

## Mitigating urban sprawl effects: a collaborative tree and shade intervention in Phoenix, Arizona, USA

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Communities in Phoenix are confronted with numerous challenges that adversely affect human health and safety, with disproportionate impacts on low-income communities. While some challenges are being addressed at the city level, new alliances at the neighbourhood level are initiating community development programmes and projects. This article reports on an intervention study carried out in collaboration with community representatives, city staff, and non-profit organisations to mitigate adverse effects of urban sprawl in the Sky Harbour Neighbourhood in Phoenix. Participatory research was conducted to design and test a tree and shade intervention. Challenges associated with navigating community desires and broader principles of sustainable development are discussed. The study offers a replicable and adaptable intervention research design aimed at empowering communities to meet urban challenges.

**Keywords:** intervention research; sustainable development; community development; urban sprawl

### Introduction

Phoenix, like other metropolitan areas in the southwest of the USA, struggles with numerous challenges, including urban sprawl, water stress, and childhood obesity (Keys *et al.* 2007, AZDHS 2010, Gammage Jr. *et al.* 2011, York *et al.* 2011). These problems, interacting with and exacerbated by economic disparities and automobile dependence, have negative impacts on public health, social equity, and public safety, in particular in low-income neighbourhoods (Grineski *et al.* 2007, Cutts *et al.* 2009, Jenerette *et al.* 2011, Ross 2011). While the City of Phoenix administration has started addressing some of these challenges (Johnson *et al.* 2011, Wiek *et al.* 2012a), the complexity of the issues, limited public funding, and resistance from beneficiaries of the status quo hamper or even obstruct city efforts. Alliances of non-profit organisations, professionals, researchers, community organisations, and citizens – here in Phoenix and elsewhere – have begun to fill this void through small-scale neighbourhood programmes and projects, often in consultation or collaboration with city staff.

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While each of these programmes and projects has particular objectives, they are usually conceived under the concept of community development. Community development often entails place-based work to build social capital (Dale and Newman 2010, Carpenter 2011) and foster sustainable practices (cf. Lineal and Laituri 2013). Regarding social capital development, community work relies on and results from the interactions between micro- and macro-level social networks (Woolcock 1998), making issues like the politics of community deliberation a fruitful area of research, as well (Shaw 2008). Community work can focus at the physical level of the neighbourhood (Smith *et al.* 2010), but also has the versatility to relate to groups of individuals with shared interest, rather than shared space (Firth *et al.* 2011). These endeavours have positive effects on reducing crime and improving public health, civic participation, and community access to external resources (Buonanno *et al.* 2009, Eversole 2010, Milton *et al.* 2012).

One social dimension enriched by place-based community empowerment includes trust, essential to bonding, bridging, and linking forms of social capital (Putnam 2000). In this context, bonding capital refers to integration of social networks within communities, bridging capital refers to linkage across communities and other actors and groups, and linking capital refers to interactions between community and city and among state and national actors (the macro-level) (Woolcock 1998, p. 168). One example of this work in action can be found in the literature on the development of community gardens (Irvine *et al.* 1999, Twiss *et al.* 2003, Kingsley and Townsend 2006, Firth *et al.* 2011).

In the community garden literature, research often takes the form of case studies of successful projects, sharing historical, descriptive, and analytical accounts of what happened with whom, how, and to what effect (cf. Pennington and Rydin 2000). Community development programmes and projects seem also to benefit from active participation by and partnership with researchers and universities (Brown and Ashman 1996, Buys and Bursnall 2007). The role of the academy in facilitating such relationships has been well documented in developing and developed nations alike (cf. Brown and Ashman 1996, Pennington and Rydin 2000). Such partnerships demonstrate researchers' commitment to engage in low- to no-budget research projects, and to become familiar with adequate research approaches that produce results useful to the community. Over the past decade, the field of community-based action research, and more recently intervention studies have made substantial strides on providing frameworks and training for faculty and students to enable community-oriented research with positive outcomes (cf. Fraser *et al.* 2009).

Despite the successes sampled above, community-based interventions are not without challenges. One such challenge stems from the way the research must integrate diverse types of knowledge. In its idealised form, knowledge generated by community-based intervention research weaves together the diverse expertise of practitioners, community members, decision-makers, and researchers (Lang *et al.* 2012). Three criteria are commonly used to assess this knowledge: credibility, saliency, and legitimacy (Cash *et al.* 2003). Credibility pertains to the trustworthiness and accuracy of knowledge generated by research; salience to the relevance of this knowledge to decision-makers; legitimacy to the fairness of the way the knowledge is produced. These three criteria are often either in tension or complement each other, depending on the project. For example, a community development project that conducted remote sensing analyses of tree cover, keyed to the questions of a city parks department project on increasing metropolitan-area shade, might generate credible and salient knowledge. Yet, if it resulted in a tree planting project that eschewed local community support, it would be wanting in legitimacy. In return, a participatory sustainability intervention project, which does not engage the community in reflections on sustainability principles and just follows what the community

wants, would lack credibility. Balancing credibility, saliency, and legitimacy of knowledge poses a central challenge to community-based intervention research.

A related challenge is the way technical expertise is privileged over other forms of knowledge. Early intervention research in development work saw the use of participation not to advance community initiatives but rather to help make it easier for development agencies to advance their agendas (Cernea 1991). Such purely instrumental use of participation plays into a perceived bias that participatory processes make for good publicity, but do little to materially advance projects (Eversole 2010). Awareness of the critical importance of so-called “place-based”, “contextual”, or “local” knowledge of community partners (Clark *et al.* 2011, McCullough and Matson 2011) represents important progress for community interventions on this front.<sup>1</sup> Accompanying this awareness is the slow transformation of community development work *for or done to* a community, to work *with and defined by* the community (Talwar *et al.* 2011, Eversole 2010).

The practical implications of the challenges posed by knowledge and expertise are felt, at the project level, through damaged respect, trust, and relationships. First-person accounts of university–community partnerships have described how degraded trust among project partners stymie researcher and community objectives alike (Brown *et al.* 2013). Other practical implications include not being able to adequately frame research questions, agree on research approaches, assess outcomes, or match research outcomes with needs of community or decision-makers (Lang *et al.* 2012). These research strains on relationships are in addition to the more common difficulties posed by resource constraints (time, energy, etc.) (Israel *et al.* 2006).

Taking these considerations into account, the goal of this study was to tackle a problem *with* and not *for* community residents (Eversole 2010). This article reports on an intervention study in the Sky Harbor Neighborhood (SHN), a low-income community in Phoenix, Arizona. Researchers from the School of Sustainability at Arizona State University (ASU) conducted the study in collaboration with various stakeholder groups. The research team approached the project without pre-defining the problem so as to bolster community buy-in through joint problem definition and community participation (Cornwall 2008, Eversole 2010) and ensure the legitimacy of the project, while also accounting for concerns of credibility and salience (Cash *et al.* 2003). For public engagements, the project leveraged relationships with city staff, non-profit organisations, professionals, and community organisations established over previous years (Johnson *et al.* 2011, Machler *et al.* 2012, Wiek *et al.* 2012a, 2012b, Xiong *et al.* 2012). The community eventually chose to develop a tree and shade programme to mitigate adverse effects of urban sprawl, including low walkability and the urban heat island effect. The project benefited from City of Phoenix staff experiences, gained through on-going efforts to implement the city’s Tree and Shade Master Plan (City of Phoenix 2009).

Drawing on intervention studies (Fraser *et al.* 2009), the collaborative project carried out research within the framework of transformational sustainability research (Wiek 2010, Wiek *et al.* 2012a). This research framework combines methods to analyse and assess problems from a systems perspective; create a coherent future vision (goal); and design and test evidence-supported strategies to transition from the current state to the envisioned future state. All research activities explicitly incorporate stakeholder experiences, knowledge, and preferences to support the creation of legitimate, inclusive, and actionable knowledge (Talwar *et al.* 2011).

The present study offers a replicable and adaptable intervention research design aimed at empowering communities to meet urban challenges. To meet the specific challenges of the SHN, we tailored the tree and shade intervention to attributes of the community and

the greater Phoenix context. The combination of scientific and community knowledge demonstrates the promise of collaboration to advance university, city, and community agendas in research on balancing the social and ecological needs of communities.

### The SHN

The SHN of central Phoenix, Arizona, is situated between N. 24th (west) and 38th Streets (east), and E. Washington Street (south) and Arizona State Route 202 freeway (north) (Figure 1). Approximately 81% of the 3635 residents of the SHN identify as Hispanic/Latino, with the remaining 19% comprising African-American, White, and Native American, Asian American, and other ethnicities (Census 2010). Median household income in 2010 was between \$30,595 (north of E. Van Buren St.) and \$20,400 (south of E. Van Buren St.) (Census 2010). Research in this study was carried out in the area south of E. Van Buren Street.

Residents of the SHN rely on automobiles for transit, spending as much as 50% of discretionary income on transportation (Machler *et al.* 2012), more than double the average American household (Pisarski 2006). Inadequate pedestrian infrastructure, low tree coverage, and high crime rates contribute to the neighbourhood's low walkability. The division of the SHN by E. Van Buren Street, which has a reputation as one of Phoenix' major red-light district streets, further reduces walkability.

Neighbourhood residents are also vulnerable to the negative effects of the urban heat island that results from cities being heat sinks during the day and heat sources at night (Jenerette *et al.* 2007). Night-time temperatures in Phoenix have increased in excess of five degrees C in the past several decades (Sun *et al.* 2009). Researchers have demonstrated a correlation between socioeconomic and demographic status with vulnerability to heat stress and extreme heat events (Harlan *et al.* 2007, Ruddell *et al.* 2012, Jenerette *et al.* 2011).

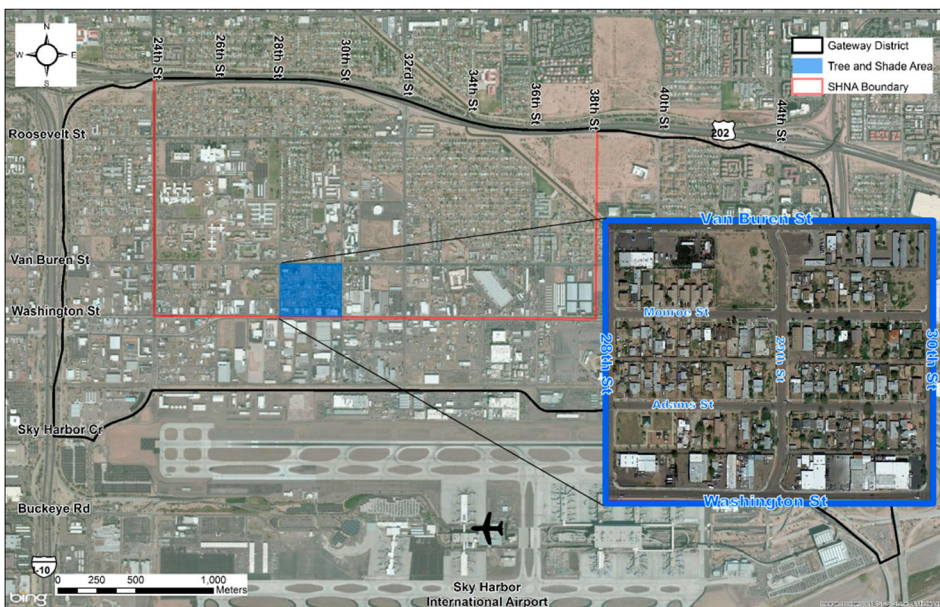


Figure 1. Aerial map of the SHN in Phoenix, Arizona, with the boundaries of the study area. Source: Map constructed by Jeffrey Scott Ditgen.

Exacerbating this increased sensitivity to heat is the decreased capacity of socioeconomically disadvantaged neighbourhoods to mitigate the impacts of extreme heat through activities like planting vegetation to promote evaporative cooling. Tree-canopy cover in the SHN is between 3% and 6%, according to the city's Parks and Recreation Department; coverage across the City of Phoenix averages approximately 11–13% (City of Phoenix 2009). The city's long-long term goal for canopy cover in residential neighbourhoods is 25% (City of Phoenix 2009).

Residents of the SHN have initiated community development programmes and projects since the 1990s. Community successes include developing a partnership with local police and courts to reduce crime and prostitution, establishing intermittent block-watch and alley clean-up programmes, and supporting neighbourhood youth recreational opportunities through the city's recreation leagues. Researchers and students from the School of Sustainability at ASU had collaborated with the community prior to the project reported here. Connections were originally made between ASU faculty and students and a SHN community leader through their collaboration in an airport workers' labour organising campaign in 2008 and 2009. Building on that relationship, Machler *et al.* (2012) constructed with SHN residents a vision for greater community accessibility, defined in terms of access to resources within the neighbourhood as well as ease of access to resources outside of the neighbourhood. One of the vision elements, a new neighbourhood park, was completed in Spring 2012 after several years of negotiation with the city (which began before ASU's involvement). These positive collaboration experiences, as well as community interest and capacity, created favourable conditions for the present study.

### **Research design**

As mentioned above, the study employed a framework that combines problem analysis, visioning, and intervention research in participatory settings (Wiek 2010). The research team collaborated with various stakeholder groups, including community, city, and non-profit representatives, throughout the study (Table 1). Community-based stakeholder engagements were conducted to generate knowledge about community challenges generally and related to urban sprawl (problem analysis); visions of a walkable, cool, and beautiful neighbourhood (visioning); strategies potentially capable of solving or mitigating urban sprawl effects and realising the community vision (intervention design); and tests through extended peer review to improve the resulting strategies prior to implementation (Funtowicz and Ravetz 1993).

Intervention research is based on the development of a pragmatic "logic model" that specifies the objective of the intervention, inputs, activities, outputs, mediating actions, intermediate outcomes, and distal outcomes. Our logic model was as follows: to mitigate urban challenges faced by the community (objective), co-create an evidence-supported intervention manual (inputs and activities), establish new partnerships among the community, the city, and other partners (outputs and mediating actions), and enable the community to implement the tree and shade programme (proximal outcome) to enhance community capacity to respond to challenges in the long term (distal outcome) (Fraser *et al.* 2009, Fraser and Galinsky 2010).

### **Problem analysis**

Problem selection began with revisiting the community visioning research conducted by Machler *et al.* (2012). We inferred from the SHN accessibility vision a series of challenges

Table 1. Summary of stakeholder engagement activities.

	Event date	Participants	Stage of research	Level of engagement
Workshop 1	11 February 2012	Community residents	Problem analysis and vision development	Consultation
Neighbourhood association meeting	8 March 2012	Community residents and City Police Department	Project selection	Consultation
Workshop 2	27 March 2012	Community residents; representatives from three City of Phoenix departments; representatives from two local non-profit organisations; two researchers from ASU	Intervention design	Partnership
Extended peer review	Various dates: late April 2012	Community residents; City of Phoenix Department of Parks and Recreation and Department of Neighbourhood Services; nonprofit organisations; ASU professors	Intervention Testing	Consultation/partnership
Tree planting	To be determined: Autumn 2014	Community residents and volunteers from research team, local non-profit organisations, and City of Phoenix departments		Citizen control

Note: Levels of engagement correspond with Arnstein's (1969) ladder of participation.

facing the community. Our first community-based participatory workshop was designed to provide community members ( $n = 20$ ; 12 female, 8 male) with an opportunity to verify, respond to, and modify these inferred challenges. Participants were recruited through solicitation at church events and canvassing of the neighbourhood. The workshop was held on a weekend morning at the newly opened park to encourage passers-by to attend. Once at the workshop, participants were asked to view a neighbourhood map highlighting the inferred challenges, to comment on the challenges, and to use stickers to identify the issues that most concerned them. The voicing and voting process (each resident had three votes) elicited the relative importance of the challenges to residents. Table 2 displays residents' weighted votes, organised according to problem domain, inferred from Machler *et al.* (2012).

In a subsequent community meeting, residents selected walkability and perceptions of safety as the key problems they desired to address and, ultimately, chose a tree and shade intervention. Based on this selection, the research team conducted a tree inventory for a subsection of the SHN to assess levels of tree-canopy cover to augment the problem analysis (Figure 2). The inventory recorded tree size (small, medium, large, extra large), tree shape (v-shaped, round, columnar, oval), fruit-bearing characteristics, and shade provided to public spaces. This mapping effort was based on the Tree Inventory and Map Project (O'Hora 2008). The inventory documented 95 trees living on or affecting (e.g. shading)

Table 2. Problem descriptions in the SHN sorted into broader problem domains.

	Tally	Percentage	Priority rank
<i>Walkability</i>	18	30	1
No sidewalks	1		
No street lights	8		
No bike lanes	1		
Dangerous intersections	4		
No caution signs/cabs too fast	4		
<i>Access to goods and services</i>	18	30	1
Too few parks	0		
No drug store	8		
No grocery store	5		
No community centre	0		
Too few jobs	5		
<i>Perceptions of safety</i>	15	25	3
Dangerous alleys	5		
Loose dogs	3		
Homelessness/vagrancy on Van Buren St	7		
<i>Urban Heat Island</i>	4	6.67	5
No shade	4		
<i>Density</i>	4	6.67	5
Too many empty lots	4		
<i>Transportation</i>	1	1.67	6
Spend too much of budget	0		
Too slow/too infrequent	1		
<i>Air pollution</i>	0	0.00	7
Dirty air	0		

Notes: There are no double-count data, yet there are areas of overlap between walkability elements (e.g. dangerous intersections) and perceptions of (un-)safety (e.g. loose dogs).

public space. Forty per cent of these trees do not provide a significant amount of shade. Of the 60% ( $n = 57$ ) of trees that do provide shade, approximately 84% ( $n = 48$ ) were classified as medium-to-large in size. Fifty per cent of these medium-to-large shade trees reside within a single park (Hilaria Rodriguez Park).

### ***Visioning***

In addition to problem analysis, the first workshop was used to re-assess the SHN vision described by Machler *et al.* (2012). At the vision station, a member of the research team read to small groups of residents (maximum five) an abbreviated version of the Machler *et al.* (2012) vision narrative. Residents were then invited to amend the narrative using photographs selected to represent elements of an ideal “day-in-the-life in 2030”. Facilitators asked residents to consider three domains of guiding questions related to sustainable development concepts, including intergenerational justice, environmental stewardship, and social cohesion (Gibson 2006): (1) What would we like to see for our children and grandchildren? (2) What would we like to see for the environment? (3) How do we want our relationships with other neighbourhoods, and the city as a whole, to be in the future? Participants had the opportunity to respond to these questions by choosing photos, drawing, writing, speaking, or some combination thereof. The responses elicited were grouped (based on the same domains as the problems; see above) and linked to the presented vision narrative. Participants were lastly asked to identify the two most important vision

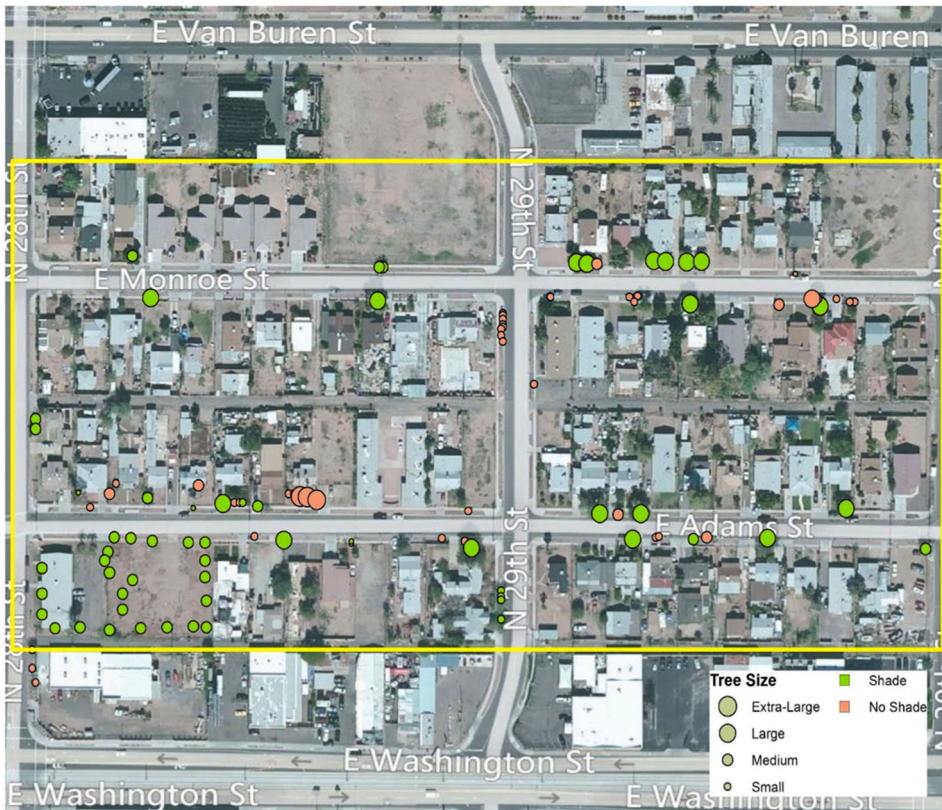


Figure 2. Tree inventory map of the SHN (March 25, 2012).

Source: Joseph Tuccillo and Google.

Notes: Trees highlighted include only trees on or shading public spaces. Size of circles corresponds to size of tree; green circles indicate trees that provide shade.

elements (ranking). The results of this ranking are shown in [Figure 3](#). Residents' top-ranked vision element was safety, with specific preferences for walkability and supervised/safe place for children. Sense of community pride received many votes as well (second rank) with specific preference for neighbourhood beautification.

The visioning results (walkable, safe, beautiful neighbourhood) align with the results from the problem analysis (low walkability, perceptions of low safety).

### ***Intervention design***

A second community-based participatory workshop focused on the collaborative design of an SHN-specific tree acquisition and maintenance plan. Researchers extended targeted invitations to city staff, non-profit organisation representatives, community representatives, and to professors from ASU. In addition to supporting intervention design, the workshop was intended to create an informal network of resources for the SHN community. During the workshop, the 12 participants were divided into 2 groups, 1 on tree acquisition and 1 on tree maintenance. Following an intervention design template (Wiek 2010), the groups discussed topics including logistics (e.g. what types of trees?), organisation (e.g. whom do we

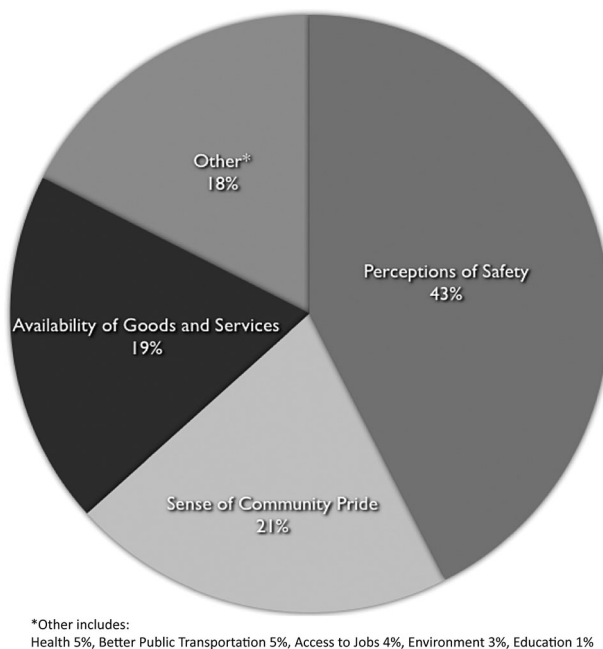


Figure 3. SHN residents' prioritisation of vision elements.

involve?), outreach (e.g. how do we involve people?), knowledge gaps (e.g. what do we need to know?), costs, resources available (e.g. partnerships), obstacles, timelines, and definitions of success (e.g. what do we measure and how?).

### *Intervention test through extended peer review*

The research team conducted an extended peer review after synthesising the results of the intervention design workshop and supplementing these results with additional research on best practices in community-initiated tree planting and management. Representatives from the community, city staff, non-profit and academe were invited to review the draft of the SHN Tree and Shade Intervention Manual (Bernstein *et al.* 2012). Community members were specifically asked to discuss the Manual's relevance to community needs and comprehensibility. Through in-person and electronic communications, City of Phoenix, non-profit, and academic experts were specifically asked to assess the coherence and thoroughness of the manual, the quality of the evidence presented, and the feasibility of the project. Feedback from this extended peer review was incorporated into the final version of the Manual, which was presented to the greater SHN community at the conclusion of the project (May 2012).

## **Results**

The intervention is structured into three phases: *Plan, Plant, and Care* (Table 3). Each phase is intended to support the community to realise its vision of a walkable, safe, and beautiful neighbourhood. To motivate the collaborating partners, each phase is oriented towards this overall vision. Each phase consists of a small number of key steps that contribute to realising the vision. Each step comprises a series of actions adapted to the needs and assets of the

Table 3. Key steps and actions of the SHN tree and shade intervention.

	Steps	Actions
Phase I: Plan	Step 1: Find the right locations	Choose a location Make sure that the selected location is appropriate
	Step 2: Organise the SHN Tree Committee	Identify and recruit committee members Build a committee of people with diverse skills and talents Take on initial tasks
	Step 3: Select Trees	Select appropriate trees to plant Plan for community ownership Find where and how to acquire trees
	Step 4: Identify needs and establish partnerships	Identify areas in the planning process that you need help on Explore connections with various partners Make a plan of what you need, whom you need to meet, and how you can collaborate
	Step 5: Secure funding	Explore grant programmes and sponsorships opportunities Link up with existing programmes Know your neighbourhood
	Step 6: Look out for typical challenges	Identify typical challenges, such as recruitment, outreach, volunteer burn-out, and budgeting
	Step 7: Learn from your success	Define what success means for your community Identify ways to measure success Communicate and celebrate success Improve on weaknesses
Phase II: Plant	Step 1: Prepare for the planting event	Recruit participants and volunteers Prepare materials like a timeline, budget, reservations, and a way to communicate with volunteers Coordinate with tree providers, residents, volunteers Review materials related to tree planting
	Step 2: Carry out the planting event	Hold an opening ceremony Showcase activities that attract more attendees Commence planting: dig holes, prepare the tree, plant the tree, water the tree Clean up
	Step 3: Follow up after the planting event	Generate excitement Celebrate success Learn from the event
Phase III: Care	Step 1: Gather volunteers to create a Tree Care Plan	Bring together the tree care volunteers Create an initial Tree Care Vision Define the tree care methods Partner up with other groups Involve youth and students Compile the Tree Care Plan
	Step 2: Carry out the plan for long-term maintenance	Have a Tree Care Workshop at the Tree Planting Event Care for the trees Learn from the phase and celebrate successes

SHN. Each phase, step, and action draws on evidence, information, and advice from literature, expert reviews, and community input. The phases are designed in a way that enables collaborating partners to track progress and learn from experiences (monitoring and evaluation of the intervention).

The intervention is documented in various formats. It is fully detailed in a manual (Bernstein *et al.* 2012) that balances technical information with readability, and includes visuals, examples, checklists, contact information of potential partner organisations, and additional resources to support community tasks such as tree selection or event organisation (appendix of the manual).

### ***Planning phase***

The planning phase starts with organising a committee to plan, execute, and oversee the tree and shade project. Planning phase objectives include selecting appropriate tree locations, forming a committee, selecting appropriate trees, developing partnerships with key organisations, and securing funding. In the first step of the planning phase the community identifies potential locations for the trees, taking into consideration local resources, climate, desired services, and local zoning laws. This includes a series of actions to form partnerships with: the specific organisation that can affirm the absence of underground water and electric lines; city departments to advise on regulatory compliance; police officers to instruct on safety setbacks; non-profits with tree-planting expertise; and the local non-profit that ensures new construction does not interfere with air traffic to and from Sky Harbor International Airport (the adjacent, central Phoenix airport). The second step of the phase is to organise a neighbourhood tree committee capable of leading and supporting the programme for one to three years. In this step, key committee recruitment and development strategies are identified, including how to take on initial tasks and invest time in building a team.

Once formed, the committee is tasked with selecting trees for planting, generating additional community support, and figuring out where and how to acquire trees. In this third step, important details include calculating water costs; strategising around media outreach; and reaching out to local organisations or national business chains that invest in local communities. The fourth key step is to seek out partnerships the committee can leverage to accelerate the project. This step details other neighbourhoods, local schools, the City of Phoenix' Department of Neighbourhood Services, and local coalitions that have in the past or might in the future support a tree and shade project. Step five highlights ways to secure outside funding, and ways to prepare grant proposal materials. The final two steps in the Planning phase focus on troubleshooting, tackling issues such as recruitment, volunteer burn-out, and budgeting, and ways to learn from and evaluate community success.

### ***Planting phase***

The planting phase turns to the nuts and bolts of organising a planting event. The key steps in this phase are divided into pre, day of, and post planting. The pre-event step comprises actions for volunteer recruitment and material preparation, and ideas on local organisations to partner with for volunteers and for educational training on tree planting activities. Options like securing a local tool truck through the city are highlighted, along with the names of specific organisations that, through the intervention design workshops, were connected to the community. For the day of step, actions include a kick-off ceremony, root preparation, planting, watering, and clean-up. Links to instructional videos on hole-digging and tree-planting were provided in this step, along with details as fine as the number of inches of mulch (two to four inches) to add to the base of tree (but not directly against the trunk, leaving one to two inches separation). For the post-event step, practices to energise the community are recommended as a way to carry momentum for the event from

the planting phase to the caring phase. One action included mounting homemade signs on trees neighbouring a resident's property to cultivate that resident's personal connection to a tree. Another action presented contact information for local media outlets to continue press coverage.

### ***Caring phase***

The caring phase focuses on the community's capacity to organise long-term tree maintenance. This phase is divided into two main steps, each with detailed actions. The first step is to gather additional community volunteers to support the development of a longer-term caring strategy. The first action for the larger group is to develop a plan of accountability for activities such as watering, pruning, mulching, litter removal, and "tree health check-ups". The accountability activities focused community attention on who would do what activities, where in the neighbourhood, when, and how. In addition to resources like an Arizona Municipal Water Users Association guide to tree watering schedules for native and desert adapted plants, information is provided on local churches and neighbourhoods that host existing tree-caring workshops. Much as in the planning phase, the first step of the caring phase points out the value of partnering with city agencies, other neighbourhoods, and local non-profits (and identifies such organisations). One example drew from the success of a Washington, DC, effort through the Casey Trees Program, which partnered with schools to involve youth in community tree-maintenance activities. The second step of the caring phase tasked the community with delivering on their caring plan. In addition this step provided recommendations on how to organise and host workshops, partner with local schools and universities to monitor the long-term health of trees, and continue building partnerships to allow for the expansion of the programme in the neighbourhood.

### ***Initial implementation result***

After the intervention manual was completed and tested through extended peer review, two members of the research team continued working with SHN residents on implementation. In a volunteer capacity, the team members helped the SHN association form the Tree and Shade Committee and consult with key project partners, including the City of Phoenix and a non-profit focused on natural resource conservation. Subsequently, these two researchers led an effort to draft a grant proposal with the SHN Tree and Shade Committee for submission to the State of Arizona's "Community Challenge Grant" made possible by the State of Arizona Forestry Division. Upon the award of funding, the researchers helped to solidify a partnership between the SHN Tree and Shade Committee and a local non-profit leader in green infrastructure projects. At the time of this writing, the first planting event is planned for Autumn 2014.

### **Discussion**

The goal of community-oriented intervention research is to develop place-based and actionable solutions with communities for community challenges. In the present study, researchers worked with a community and various city, non-profit, and university partners to mitigate adverse effects of urban sprawl in Phoenix. While some of these challenges are also being addressed at the city level, new alliances are contributing efforts at the neighbourhood level, the present study being one such example.

### ***Creating credible, salient, and legitimate knowledge***

One way in which the challenge of creating credible, salient, and legitimate knowledge (Cash *et al.* 2003) presented itself in this study was in meeting the needs of the community while also complying with broader principles of justice, environmental integrity, and social cohesion called for in sustainability (Gibson 2006). This tension manifested in the seeming incongruence between community problem priorities (lack of streetlights, lack of a drug store, and concerns over homelessness/vagrancy) and the formal intervention targets (adverse effects of urban sprawl). Ignoring these community problems would have significantly reduced the legitimacy of the research and, being community-based action research, the credibility as well. The team sought to resolve these issues first by linking the problem perceptions of the community to adverse effects of urban sprawl, including walkability, perceptions of safety, and urban heat island (Jacobs 1961, Donovan and Prestemon 2012). The second step we took was to define with the community a set of criteria for selecting the intervention: contribute to solving a community problem; foster a community-led effort; build up and draw upon a network of city, non-profit, and academic expertise; connect to programmes in greater Phoenix; support people and the planet, now and in the long term. These criteria were intended to bridge community interests and the broader principles of justice, environmental integrity, and social cohesion, helping enhance research legitimacy and credibility. The third step was to engage residents in direct conversations about these broader principles during the participatory workshops and community meetings.

In the process of reconciling community and research objectives, we observed a misalignment between project design and participant capacity. Research team members experienced difficulty gauging residents' capacity to discuss broader principles of justice, environmental integrity, and social cohesion, and overcoming the low salience of topics like sustainable development, a difficulty raised by Whitmarsh *et al.* (2011). These challenges made the conversations held with residents rather superficial. For example, to discuss the principles of social cohesion and justice researchers asked questions about the hypothetical needs of children and grandchildren (proxies for future generations), but without delving into the nuances of trade-off making, interdependence, etc. To discuss the above principles at the problem analysis and visioning workshop, a facilitator asked questions directly of residents. In the future, engagement activities that take more time or make more salient principles of justice, environmental integrity, and social cohesion might benefit from including more dynamic visuals, narratives, or other learning aids (cf. Wiek *et al.* 2013). Our observed mismatch in capacity, in part, also reflects the biases discussed earlier around the privileging of technical expertise over other forms of knowledge. While the level of community inclusivity in our project helped make for research "with" and not "done to" residents (Eversole 2010), further steps could have been made to reframe perceived lack of community sustainability as capacities rather than deficiencies (Schneider *et al.* 2008), as done in asset-based community development (McKnight and Kretzmann 1993).

As a possible offshoot of challenges related to balancing the need for legitimacy, we observed strains in community–researcher relations around expectation setting. While community-led problem identification enhances research legitimacy, the process can generate overly high expectations, leading to frustration should the project meet with unforeseen complications. We were dedicated to having the community lead the process of problem identification. In turn, the research problem was identified rather late in the research process; however, the lack of early problem definition removed a degree of control from

the research team, making project preparation difficult. Improvements to the process could have been made, but uncertainty and potential disruption may be one cost of engaging communities in the orientation and design of community-driven intervention research (Talwar *et al.* 2011) to gain legitimacy and credibility.

### ***Issues of representativeness***

Stakeholder representation at workshops posed a logistical challenge, with implications for research results. Despite local canvassing efforts with the help of the neighbourhood association president, low turnout ( $n = 20$ ) undermined the ideal behind community-led problem identification. If a large enough population is not represented at this stage in the process, it is difficult to ensure that resulting interventions benefit the entire – versus one subset – of the community. This experience of “selective participation” (Rydin and Pennington 2000, p. 156), and the attendant risks of inequitable distribution of the benefits of engagement or development, is not unique to community-based intervention research (Rowe and Frewer 2000). The issue of representativeness in public participation demonstrates a misalignment between the aspirations of the researchers to engage a community, the capacity of the researchers to organise a community, and the ethos of “activism” within the community. With greater resources, more workshops for a larger number of individuals could have been held. In addition, complementary “satellite” engagements at established, on-going community events could be pursued (Wiek *et al.* 2013) to further combat the effects of underrepresentation.

The closed (invitation only) second workshop – over which the research team had greater control – presented a different type of representativeness issue. Stakeholder engagement necessarily depends on social networks; invitees are selected from researcher roldexes, and stakeholders who agree to participate represent a self-selecting sample. Yet, resolving this sampling bias by opening recruitment presents challenges of its own. Open recruitment, while more inclusive and less selective, reduces researcher knowledge of attendees. For higher-intensity strategy development workshops, such a lack of knowledge might lead to sub-optimal workshop experiences, jeopardising not only the intervention products (e.g. the manual) informed by the workshop but also the knowledge and social capital critical to the intended long-term outcome, community empowerment.

### ***Sustainability intervention research and social capital***

Using community-driven intervention research presents an interesting opportunity for fostering the development of social capital in communities. Social capital plays a role in reducing property crime rates, energising civic participation and networking, and connecting local communities to external resources (Buonanno *et al.* 2009, Dale and Newman 2010, Eversole 2010). In the UK, for example, social-capital enterprises like time-banks, in which skills and resources are traded for services, have led to several thousand pounds in economic savings per recipient per year (Knapp *et al.* 2013). These tangible benefits are thought to flow from the dense networks of knowledge, trust, and relationships built through community (Rydin and Pennington 2000). As Phoenix faces down an almost \$38 million budget deficit (Cerreta 2014), investing in social capital may provide a valuable return.

Beyond tangible material benefits, social capital more generally helps overcome barriers to collective action. Collective action dilemmas are cases when cooperation will best serve individuals in the long run but when individuals pursue self-interest in the short run, do not cooperate and, thus, reduce the long-run optimal benefit available to the group (Poteete *et al.* 2010). Dense, functioning networks of interacting individuals

help build the trust critical to promoting small-group communication and collective action (Rydin and Pennington 2000) and functioning participatory work (Israel *et al.* 2006). Such networks are best built by and with the community, rather than imposed from above (Eversole 2010); indeed, empirical work bears out the damaging effects on community of top-down interventions that do not take into account local context and expertise (Ostrom 1990). By connecting the SHN to external social resources in the city and non-profit organisations, this intervention project helped community leaders develop a network of civic and civil organisation partners, contributing to the development of bridging social capital, key for future collective action.

The City of Phoenix Tree and Shade Master Plan lays out a vision for a “healthier, more liveable, and prosperous Phoenix” (City of Phoenix 2009). However, the plan does not specify actions for achieving the city’s vision at the neighbourhood-community level. The SHN tree and shade intervention represents an adaptable process for citywide replication and implementation, should longer-term outcomes monitoring the soon-to-be-planted SHN trees prove promising. With sufficient investment, community-specific tree and shade interventions could be developed and implemented across Phoenix in ways that leverage community social capital, promote community-driven collective action, and reduce cost for city government in ways discussed by Knapp *et al.* (2013).

## Conclusions

Community-driven intervention research, if carefully designed, can link scientific and community knowledge to tackle local development challenges. However, there is a need to navigate tensions among community expectations, broader development principles, and project feasibility. Considering the importance of reaching a critical mass of community members, intervention researchers must pursue innovative venues of engagement to ensure that interventions reflect the needs of the greater community and not just an active, representative, or well-connected few. While the City of Phoenix could stand to benefit from a suite of neighbourhood-level tree and shade plans, further research is needed to determine the success of SHN Intervention before pursuing programme adaptation and replication. Given its potential to catalyse social capital generation among city, non-profit, and community partners, intervention research presents a promising paradigm for pursuing community empowerment to resolve or mitigate urban development challenges.

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## Note

1. For an excellent account of the complex ways in which local knowledge is shaped by community and, in turn, shapes a community’s ability to drive its own development and resource management, see Ostrom (1990).

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