of natural resources, mobility, energy, water and waste management, health and well-being. Managing the spatial distribution, scale, multi-function-, and multi-stakeholder complexity of the interactions between these issues is a challenge for policy makers and spatial planners (Verweij et al., 2016).

Current planning and assessment methods are often experienced as lengthy (Pope et al., 2013). Often by the time the evidence is produced by current scientific methods, the context has already evolved (Adelle et al., 2012). Urgent action is vital. Fast developing contexts, like rapid urbanization and increased climate change, call for decision makers to respond much faster than in the past. However, acceleration should not go at the expense of a loss of evidence-based, well-informed and fair decision making, but needs to be carefully balanced.

Spatial planning concerns the future distribution of activities in space. Spatial planning is usually largely organized and executed by the public sector (Meerow and Newell, 2017). Its aim is to achieve desired spatial allocation goals, including environmental protection, urban development, different forms of economic activities, infrastructure development, and water management. There

are various governance modes to conduct the planning process. Schatz and Rogers (2016) and Özdemir and Tasan-Kok (2017) distinguish between technocratic and participatory approaches in urban spatial planning. In technocratic planning the system operates with elected representatives in the government which heavily depends on technocratic expertise of professional planners. In participatory planning a group of common local citizens decide “instead of a collective of elected representatives” and their professionals (Farrar, 2007). Whatever mode is practiced, stakeholder support is pivotal for well-informed and supported decisions (De Gooyert et al., 2017).

It is assumed that spatial planning and the use of spatial data, tools and models are closely interrelated. However, the actual use of data and modeling tools in spatial planning is limited in contrast to the amount of what is available (Vonk and Geertman, 2008; McIntosh et al., 2011; Voinov et al., 2018). One of the reasons is that available tools are often “based on a technocratic, rational image of spatial planning, which does not satisfactorily support the qualitative sociocratic, political situation with which spatial planners are confronted” (De Wit et al., 2009).

There is therefore a need for a method that facilitates the use of evidence (data) in participatory spatial planning processes, and that results in a joint understanding of the most important causalities, as a means to build capacity across actors. This paper demonstrates the usability and usefulness of the QUICKScan mapping method (Verweij et al., 2016), for metropolitan planning challenges by presenting an overview of its application in four example cases.

PARTICIPATORY MODELING WITH QUICKScan

QUICKScan is a participatory modeling method (Voinov et al., 2018) “that links stakeholder- and decision maker knowledge and preferences to available spatial and spatio-statistical data, and is designed for group use” (Verweij et al., 2016; detailed in **Box 1**). QUICKScan is often used in combination with a software tool to support the method. QUICKScan was developed in close cooperation with the European Commission in the early 2010’s in their demand for an easy to handle research tool that is fast, simple and transparent, and that requires little data and can be carried out in a multi-actor setting. QUICKScan is applied in the early stages of planning, to collaboratively explore alternative strategies by spatially allocating measures and assessing their implications. This joint exploration helps to do an initial screening. In later stages of the planning process more elaborate assessments might be required.

A typical QUICKScan application consists of a scoping phase, in which the questions are formulated, a preparatory phase in which participants are selected and data are prepared, and one or more facilitated workshops in which the participant knowledge is linked to the data. During a workshop an iterative approach is followed, based on creating rules and sharing knowledge of participants. The QUICKScan software is capturing this knowledge of the participants in a conditional, mostly qualitative, form (like “if *green roof* then *increased insulation capacity*). These

rules are applied to (a combination of) spatial datasets and results are displayed in maps, bar charts and trade-off diagrams. In this way also alternative (spatial) plans, stakeholder perspectives and policy options can be compared. Successive iterations can be used to improve the quality of the model, or to include changes in stakeholder points of view.

USE OF QUICKScan IN PRACTICE

Over the past few years, QUICKScan has been applied in about 80 workshops in 25 countries, dealing with a diversity of issues on different spatial scales and time horizons. In all these applications, the participatory modeling with QUICKScan helped to bridge of the gap between the decision-making level (varying from continental to local) and the level at which action takes place (e.g., river basins, neighborhoods, and villages). Typical urban issues for which QUICKScan was applied related to urban management, integrated water and waste management, emergency management and institutional strengthening (Hardoy et al., 2018).

In the following paragraphs four urban QUICKScan applications are described, that vary in objective, scale and institutional setting. Evaluations of the QUICKScan process by workshop participants are also listed. Evaluations shed light on the importance of speeding up the planning process, collaboration amongst actors, and gaining insight in challenges in planning (for nature based solutions) in urban environments.

Societal Functions of Urban Green to Achieve a Healthy City, Utrecht, the Netherlands

Utrecht is a city in the middle of the Netherlands with a historic center dating back to medieval times. With its population of 350.000 it is one of the largest cities in the country. In this first example we specifically describe the steps in the application process as detailed in **Box 1**.

Scoping

Because of its central location the Utrecht urban area is a hub of highways, waterways and railroads. A multitude of functions cause increasing pressure on the living environment, resulting in air pollution, noise stress, soil sealing, occasional flooding, and heat islands. The city wants to implement measures to counteract these problems by focusing on Green Infrastructure. Measures should also solve specific issues of the existing green infrastructure, like the vulnerability to pests of single-species tree lanes (e.g., oak processionary or the Dutch elm disease) and bad air circulation at busy tree-covered roads. In the workshop different options to tackle these issues have been explored by iteratively drafting possible measures and visualizing their effects.

Preparation

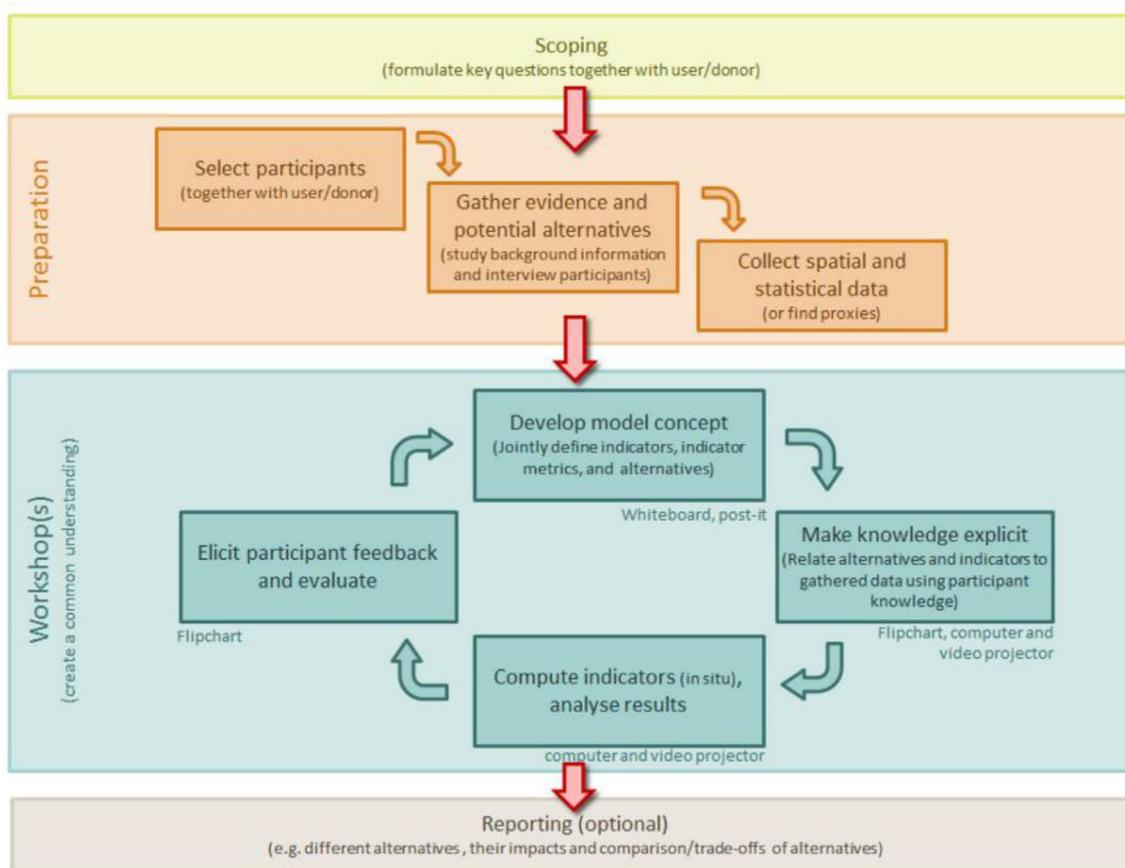
Collecting and preparing 5 × 5 m resolution digital maps of: individual trees with species, age, and size information, green index (percentage of green per grid cell), temperature (hot summer day), noise level, air pollution, land use, and topography.

BOX 1 | Short overview of the QUICKScan participatory modeling method and software tool (Verweij et al., 2016).

The QUICKScan methodology is based on “Rapid (Participatory) Appraisal (McCracken et al., 1988; Ison and Ampt, 1992), qualitative deliberative participatory methods (Davies and Dwyer, 2008), and preference elicitation (Aloysius et al., 2006; Kodikara et al., 2010). QUICKScan is not restricted to a specific geographic location or spatial resolution.”

Each QUICKScan process follows a number of logical phases:

1. In the *scoping* phase, the team facilitating the process assists the client in formulating the key questions.
2. In the *preparation* phase, the relevant stakeholders, experts and data are selected. Desired workshop participants are identified and invited. Examples of relevant data are Remotely Sensed land use maps, population statistics, climate projections, road network and soil maps.
3. One or more facilitated *workshop(s)* following an iterative approach:
 - a. Develop a concept knowledge model—The participants jointly make an inventory of relevant indicators, indicator metrics and alternatives; or compare different stakeholder perspectives.
 - b. Make stakeholder knowledge explicit—The participants relate indicator concepts to available data by building a causal chain of participants’ knowledge.
 - c. Compute the indicators—The tool operator calculates indicator maps and summary charts as requested by the participants (e.g. averages per neighborhood, or trade-off of a number of indicators per administrative unit).
 - d. Evaluate—the participants evaluate the performance of the indicators in a single alternative, or evaluate the performance of summaries of indicators across alternatives. The evaluation might trigger another iteration in which participants identify additional indicators, perspectives and refining knowledge.
4. *Reporting* on results and observations. After the workshop the results and the participants’ evaluations are documented in a report to capture progress, and document agreements and disagreements.



Workshop

A 1 day facilitated workshop was organized with municipal civil servants specialized in green design, soil, energy, health, air quality and experts on nature based solutions. As a first step, storytelling by participants, supported by maps of the city, converged perceptions of the areas under pressure by noise, air pollution, heat island effect, etc. This was followed by

an inventory of options for counteractive measures, including different green management regimes and accessibility changes. In a final step, the feasibility and effectiveness of solutions were calculated and visualized, building on the consensus of all participants. This revealed that current trees could effectively reduce the urban heat island effects if optimal tree growth conditions would be met (**Figure 1**). Moreover, alternating

vegetation height creates turbulence, greatly enhancing the air quality. However, the measurable effect of green infrastructure to reduce noise is negligible, while there is definitely a perceived noise reduction when the source of the noise is hidden by vegetation (Gehrels et al., 2016).

Workshop participants indicated:

- *“This workshop forces us to work interdisciplinary, which hardly happens in our regular working situation, although we have the same people around”*
- About air quality and noise reduction one of the participants remarked *“For quite some time we have had the idea that green elements would have huge impacts, but within these few hours we have come to understand that it will never have the magnitude we had presumed. We need to change our approach.”*

Urban Sprawl in Europe

Europe is one of the most urbanized continents in the world. Today, ~75% of the European population lives in urban areas, while still enjoying access to extensive natural or semi-natural landscapes. More than a quarter of the European Union's territory has now been directly affected by urban land use; by 2050, ~84% of Europeans will be living in urban areas (United Nations, 2019). As a result, the various demands for land in and around cities are becoming increasingly acute. Major impacts are increased use of energy, land and soil consumption threatening both the natural and rural environments, raising greenhouse gas emissions that cause climate change, and elevated air and noise pollution levels which often exceed the agreed human safety limits. Where unplanned, decentralized development dominates, sprawl will occur in an autonomous way. Conversely, where growth around the periphery of the city is coordinated by strong urban policy, more compact forms of urban development can be secured.

Two preparatory meetings and one workshop with European urban experts and policy assessors from the European Commission were organized to explore the effects of city sprawl. Scoping was performed in a first 1-day preparatory meeting. A second half-day preparatory meeting resulted in the formulation of alternative scenarios (business as usual, sprawl and urban intensification) and the identification of the maps and statistics required for modeling their effects: land cover (historic data and present situation), urban night light, protected nature areas, elevation, Gross Domestic Product and population density, accessibility to cities, agricultural soil production, soil suitability for construction, administrative boundaries at 1 × 1 km resolution. During the workshop (2 days) the alternative scenarios were built and linked to indicators (population trends, urban zones) using knowledge of both participating experts and policy assessors, resulting in the characterization of European metropolitan areas, their growth policy and projections of the urban growth within the different scenarios. Discussion amongst participants, e.g., on the (normative) interpretation of maps, helped to reach a shared understanding and a result supported by all participants. Results for instance showed that the highest projected population decline of inner cities was found in eastern Germany. The highest population intensification is expected in

middle-sized cities, like Dublin, Amsterdam, and Napoli. Urban sprawl especially takes place in Europe's biggest metropolises: Madrid, London, Athens, Rome, and Paris. The results have contributed to the 2015 State of the Environment Report from the European Commission (EEA, 2015).

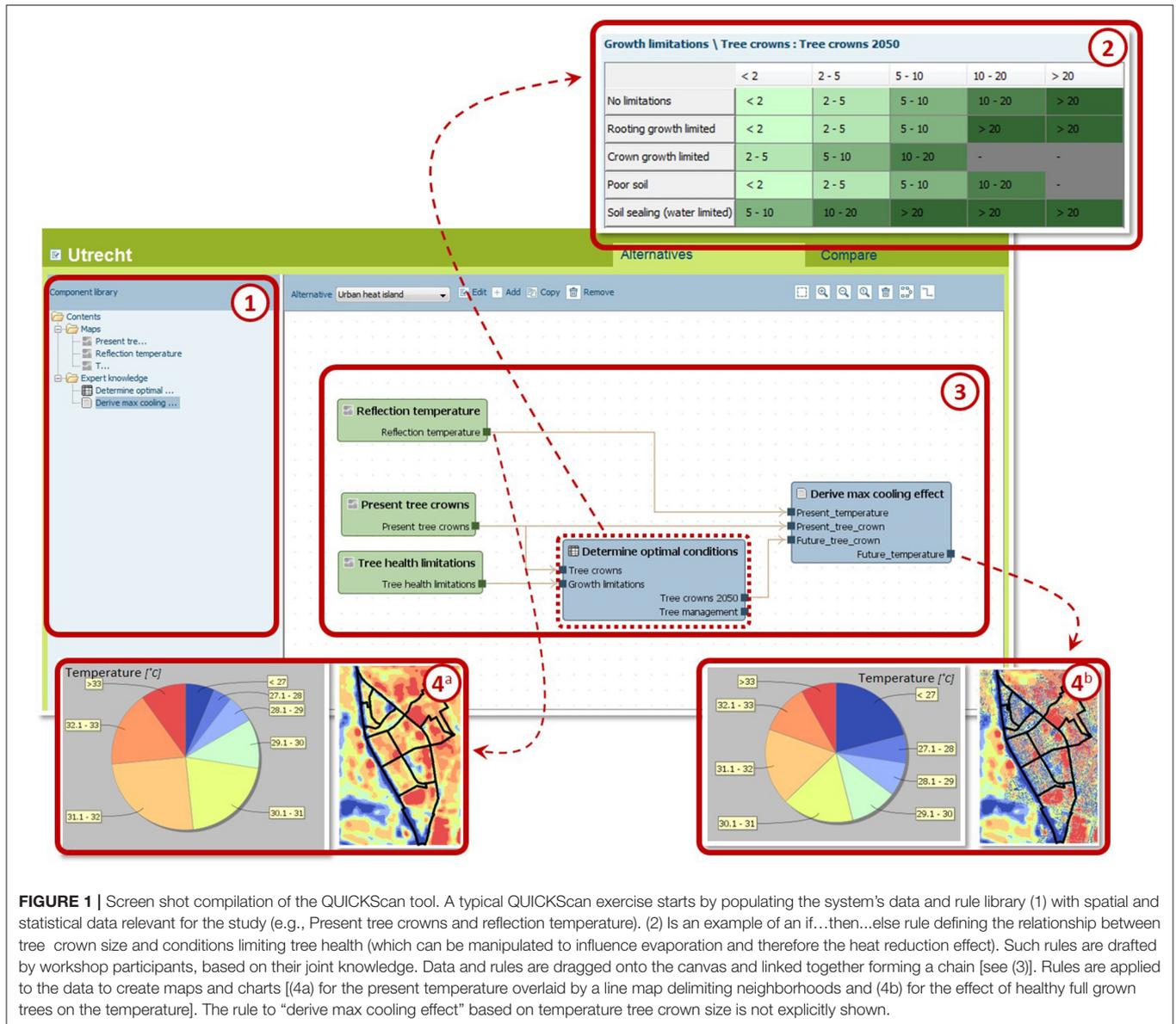
Workshop participants indicated:

- *“I Like the possibility to use maps, relationships between them and dialogue. Very enlightening”*
- *“The rather extreme alternatives with which we started made clear where we had to refine and which ones didn't have the expected result. It helped us formulate several more robust solutions”*
- *“I have the feeling there are better base maps available. There is not enough time to learn about the method through which the base maps were generated. As these maps form the foundation for the end result, I cannot objectively assess the results.”*

Nature Based Solutions for Climate Proofing Donostia-San Sebastian, Spain

San Sebastian is a coastal city of just under 200,000 inhabitants in the Basque country (in the north of Spain). It's main economic activities are commerce and tourism. San Sebastian has a mild maritime climate, but experiences an increased amount of extreme climatic events such as severe storms, river flooding and heat waves. The city wants to implement measures to counteract the climate change effects. With QUICKScan we identified the hotspots (areas most suitable for implementing measures), as input for the city's climate change adaptation plan.

Preparation took place during a 1 day session with local researchers actively involved in a climate vulnerability assessment for San Sebastian. The prepared data included land use, exposure, vulnerability, adaptive capacity and risk maps for (coastal and river) floods and urban heat island effects (on biodiversity and health) as well as potential nature based solutions (e.g., green roofs, water retention basins and permeable pavement on parking lots). A 1 day plenary workshop with a dozen municipal civil servants on environment, water management, urban planning, green infrastructure, population and experts on climate change adaptation and nature based solutions was organized. As a first step areas where measures against natural disasters should be taken were identified. This was followed by an inventory of options for counteractive measures and their possibilities for application, e.g., water permeable parking lots and gardening on flat roofs. Subsequently these were mapped by linking solutions to topographical features. In a final step the feasibility and effectiveness of solutions were determined. Hotspot areas for the most effective measures were appointed: gardening on flat roofs in the old city to reduce the heat island effect and water permeable parking lots spread all over the city to reduce flash floods caused by local downpours. Since the old city buildings are privately owned, incentives need to be developed to stimulate the transformation of the flat roofs into gardens. Flood risks from upstream heavy rain cannot be solved in the low lying city



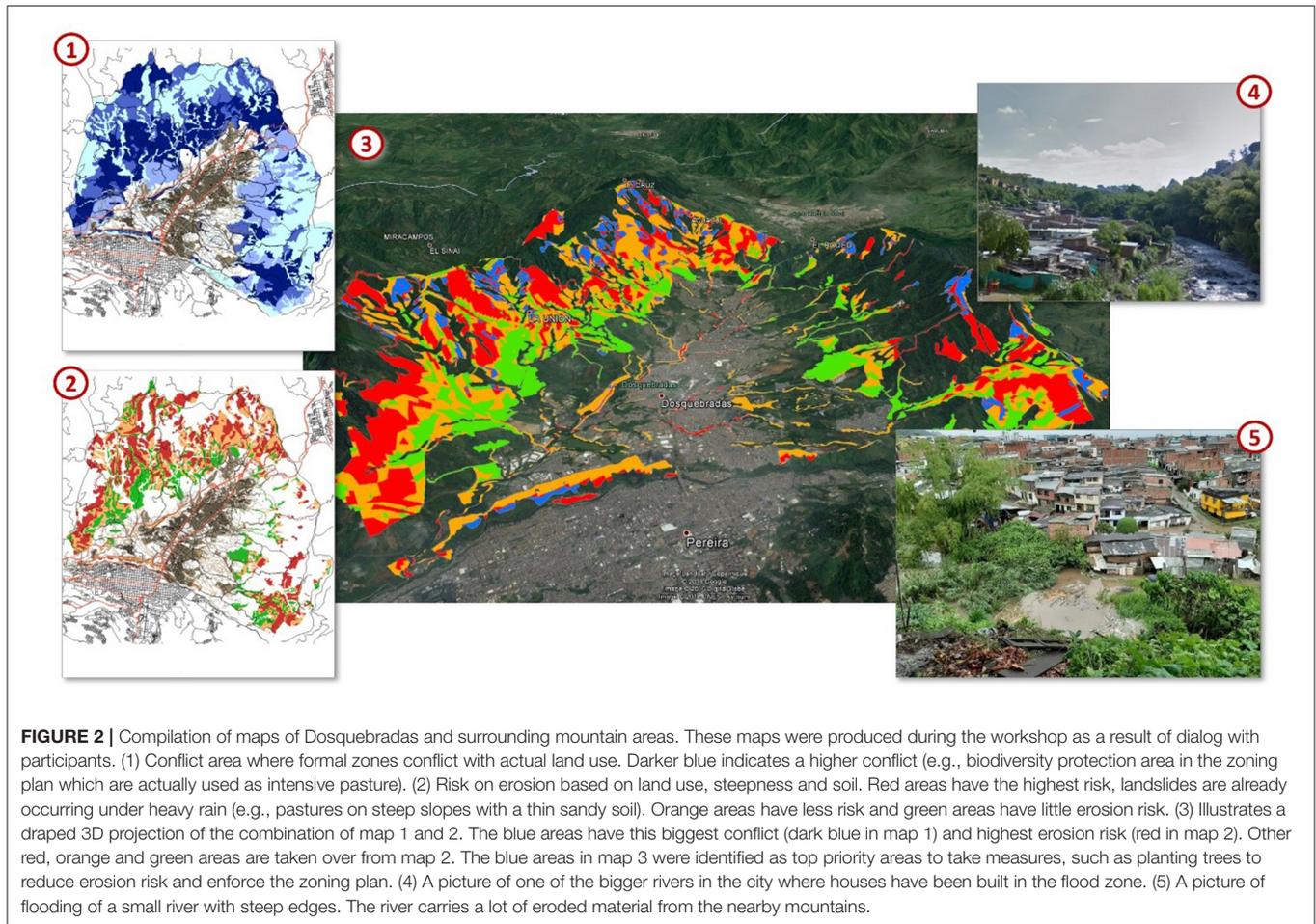
and solutions therefore should be sought in cooperation with upstream municipalities.

Workshop participants indicated:

- “The iterative approach of starting simple and adding complexity later on is very useful. QUICKScan is very practical and easy. It is a good communication tool”
- As eye-openers: “Complex spatial and actor interactions cannot be assessed within a single workshop,” and: “Without the relevant participants (e.g., local field knowledge) the assessment results might lack robustness”
- About the use of participatory modeling: “The results can be obtained via a traditional desktop study where a visionary leader guarantees that the right perspectives are taken into account and assigns tasks to individuals.”

Planning Climate Resilient Suburbs in Dosquebradas, Colombia

The population of Dosquebradas (Colombia) quadrupled from 50,000 in 1975 to 200,000 in 2015. Dosquebradas experiences an increased vulnerability to flooding and landslides, triggered by climate change, urban expansion in the natural river beds and regional land use changes. In the surrounding upstream mountain river catchments, coffee plantations have been replaced by pastures and built-up areas, naturally absorbing less rainwater. The drainage system is made up of natural riverbeds, that become smaller and congested due to urban expansion and waste dumps (solid waste and debris). The waste dumps cause water pollution issues and disrupt the city's aesthetic. Moreover, extreme rainfall events increase, which result in more frequent and severe floods.



A 2 day QUICKScan workshop with experts from the Technological University of Pereira, representatives of local NGO's and the municipal government focused on the definition of priority options for catchment restoration, under the precondition of community participation. Combining the data in a participatory setting resulted in newly defined priority areas for taking action (Figure 2). A number of spatial activities and policy measures were explored: (1) increasing the upstream water retention capacity by preservation and recovery of identified nature area relicts; (2) drafting policies (incentives and sanctions) for the proper management of solid waste and debris and; (3) guaranteeing enforcement of the new regulations.

Workshop participants indicated:

- Eye opener: “The use of matrices and the ability to mix numbers with textual categories is very straightforward. It enabled us, normal people, to take part in deciding where to plant trees on steep, erosion sensitive slopes”
- “The storytelling of the others at the start of the workshop, and their choice of maps to illustrate it, helped me understand their viewpoint”
- Eye opener: “The method depends on the availability of spatial data. If the data is not available on the right scale or is of

poor quality the result will be useless. Maybe it even causes more confusion”

- “It enforces dialogue, prioritization and consensus which enable to jointly define an implementation strategy and generates support from the ones involved”
- Critical: “This is no objective assessment. It uses too much simplifications and on the spot gut-feeling assessments. After a bit of explanation and discussion, assessments would sometimes change quite drastically.”

BENEFITS AND SHORTCOMINGS

In summary, a major mentioned benefit of this form of participatory planning using the QUICKScan approach, is the reduced lead time for problem scoping. Although the method requires time for data preparation and discussions before the workshop, it is potentially quicker than contracting out extensive research or expert group consultations. Moreover, QUICKScan improves the joint understanding between stakeholders. Joint understanding of a problem lowers the risk of conflict, which is likely to occur when people perceive a situation, and their proposed successful solution, differently. In such cases people try

to solve what are essentially incompatible problems (Cronin and Weingart, 2007). The QUICKScan method facilitates knowledge integration, learning and shared understanding by encouraging participants to listen to each other and co-develop ideas, as it has been assessed by a sociologist attending a selection of the workshops (Rodela et al., 2017). Furthermore it creates commitment from different stakeholders for future steps. Voinov et al. (2018) define participatory modeling as “a purposeful collaborative learning process for action that engages the implicit and explicit knowledge of stakeholders to create formalized and shared representations of reality.” As such, participatory modeling is supposed to create understanding and awareness for all stakeholders.

The QUICKScan approach to participative modeling also has some shortcomings. A possible weakness of this type of participatory modeling is that significant drivers may be forgotten if no expertise, or data of the issue is available. This makes the outcome less accurate or even incomplete. Participant interpretations may also miss out on data signals that could be found through statistical methods (e.g., spatial cluster analysis, regression, or route network analysis). In later stages of the planning process more elaborate assessments can be applied. The results of such a detailed analysis might ask for a new iteration with stakeholders. Incompleteness of the assessment can also result from missing out on representatives of perspectives (e.g., marginalized groups) that are impacted by the planning issue, which might result in conflicts at later stage in the process. To prevent this from happening Gregory et al. (2020) provide a framework to identify stakeholders.

CONCLUSIONS AND RECOMMENDATIONS TO FUTURE USERS OF THE METHOD

We demonstrated that the methodology supports the development of scenarios, the defining of indicators for measuring the success and to jointly create new plans while building support for future steps. The most critical requirement for a successful QUICKScan session is to: (i) include crucial participants (decision maker, local data and thematic experts, and stakeholders) in a single plenary workshop, (ii) create an open atmosphere in which each and everyone's opinion is treated equally, (iii) dialogue is more important than an abundance of detailed spatial data, and (iv) start with simple modeling rules and iterate often while expanding the set of rules and trying out alternatives.

QUICKScan speeds up the initial stages of spatial planning by simplifying the internalization of knowledge into spatial images through a strongly mediated group process. Speed is vital in planning as fast developing contexts, like rapid urbanization and

increased climate change, call for decision makers to respond much faster than in the past. Speed, however, should not go at the expense of evidence-based, well-informed and fair decision making.

In planning for nature based solutions to urban challenges like neighborhood deterioration, liveability and climate change (e.g., heat island effects and flooding), people need to have a shared understanding of the challenges, to shape jointly supported, and thus viable, interventions (cf. Frantzeskaki, 2019). The collaborative QUICKScan approach helps to gain such a joint understanding. It can integrate local, tacit and scientific knowledge and reach broader support for policy interventions, as long as all relevant stakeholders are included.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Data is owned by the governmental and private organizations with whom this work was carried out. Requests to access these datasets should be directed to michiel.vaneupen@wur.nl.

ETHICS STATEMENT

Ethical review and approval was not required for this study with human participants, in accordance with the local legislation and institutional requirements.

AUTHOR CONTRIBUTIONS

PV, ME, and MW designed the research. PV, ME, MW, and JH executed the research. PV and AC wrote the paper. ME, MW, and JH commented on the paper. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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