

Article

A Time and a Place for Everything: Aligning Community-Engaged Research to Context

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Abstract: Community-engaged research is understood as existing on a continuum from less to more community engagement, defined by participation and decision-making authority. It has been widely assumed that more is better than less engagement. However, we argue that what makes for good community engagement is not simply the extent but the fit or alignment between the intended approach and the various contexts shaping the research projects. This article draws on case studies from three Community Engagement Cores (CECs) of NIEHS-funded Environmental Health Science Core Centers (Harvard University, UC Davis and University of Arizona,) to illustrate the ways in which community engagement approaches have been fit to different contexts and the successes and challenges experienced in each case. We analyze the processes through which the CECs work with researchers and community leaders to develop place-based community engagement approaches and find that different strategies are called for to fit distinct contexts. We find that alignment of the scale and scope of the environmental health issue and related research project, the capacities and resources of the researchers and community leaders, and the influences of the socio-political environment are critical for understanding and designing effective and equitable engagement approaches. These cases demonstrate that the types and degrees of alignment in community-engaged research projects are dynamic and evolve over time. Based on this analysis, we recommend that CBPR scholars and practitioners select a range of project planning and management techniques for designing and implementing their collaborative research approaches and both expect and allow for the dynamic and changing nature of alignment.

Keywords: Environmental health science, community engagement, community based participatory research, community-university partnerships

1. Introduction

Research conducted in collaboration with non-academic stakeholders has seen a substantial increase in popularity in recent decades [1-3]. Through these collaborations local partners gain access to scientific resources and knowledge that can help inform community advocacy and bolster legitimacy in political and other public discourse, as well as help shape the research agenda of universities to respond to community priorities [4]. Researchers gain the firsthand knowledge and insight of local partners, develop interventions with greater relevance and feasibility, build bridges between the university and broader community, and support the self-empowerment of disadvantaged communities to take part in the production and mobilization of knowledge.

Participatory and community-engaged approaches to research have been employed in a range of fields including social work [5], education [6], development [7], public health [8], and ecology [9].

Due to the well-recognized benefits of community engagement, such approaches to environmental health research have been translated into funding initiatives by a range of private foundations and public organizations, as well as into policy statements by state and federal governments. The National Institute of Environmental Health Sciences (NIEHS) has demonstrated a strong commitment to promoting community engagement through its Environmental Health Sciences Core Centers, Superfund Research Program, and NIEHS/EPA Children's Environmental Health and Disease Prevention Research Centers. Each of these programs includes support for a Community Engagement Core (CEC) or Community Outreach and Translation Core (COTC), which are designed to facilitate bidirectional interaction between community stakeholders and researchers and translation of research into action. While community engagement can include a wide range of activities, the NIEHS has recognized Community Based Participatory Research (CBPR) – one form of community-engaged research – as a particularly effective tool for understanding and addressing environmental health concerns [10].

While definitions of CBPR draw from some of the same principles, no single definition has been accepted across the field of scholarship or practice. Perhaps the most widely recognized parameter used in defining CBPR is the extent to which the non-academic partners are involved in the research process. One foundation of this framework originates from planning scholar Sherry Arnstein's (1969) 'Ladder of Citizen Participation'¹ [11]. This ladder represents community participation in determining federal social programs as existing on a continuum from "nonparticipation" to "tokenism" and finally to "citizen power." Her continuum highlighted a concept that remains central to our understanding of CBPR today: that community participation in a program or process must be assessed based on the degree to which participants have the real power to affect the outcome of that process. The involvement of non-academics in research has since been conceptualized as falling along a continuum similar to Arnstein's, with "nonparticipation" corresponding to conventional academic research, "tokenism" referring to research partnerships in which no real power is vested in community partners, and "community power" occurring when community partners take the lead in determining the questions, methods, and applications of the research. This continuum concept, which promotes high levels of active involvement and authority of the non-academic partner, has been widely accepted among CBPR scholars.

The idea that "more is better" in community engagement can be seen in a number of widely accepted definitions of CBPR. Israel et al. [8] (p. 178) defined CBPR using eight principles, including "facilitates collaborative partnerships in *all phases* of the research" (emphasis added). Their CPBR typology encourages very high levels of involvement by members of the affected community, starting with selection of the issue of concern and continuing throughout the development of the research question and design, data collection, dissemination of the results, and application of the findings to social action. Other scholars have proposed that only the projects exhibiting the highest levels of community involvement and authority qualify as CBPR [12-13].

Despite the popularity of these definitions of CBPR, other scholars employ the term to describe a much broader array of translation-focused, partnership approaches to research [1, 14-15]. Indeed, Spears Johnson et al. [16] revealed that, of 25 CBPR health projects funded by the Centers for Disease Control and NIH, community involvement ranged from 2 out of 13 defined phases of the research project to all 13. While some studies reflected Israel and colleagues' [8] definition of CBPR and demonstrated high levels of non-academic partner authority throughout the project, others involved community partners in only the participant recruitment or dissemination of the results phases. This inconsistency suggests that scholars are using the term CBPR to describe projects with very different approaches and levels community involvement. One way to interpret these findings is that some

¹ While Arnstein's original study used the term citizen, we use the term "community" to avoid the problem of limiting inclusion to citizens, especially in a time of anti-immigrant discourse and policies. At the same time, we also acknowledge the problems associated with the term "community" as masking divisions and hierarchies.

projects are being inappropriately classified as CBPR and in some cases this is likely correct (for example in projects that only use community organizations to recruit study participants.) It is certainly clear that the level of community involvement required to classify a study as CBPR is inconsistently interpreted and represented in the literature. However, these findings also raise the question of whether a linear “less/more continuum” alone provides an adequate basis for studying or applying CBPR in a wide and changing variety of settings or whether other frameworks might be more suitable for describing and designing context-appropriate strategies.

This paper emerged from the authors’ search for a CBPR framework that could support our work facilitating community engagement among a diverse array of environmental health sciences researchers and community partners. In our roles as CEC leaders for NIEHS-funded research centers, we work closely with university and community partners to support community engagement activities. Our search for a framework that could explain the successes and challenges of our work revealed an abundance of definitions and approaches, many of which were too prescriptive to fit our diverse contexts. We also recognized that each of our projects demanded different CBPR approaches and that the level of our success (or challenge) was not dependent solely on the extent of community engagement but also how our approaches fit our specific contexts. We therefore sought to develop approaches to research partnerships that would more effectively capture the individual capacities, organizational or institutional settings, and objectives of our constituents.

Building from the large body of literature characterizing and promoting research involving communities described above as well as our own decades of experiences facilitating community engagement in the environmental health sciences and other contexts [4, 17–21], we propose a framework for facilitating and sharing knowledge about community-engaged research that emphasizes alignment between *what* the project intends to accomplish and *how* it will be undertaken.

Recognizing the diversity of factors that can shape community engagement in a given research project, we suggest that “good” community engagement does not always maximize the extent of community involvement but instead optimizes that involvement based on the alignment between the collaborators’ interests, capacities, and socio-political contexts. It is crucial to ensure that, given historical power disparities between academic institutions on the one hand and low-income communities and communities of color on the other, that alignment does not privilege the academic partners’ goals over the non-academic partners. Instead, our approach to alignment in CBPR is based on meeting community needs and interests as its primary goal. This multidimensional framework highlights the crucial roles that CECs and similar organizations within the research institution play in developing and maintaining this alignment as well as the value of clear communication about the expectations, goals, and concerns of the range of collaborators.

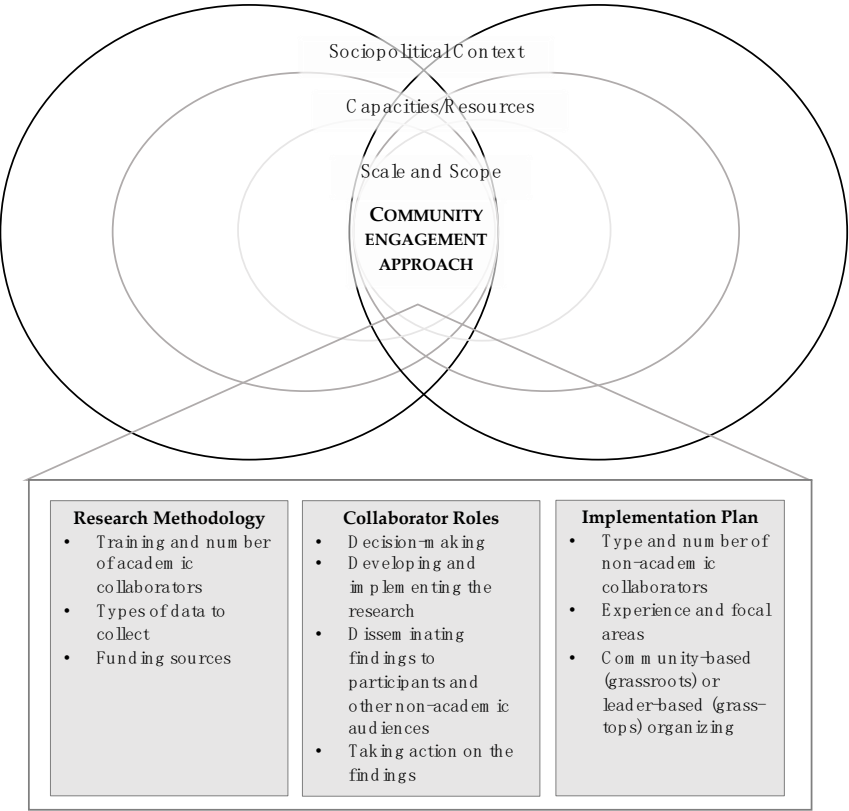


Figure 1: Framework for developing a well-aligned community engagement approach

Figure 1 depicts the authors’ framework for developing a well-aligned community engagement approach. There are two sets of converging circles to represent the fact that the partnerships are formed by intersecting relationships between the roles of the community and the university partners. Each set of concentric circles (scale/scope; capacities/resources; socio-political environment) in the diagram represents different levels of contexts and influences on a given CBPR project. All of these contexts must be taken into account in developing a well-aligned community engagement approach. The boxes in the community engagement approach represent the different factors (research methodology, collaborator roles, and implementation plan) that can be considered when creating alignment between the CBPR project and its context. We now address each context in turn.

Project Scale and Scope

At the core of successful CBPR partnerships is the respective alignment of project goals for the researcher and the community. The *scale* of CBPR goals can vary considerably—from tribe – to community- to state- and to nation-scale impacts—and the *scope* of goals can range from policy change to increases in health literacy to decreases in health disparities. Project partners must find a set of shared goals and deliverables in order for the project to be mutually beneficial. This does not mean that the goals of the researchers and the community need to be exactly the same. The goals are often a combination of very different but hopefully complimentary goals by the partners (e.g., the researcher’s goal is a manuscript, the community partners’ goal is data to inform a policy or campaign). The scale and scope of partners’ goals may influence such elements as the type of data collected and the collection method [22], the timeline of the project [23] and the number and type of collaborators (academic and non-academic). Agreeing on shared goals and deliverables does not mean that one or both parties needs to compromise their core interests, but that an overarching framework is needed that can accommodate both sets, and ideally find as much common ground as

possible. However, as noted above, the community-generated scope and scale of goals should take precedence in developing this overarching framework.

Capacities and Resources

Even when partners have established alignment in their project goals, their respective capacities and resources – on an individual or organizational/institutional level – may act as facilitating or limiting factors to achieving these goals. The community engagement approach must be developed in a way that neither over- nor under-estimates the capacities of each collaborator, that values each collaborator's time and expertise, and provides each collaborator with an appropriate level of financial compensation or other resources. If the community engagement approach does not align with the capacities and resources of the collaborators, projects may overburden or undercompensate one or more collaborators, hinder participation, and/or fail to achieve one or more collaborators' goals. An assessment of capacities must be conducted with both the academic and non-academic partners, including approaches to build needed capacities (for both sets of partners) to develop a project that meets all parties' needs and interests.

Socio-political Environment

The socio-political environment of a CBPR project is shaped by power relations between social groups, dominant political attitudes, population demographics, and historical relationships between the university and communities [24-25]. These contexts can in turn affect the availability of research funding, the willingness of non-academic partners to engage with researchers, the willingness of researchers to conduct CBPR, and the project's likelihood of achieving political or behavioral change [25]. These contexts can be experienced at multiple scales. At the community scale, it is important to recognize the variety of types of associations. These associations can range from community of place (e.g., residents of a neighborhood or region), a community of identity (e.g., defined by race, tribe, ethnicity, socio-economic status), community of affiliation (e.g., members of a social movement, religious or occupational group), or other form [26-27]. Communities are also not monolithic and dynamics of conflict, collaboration and hierarchies must be addressed [28-30].

Alignment Across Levels of Contexts and Influences

It is important to note that alignment between and among all of these contexts illustrated by the two sets of three concentric circles and the CBPR project is dynamic, involving ongoing implementation and adaptation ideally through collaborative process but also involving struggle. Much as the weaving of a fabric requires both the static structure of the "warp" and dynamic nature of the "weft", research partnerships require formal structures of accountability that can support the dynamic processes of creativity and collaboration [19]. Acknowledging and navigating the tensions that arise throughout the collaborative process—resulting from power disparities, challenging interpersonal or group dynamics—pushes the members of the collaboration to consider the perspectives of others and challenge their own biases.

CBPR Approach: Relationship Development, Research Methodology, and Collaborator Roles

To develop an effective and equitable partnership between the researchers and the community members, the combined team must develop a shared understanding of the scale/scope, partner capacity, and socio-political context. This shared understanding will then form the information basis to create a context-appropriate CBPR approach. This approach includes the processes for building and maintaining trusting relationships between all partners, designing a research methodology that answers the questions identified by the community partners, and designating substantive roles for each partner. The three cases below illustrate these elements of the CBPR approach.

Below is a three-by-three matrix the authors developed (Figure 2.) to illustrate this approach. The matrix calls out the *alignment of the project to its context* (e.g., scale and scope of project goals, institutional capacities, and the socio-political environment) and the *extent of the community*

participation. The engagement is tracked over time for the extent and alignment of community engagement through dashed arrows. This accounts for the dynamism of such projects and emphasizes that engagement is a process that continues to evolve over the life of a project or across multiple projects in a given institution such as a CEC.

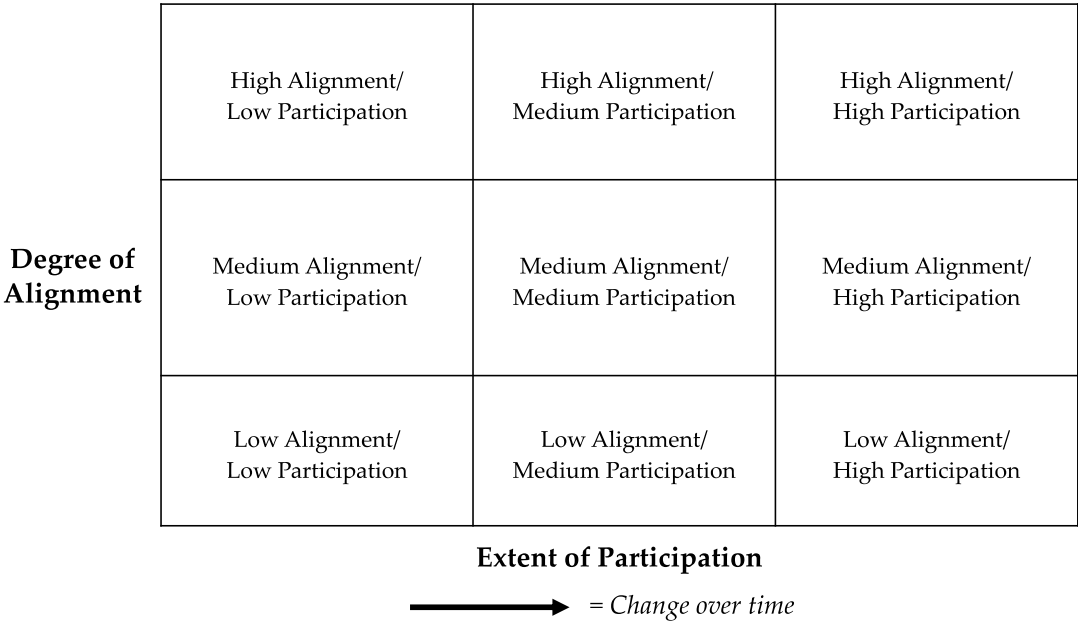


Figure 2: Matrix of community engagement

2. Materials and Methods

This article uses a comparative case study method to examine three different manifestations of CBPR in university-community partnership contexts. The intention of the comparison is to construct a typology of CBPR partnerships by drawing out both the distinctions and commonalities of the cases. These cases are drawn from projects from within Environmental Health Science Core Centers (EHSCCs) funded by the National Institute of Environmental Health Sciences, at Harvard University, University of Arizona and University of California, Davis. The Community Engagement Cores in all three EHSCCs are committed to supporting research that is mutually beneficial, mutually respectful, and that promotes multi-directional learning between university researchers and community partners. They also all use a variety of methods to build the capacity of both university and community partners to engage in such productive partnerships. This variety of methods reflects the specific contexts and goals of the research partnerships. We selected the case studies to provide illustrations of the community-engagement approach used by each center. In each case a matrix of community engagement (illustrated above) is provided to indicate the levels of engagement and the changes over time. These matrices will provide a way to compare the three cases and to show the differences in the dynamism of each of the cases.

We seek to answer the following research questions.

1. In what ways and to what extent did each project or initiative align with the scale and scope of its goals, with its capacities and resources, and with its socio-political environment?
2. What were the processes involved in developing and implementing the CBPR approach?
3. What were the implications of these approaches on the outputs and outcomes of the projects?

By answering these questions across all three cases, we hope to inform the development of a conceptual framework that can be used for those engaged in CBPR projects whether in academic or non-academic institutions.

We used an action-research methodology to construct the case studies. In particular, we drew our data from the critical reflections of the experiences of the co-authors in designing and implementing the CBPR projects as well as an extensive dialogue between the project leaders about the similar and divergent processes and outcomes of their work. Qualitative data were collected through field notes from the lead researchers developed during and following the projects. Using a comparative approach of projects with three different institutional, topical, and methodological contexts is useful for developing a generalizable analysis that a single case study could not accomplish.

3. Results and Discussion

3.1. Case Study 1: Exploring The Asthma/Obesity Connection in Response to Community Concerns (Harvard University)

3.1.1. Context

This case study follows a course of action which the Community Engagement Core (CEC) of the Harvard Chan-NIEHS Center for Environmental Health (Harvard Chan Center) undertook to address the health concerns expressed at a Dorchester (Massachusetts) neighborhood workshop sponsored by the Boston Public Health Commission. The Harvard Center includes researchers who study the impact of exposures related to particulate matter².

As in the case studies that follow this one, this case examines the alignment among the collaborators in terms of the project's scale and scope, its capacities and resources, and the socio-political climate within the context of engagement.

3.1.2. Background

Dorchester is a community located south of and adjacent to Boston. It is bordered by the Atlantic Ocean to the east and toward a collection of towns and cities in the other directions that display a rich history and strong traditions. It has an ethnically and socioeconomically diverse population and, like other settlements in the area, a high population density. Route I-93, an intensely used interstate highway that services Boston, runs along the eastern boundary of Dorchester and next to the Atlantic Ocean coastline. This highway is a source of particulate matter pollution.

Prior to 2012, the CEC of the Harvard Chan Center had set up two stationary air monitors, funded by a Center pilot project, in an effort to describe the contribution of I-93 and neighborhood traffic to local air pollution. In 2012, the Boston Public Health Commission (BPHC) held a series of neighborhood meetings to identify the health concerns of Boston communities. Ann Backus, a leader of the Harvard NIEHS CEC, was a facilitator at the Dorchester meeting. The BPHC introduced the meeting with health data from the neighborhood. Meeting participants pointed to high traffic volume as responsible for poor air quality, dense residential neighborhoods, and a lack of parks and green spaces in Dorchester compared to surrounding neighborhoods. Participants entreated the city to mark bicycle lanes for safety, provide a bicycle rental program, and increase the number of biking and walking paths in order to encourage more physical exercise. The consensus of the meeting was that asthma and obesity were/are major health concerns in Dorchester.

Past and present asthma and obesity data from Dorchester support the community's recognition of these health issues. The Health of Boston Report 2016-2017, which is a combination of the Behavioral Risk Factor Surveillance Survey (BRFSS) of 2013 and 2015, states that the emergency

² The Harvard EHSC also focuses on research related to persistent organics and metals.

department visits of children aged 3 to 5 per 10,000 population in North and South Dorchester, exceeded that of neighboring Boston by 114 and 126, 3-5 year old children per 10,000 population, respectively. The prevalence of adult asthma was 11.8% in Boston while it topped 18.1 % in North Dorchester. Similar exceedances hold for obesity: 21.8% in Boston compared to 28.8% and 26.3% in North and South Dorchester, respectively [31].

After reviewing the research of Harvard Chan Center researcher Dr. Stephanie Shore and her lab as well as research from Johns Hopkins [32], the Center submitted a CEC proposal as part of its P30 resubmission in 2013 to explore the intersection of asthma and obesity and develop interventions for at least one of the audiences: community at large or health care professionals. The P30 was funded for the period 2014-2019. Thus, the idea to explore the connection between asthma and obesity began in Dorchester in 2012 as a community-city-university partnership.

In preparation for delving into the intersection of asthma and obesity and developing interventions, the CEC undertook several activities to understand the community's concerns about air pollution and obesity, separately. The CEC sponsored a Science Café on air pollution/particulates at the Massachusetts Affordable Housing Alliance in Dorchester. During this Science Café gathering, Douglas Dockery, the Harvard Center Director, presented facts and findings about air pollution, and Ann Backus led the community members in a brainstorming exercise designed to zero-in on specific community issues. Again, transportation surfaced as a major issue – both how traffic contributes to pollution and how unsafe the community feels that bicycling is in the congested city of Dorchester. In an attempt to understand some of the new potential solutions to the traffic problems. The Boston Complete Streets Program was a program of the Boston Transportation Department that focused on multimodal accessibility, green and smart streets, including traffic calming, inclusion of bike lanes, improvement of walkability and accessibility, street trees, bio-swale, permeable surfaces and smart parking meters and intersection controls.

Having done this preliminary work to scope out community concerns and some interventions that were underway, the CEC proceeded to “pilot” some interventions of its own. In 2016, Brown, a post-doctoral scholar, joined Dr. Shore's lab and subsequently became a volunteer with the CEC. Her presence catapulted the asthma/obesity project into high gear, and the CEC began to develop a broader community involvement and infrastructure for the project. In the parlance of this article, the CEC was exploring the alignment of its efforts to understand the asthma-obesity connection with the concerns of the community. The CEC was also testing out the capacity and resources of the Center for addressing these concerns.

Dr. Brown, an expert hula-hooper, developed a ‘whole health hooping’ after school activity at the Dorchester Boys and Girls Club that encouraged exercise and mindful eating. She also formalized the Harvard Chan Centers outreach activities at the Dorchester Winter Farmer's Market into a ‘Science at the Market’ format which included peak flow measurements, LEGO™ activities to demonstrate particulate formation from incomplete combustion, and inflatable lungs – all designed to teach about airway and lung health and to provide an opportunity to discuss smoking, asthma, and air pollution. This phase helped develop more research capacity for understanding asthma and obesity and allowed the CEC to contribute its information resources to those of the community.

At this point the project became formally known as the asthma/obesity connection (A/O Connection) and three aims were defined: 1) to gather information about the A/O connection; 2) to identify a constituency that would find this information useful; and 3) to develop an intervention that would include development of materials and dissemination of information about the A/O connection and its implications for public health.

To achieve Aim 1, the CEC undertook a literature review, engaged with medical professionals treating asthma or obesity, and used Dr. Shore and her lab team as a guide to test the strength of the literature and empirical experience of medical experts with respect to the A/O connection. Thus, the researchers and medical experts became the “knowledge generator network.” In this network, the flow of information was bi-directional and iterative. When the CEC staff wanted to test a concept or a presentation, they would involve the researchers and medical experts. In turn, the researchers and

medical experts would suggest new articles and give examples from their own research and medical practice experience.

To achieve Aim 2, the CEC established a relationship with the directors of the Community Health Worker Programs in the asthma and nutrition divisions of the Boston Public Health Commission. The directors provided feedback and suggestions regarding the information that had been gathered regarding the A/O Connection through the knowledge generator network, and they became the CEC's "practice/users network."

In May 2018, the CEC hosted a workshop on the A/O Connection titled "Asthma and Obesity: Approaches to Care." This workshop brought together the knowledge and the practice networks. The practice network was now intentionally increased to include staff from non-profit organizations and from community health centers in the Boston area. The CEC was seeking to create an alignment between the scope and scale of the respective goals of the generators and users that would inform Aim 3, the development and dissemination of materials.

The socio-political aspect of the engagement surfaced at this point when the community participants in this workshop pointed out that obesity has different meanings for different cultures; they cautioned the team about approaching obesity from a perspective of shame and encouraged them to consider adding-in the contribution of the built environment (lack of walking, biking and park or green spaces). For these and other reasons, the CEC focused their deliverable, a booklet for health professionals, broadly on "lifestyle factors" rather than narrowly on obesity.

During the materials development phase of this work, the CEC Stakeholder Advisory Board were heartily supportive the work. Member Eugene Barros, of the Boston Public Health Commission, Division of Healthy Homes, solidly endorsed the work as valuable and pledged support of his unit; Dr. Alan Woolf, of the Pediatric Environmental Health Specialty Unit (PEHSU) at Boston Children's Hospital was similarly supportive and invited the CEC to present the work at the PEHSU spring advisory meeting.

The final work product is a booklet for health care providers titled *Obesity and Asthma* that practitioners such as Community Health Workers, nurses, school nurses, and others can use as a resource with their clients and patients.

3.1.3. Alignment of Project Scale and Scope

Initially, the Center did not have at hand the research that would shed light on whether or not there is a connection between asthma and obesity. This constituted a misalignment between the Center, *i.e.*, how the CEC planned to address the community concerns (asthma/obesity connection) and what the Center could provide, and the community's need for information about asthma and obesity. However, the CEC could see that this was a dynamic, rather than static situation, and that it could increase the scale and scope of the project on the Center's side to meet the needs of the community

The CEC began to correct this Center/community misalignment in the area of project scale and scope when the PhD toxicologist joined the CEC, undertook an extensive literature search and personally engaged with experts in the field. She also developed strong relationships in the community with organizations that were either addressing asthma or obesity. She met with staff of organizations such as Healthworks Community Fitness, Mattapan Food and Fitness Coalition, Massachusetts General Hospital: Weight Center, and Codman Square Health Center. These relationships netted the Center a cadre of practitioners who could be resources both to the Center during project development, and to the community in the future. Thus, by tightening the relationships with organizations that shared the goal of reducing asthma and obesity, the CEC began to trade misalignment for alignment with respect to the scale and scope of the project.

3.1.4. Alignment of Project Capacity and Resources

In addition to low alignment of scale and scope in the early phases of the project, there was little alignment of capacity and resources. In spite of the fact that the Center has PM (particulate matter) as one of its areas of research, it had only one lab looking at airway health and obesity and then only

in a limited way. The Center's capacity to answer the question, "Is there a connection between asthma and obesity" was slim. This meant the Center did not have a cadre of researchers who could be pulled into the project on the asthma side.

On the obesity side, the Harvard Chan Nutrition Department was very ready to engage. A nationally known researcher in the area of nutrition and mindfulness, as well as others, gave generously of their time and expertise, and the CEC staff boosted their knowledge of nutrition and obesity by attending noontime nutrition seminars.

On the community side, the capacity was not ready-made either. Dr. Brown's interviews with practicing asthma educators and physicians in the Boston area revealed that none had any notion about obesity as a risk factor for asthma, a concept that had become clear to the CEC as a result of the extensive literature review and the discussions with several practitioner/researchers in the fields of pulmonary and bariatric medicine. The divisions at Boston Public Health Commission that address asthma and obesity (nutrition, in general) were wholly separate entities, and their respective staffs had never met together on the asthma/obesity connection topic. In fact, BPHC would probably have continued to address asthma and obesity as separate concerns if the partners had not hypothesized that there might be a connection and intervened on that connection.

Once the CEC-based toxicologist had connected the CEC with the community and established a relationship with the asthma and nutrition staff at BPHC, the CEC then had direct access to the Community Health Workers who would be the primary users of the A/O materials. In addition, as mentioned above, at the Stakeholder Advisory Board meeting, the Director of the Healthy Homes Division of the Boston Public Health Commission offered the assistance of his division and the Director of the Region I Pediatric Environmental Public Health Unit at Boston Public Health endorsed the Asthma Obesity Connection project as well.

3.1.5. Alignment with the Sociopolitical Context

In this project, the socio-political climate showed up in several contexts. First, perhaps it is worth mentioning that as far back as 1999, a research team at the Harvard School of Public Health consisting of renown researchers, Dr. Walter Willett of the nutrition department and Dr. Frank Speizer of Environmental Health, published an article titled, "Prospective study of body mass index, weight change and risk of adult-onset asthma in women" [33]. However, this article had no meaningful traction at the time with practitioners and was not introduced to the community. Therefore, when the community of Dorchester cited asthma and obesity as major health concerns in 2012, they were not referring to the asthma-obesity connection, but to asthma and obesity as separate health concerns. It was not until CEC Director Ann Backus proposed to explore the link between these two diseases that the ideas surfaced by Willett and Speizer in 1999 [33] were brought back into open discourse.

On the community side of the socio-political context, the 2018 workshop participants specified that obesity has different meanings and values in different cultures. For example, whereas in Anglo cultures, slimness maybe desirable, in some African and Hispanic cultures, a fuller body maybe preferred. In this socio-political domain, the partners also discussed that obesity is often presented and/or understood in the context of shame, and the community cautioned the CEC that their materials should avoid a shaming or judgmental approach. In part to de-emphasize the strict relationship to obesity and give practitioners a more generic handle with which to talk with their clients and patients, the CEC chose to express the obesity intervention in terms of healthy lifestyle choices rather than weight loss. This approach also gave the CEC an opportunity to suggest that communities have a role to play with respect to infrastructure change (e.g., safe biking and walking routes, playgrounds and parks, rental bikes, marked roadways, and mitigating food deserts).

The historical inequities of lack of accessibility to health care and low-income housing were being addressed by the organizations with which the CEC had built relationships such as the Codman Square Community Health Center. Food desserts and lack of fresh produce were being addressed by Mattapan Food and Fitness Coalition and by the Winter Farmers' Market (in which we participated) sponsored by the Codman Square Community Health Center. Healthworks Community Fitness for women and children at the Codman Center offered and continues to offer low cost fitness programs

and free childcare as well as The Daily Table – a low cost “grab-and-go” food shop - and a Teaching Kitchen. With the CEC’s relationships to Codman Square Community Health Center and Mattapan Food and Fitness, it was aligned with the socio-economic climate and perhaps by inference, the political climate as well.

The CEC is in the dissemination and adoption phase of this project. *The Obesity and Asthma booklet for health care providers* is supported by the Boston Public Health Commission and is available to the Community Health Workers in the asthma and nutrition divisions. The CEC expects to reach out to the BPHC Community Health Workers, again, and to the health care professionals and the various community health centers over the next months. A presentation on the topic was made at the APHA 2019 Annual Conference in Philadelphia.

3.1.6. Synthesis

Within this relatively narrow project vis a vis the others cited in this paper, the Asthma-Obesity Connection project went through different phases of alignment, starting with low alignment (of scale and scope) and low participation (based on limited capacity and resources). When the toxicologist post-doc joined the CEC program, the participation / capacity of the community and to some degree of the Center, increased noticeably which in turn improved the alignment with scale and scope. At the point the project is now, in its dissemination phase, there is quite good alignment – both the Center and a portion of the practicing community have solid knowledge about the asthma/obesity connection. The level of participation is classified as moderate because there is still a significant amount of dissemination and encouragement of adoption yet to be done in Boston. The project was also largely initiated and supported by the CEC, a university entity. With that said, the concern for the A/O connection emerged directly from neighborhood meetings, and the project has been shaped by significant contributions from local policy leaders, health practitioners and neighborhood residents. In the matrix shown below, the change in alignment and participation over the course of the project is indicated by the arrows from low alignment/low participation to medium alignment/medium participation and then to high alignment/medium participation. The goal is of course to achieve both high alignment and high participation. Clearly in any project there are multiple routes to the upper right, high/high, cell.

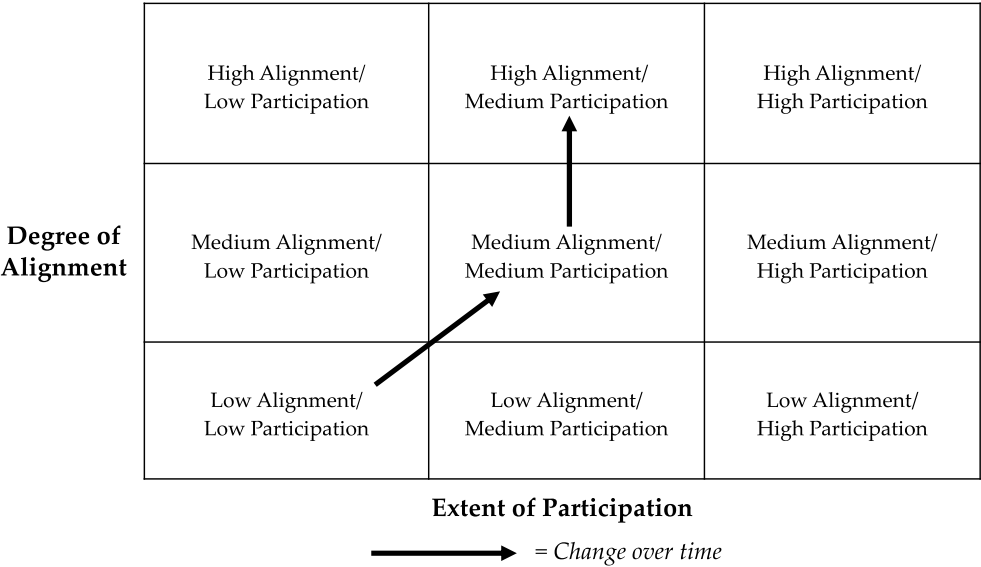


Figure 3. Extent and Alignment of Community Engagement: Harvard Case Study

3.2. Case Study 2: Seeking Clarity in Air Quality Research: Imperial County PM Study (UC Davis)

3.2.1. Background

The Imperial Valley in Imperial County is a largely agricultural and desert area in the southeast corner of California with the Salton Sea to the north and the US-Mexico border to the south. While remote from the rest of the state, it is integral to California's agricultural economy and its cross-border economic, social, cultural, and political relationships with Mexico. Latinos, many of whom are hard-working farmworker families, comprise 84% of the county's population.

The Imperial Valley is also the site of several fierce environmental justice struggles over issues such as agricultural practices (e.g., concentrated animal feeding operations and field burning), drinking water contamination, cross-border air pollution, the heavily contaminated New River and the fate of the Salton Sea. The political climate is generally conservative and dominated by major economic interests while the majority Latino population contends with problems of poverty, political representation and harsh environmental conditions.

The Imperial Valley has consistently ranked as the California county with the highest asthma rates in children [34-35]. Data from many studies, including the southern California six cities study, show that respiratory health problems in children can be worsened by increased levels of pollution [36]. Particulate matter is one of the greatest environmental threats to cardiopulmonary health [37]. The most apparent growing source of particulate matter (PM) in the region is the recently exposed lakebed of the Salton Sea. The Salton Sea is in fact California's largest lake, formed by the overflow from a flood of the Colorado River in 1905 [38]. Since that time, the lake has served as a sump for agricultural run-off, industrial discharge, and municipal waste [39]. In the last 10 years, as the primary inflows from area farms have decreased, the water has become more saline and 18,000 acres of lakebed have been exposed, drastically changing the surrounding environment by contributing vast increasing amounts of PM into the region's air [40].

Community advocates, often led by the Comité Civico del Valle (CCV), have worked to confront these challenges. CCV is the only environmental justice organizations in the Imperial Valley, and thus takes on a wide range of issues and campaigns, including air quality monitoring, the management of a state-wide environmental violations reporting network and cross-border environmental protection. For many years, CCV has played a strong leadership role in educating the community and serving as a voice to local and state government agencies. Against great odds, it has won some important campaigns and has an ambivalent relationship with local, regional, and state public agencies. CCV has significant experience in community-based air quality monitoring through collaborations with public agencies and university researchers as well as provision of technical assistance to other community-based monitoring networks throughout the state [41]. Leaders with CCV realized that creating an effective air quality strategy would require more evidence of a causal relationship between Imperial Valley's elevated levels of particulate pollution and asthma rates.

The CEC of the UC Davis UC Davis Environmental Health Sciences Center (EHSC) – established in 2014 - has a mission to connect community organizations such as CCV with UC Davis researchers with relevant expertise to pursue collaborative research projects. As part of its annual call for pilot project studies, the CEC reached out to Colin Bailey, then the Executive Director of the Environmental Justice Coalition for Water (EJCW) and one of the members of the EHSC's Community Stakeholder Advisory Committee, for suggestions on project ideas. Bailey connected the CEC with CCV and worked with the CEC leadership (then managed by post-doctoral scholar Karen Andrade and directed by professor Jonathan London) to write a proposal. London had worked with both EJCW and CCV on earlier environmental justice research projects and Andrade had significant experience with CBPR. The CEC then sought out EHSC-affiliated faculty with relevant expertise and identified Kent Pinkerton and his lab, which is internationally renowned for its expertise in the respiratory health effects of air pollutants [42-46]. With assistance from the CEC the Pinkerton lab worked with CCV and EJCW to develop a proposal for a project that would draw upon the local expertise of the community and university expertise in the respiratory health effects of particulate pollution. The Pinkerton Lab, CCV, and EJCW received funding through the EHSC in the form of a two-year \$60,000 pilot project grant from the UC Davis EHSC with \$10,000 going to CCV to support their active

engagement in the project using a CBPR approach. Although this distribution of funds was not part of the pilot project requirements at the time of the award, it has since been formalized.

3.2.2. Project Scale and Scope

The pilot grant required a CBPR research approach [8] in which the community partners would play a central role in developing the research design, implementation, and application of the findings to inform community action. The project's scientific goal was to differentiate the sources of PM in Imperial Valley and measure source-oriented PM toxicity and its potential to invoke or exacerbate an asthmatic response in a model. The proposal included an open-ended community action goal, which stated: "The results will be shared with the community so they can inform future action if they desire to do so. Future action may be translating and leveraging the results for policy advocacy or co-writing articles and funding proposals for further research." This was an important outcome goal, but did not adequately specify the roles of CCV in the research design and implementation itself. One challenge was that EJCW played a more substantial role in the proposal development than did CCV, reducing the direct engagement of CCV in the development of the project. This attenuated process of relationship-building and limited specificity about the scale and scope of the goals would lead to challenges as the project proceeded.

The first meeting between the project collaborators included CCV's CEO, Luis Olmedo, and lead air monitoring program coordinator Humberto Lugo; UC Davis air quality engineer, Keith Bein; the UC Davis Western Center for Agricultural Health and Safety's (WCAHS) Education and Outreach Specialist, Teresa Andrews; and a PhD student, Savannah Mack. This comprised the UC Davis team which would be led primarily by Savannah Mack.

The UC Davis team described their proposed scientific plan and the group then discussed CCV's previous research collaborations as a context for the upcoming project. CCV emphasized that they needed this to be a true collaboration that would have a lasting community impact, as opposed to many other collaborations that had ended with scientists collecting data and leaving. The UC Davis team was in strong agreement with this value. However, when the discussion turned to how this could be done with this project, it became apparent that both UC Davis and CCV expected the other party to develop the community engagement strategy and action plan. They ultimately agreed upon "learning more about PM in Imperial Valley" as a desired outcome. Although this general goal was altered slightly throughout the course of the study, it never became more specific, and the issue of how leadership of the community engagement component would be managed was not fully addressed.

3.2.3. Partnership Capacities and Resources

While the Pinkerton lab research team itself had no prior experience with CBPR, they did have the benefit of the Western Center's Education and Outreach Specialist and the support of the CEC. They also had significant expertise in the scientific methods to be used in the project. In addition, CCV had extensive experience working with other universities on air quality monitoring projects. A key challenge of capacity that was difficult to overcome resulted from the ambiguity of roles and responsibilities for applying the research. Both teams lacked a clear vision of each other's capacities and the training needed to bridge that gap. CCV was expecting UC Davis to have a plan to implement their results in the community, whereas UC Davis was expecting that guidance to come from CCV as the primary community partner. This was challenging for the UC Davis research team as it did not have prior experience with community-based action-oriented research.

Based on an overestimation of the strength of the collaborative relationships and the capacities of the UC Davis team, the CEC did not get directly involved in the early meetings. In hindsight this direct engagement would have been very helpful. Several times throughout the course of the project when miscommunications between the UC Davis research team occurred, the CEC stepped in to moderate. This assistance in problem solving was very useful as the project navigated applying for new funding and made decisions on how to move the study forward. As the project evolved, the team realized that instead of a background coaching role, it would have been better if the CEC had

helped facilitate from the onset of project development and subsequent meetings. In addition, it would have been helpful if the CEC had provided earlier training in CBPR for the UC Davis researchers. Based on these experiences, the CEC has now reoriented its approach to work more closely with all CBPR projects funded through the Center, including facilitating early relationship-building, development of project MOUs, and more extensive training in CBPR.

To increase the level of community engagement, CCV recommended the creation of a community advisory committee, as had been typical with their other CBPR projects, and one of their staff members took the initiative to organize a group of community members to participate. This group included community members from a variety of occupations and locations throughout Imperial Valley, all of whom had previously participated, or currently were participating in multiple advisory committees for CCV. The committee members therefore had strong background knowledge and valuable lived experience in the health and pollution problems in the region. However, their multiple roles caused some difficulty differentiating between the various projects. After the creation and first meeting of this group (hosted by CCV but run by Savannah Mack), the community advisory committee and CCV became increasingly integrated into the project. Although they did not participate in the sample collection or data analysis (this was conducted solely by the UC Davis researchers), the community partners' input was quite valuable in developing the study design. For example, the advisory committee clearly identified that the Salton Sea was their main concern so the UC Davis researchers located the sampling site as close to that PM source as possible. With the help of the CCV's Humberto Lugo, the UC Davis team identified and secured a sampling location on the grounds of a local high school. The Pinkerton Lab decided that, since sampling would occur on school grounds, close collaboration with the high school itself would be helpful in conducting remote sampling.

While placing the sampling unit, UC Davis formed a relationship with one of the high school teachers, and enlisted her students' help to maintain the sampling unit between the researchers' visits. Mack trained the high school students on the operation of the unit and engaged them in the data analysis as well. Mack then secured separate funding in addition to the EHSC pilot grant from the WCAHS, and established a week-long internship for high school students on the UC Davis campus. This internship continued for two summers and included students from the sampling-site-school as well as another high school in Imperial Valley. To UC Davis, this collaboration with the high school students, although separate from the direct collaboration with CCV, was an example of an outcome of CBPR and provided great educational value to community youth. However, CCV did not consider this sufficient community involvement as it was not directly integrated into the organization's activities.

The results of the air sampling came at a much slower pace than originally expected due to difficulty with the setup of the sampling trailer, and so by the time the project funding period had ended, no significant scientific conclusions could be made. The difference in timeline and lack of progress in this aspect of the project was disappointing to both CCV and to the UC Davis team, as was the fact that there was no action plan to do something with the eventual results. Although multiple conversations and brainstorming occurred over the course of the two-year project with both CCV and the advisory committee, it was generally agreed that an action plan would be based on data collected. In the absence of data, no formal action plan was never finalized.

In the year after the pilot ended, the UC Davis team secured additional funding from WCAHS to continue maintaining the sampling site, as well as to continue the high school internship for a second year. The research team collected and analyzed samples for two agricultural seasons and observed significant differences in the toxicity of particles based on size. It was concluded that different size particles (potentially from different sources) produce different adverse responses in the lung. Larger particles are usually wind-blown dust, whereas smaller particles are combustion particles like those produced by diesel engines. UC Davis researchers are currently analyzing this size comparison data, as well as completing a seasonal comparison. The UC Davis researchers shared the results to date with the high school students during their internship and made plans for the

students to share their new knowledge with their schools, respective communities as well as the advisory committee and CCV. The scientific analysis of the data collected from this project is ongoing.

3.2.4. Sociopolitical Context

As noted in the introduction, the socio-political environment of the region is marked by historical conflicts between community environmental justice and health equity organizations and the dominant agricultural interests with their allies in local and regional government. This puts significant pressure on community organizations such as CCV to confront these problems. In keeping with discussions with CCV staff, the UC Davis team intended to use the scientific results from this project to aid them in the funding proposals and advocacy campaigns to mitigate PM in the Imperial Valley. The UC Davis researchers attempted to align their work to address these challenging socio-political factors by designing a project that would provide information to inform CCV's air quality action strategies. It also worked to build the human capital of the community through the development of the student CBPR process and summer internship program for under-served youth.

3.2.5. Synthesis: Alignment of Goals, Capacities, and Sociopolitical Context

Assessing the overall alignment of the project with the Imperial Valley community is complex, partially because of the range of entities that make up the "community," and the transformations of the partnerships over time. The alignment of goals between CCV and UC Davis was moderate at the project's inception as the UC Davis team and EJCW with assistance from CCV collaborated to write the funding proposal. This could have been higher if CCV had been more directly engaged in the project development. In particular, had CCV been involved in this stage, their expectation that the university team develop a public health action plan may have been made explicit and subsequently integrated into the structure of the project.

Because CCV was engaged in several academic collaborations at the same time as their project with UC Davis, the distinction between the projects being conducted by various institutions in the region were not as clear as they could have been. This confusion was amplified by the fact that UC Davis and CCV each had several team members involved in this project. Although Savannah Mack and Humberto Lugo, the air monitor technician from CCV, were talking regularly, the team did not sufficiently engage the CCV leadership. When Humberto Lugo moved jobs to a different organization, the UC Davis team realized that the full scope of activities and connections developed with him had not been integrated into the organization as a whole. More broadly, the project had to contend with a longer legacy of relationships with other researchers who had conducted their work and not linked it to community organizations in a way that had seeded distrust. Conversely, based on other positive experiences, CCV had strong visions of what would be a good outcome. Unfortunately, despite the best intentions of the researchers, the implementation of the main research project and the later collaboration with the high school did not fully meet these expectations. Part of this was based on the fact that CCV had its own youth science curriculum called the Youth Environmental Health Internship Program that would have been useful as a context to integrate the UC Davis components.

The alignment between the UC Davis team and the Community Advisory Committee was strong throughout the project as it served as a forum to identify local needs and interests in the project and to shape the study design to meet them. One advisory committee member observed that this project was "necessary and important" but also "barely scratched the surface" of what they felt needed to be done to improve public health in Imperial Valley. One institutional challenge was that, while the group had been developed in collaboration with CCV, it was facilitated solely by the UC Davis research team and therefore did not have a close enough connection to build co-ownership with CCV. There also was not sufficient continuity of advisory committee members across the meetings to ensure robust engagement.

Finally, there was very strong alignment between the goals and the activities of the UC Davis research team and the teachers and students at the local high schools. The educational value of the project as well as the internship was mutually appreciated. The principal from Calipatria High School

said, “The partnership has a tremendous effect on the students.” One student evaluation said: “I want to share what we learned with our community and feel like I now have the skills to do so.” Like the community advisory committee, however, because this element of the project was not directly connected to the CCV, it was not perceived by CCV as representing a sufficient community partnership that the UC Davis team had hoped and intended.

While challenged in many ways, the project has had multiple benefits. First, it has ignited a passion in Savannah Mack to complement her scientific expertise in toxicology with a CBPR approach. She intends to pursue a postdoc with a focus in CBPR and wants to create a program to help graduate students learn how to best implement CBPR in their scientific research. The student internship has also catalyzed the interests of local youth in environmental health science, as evidenced by their excitement to return for a second summer and the fact that several students are pursuing bachelors degrees in Environmental Justice. Additionally, the local teachers are integrating this project and air quality issues into their curriculum. The results themselves are promising in their ability to identify the sources and health consequences of air pollution in Imperial Valley and will be shared with CCV to help inform their air quality advocacy.

Finally, the project experience prompted a number of improvements in the CEC’s approach to the CBPR projects. First, the CEC now provides a robust training in CBPR principles and practices for all Pilot Project grantees. This includes provision of funding (at least \$10,000 out of a \$60,000 project) for community partners. The CEC also works with the grantees and community partners to develop a MOU to spells out expectations, roles and responsibilities. Furthermore, it now plays a more active role in facilitating project meetings, especially in the initial relationship-building phases and provides more intensive coaching on CBPR to researchers.

The following figure summarizes the extent and alignment of the community engagement throughout the life of the project. It includes three different trajectories for each of the three major stakeholders in the project: CCV, the Community Advisory Committee and the students and teacher in the local school. The partnership with CCV began with mid-alignment and mid-participation and shifted to a lower level of alignment with the inability of the project to develop a public health action plan. The partnership with the Community Advisory Committee began with mid-alignment and high participation and shifted to high alignment and mid-participation. As the project ended its information and data collection phase, the advisory board was less involved, but with regular updates from the UC Davis team, Community Advisory Committee members showed continuous and increasing appreciation and support for the collaboration with local students. Finally, the partnership with the school began with high alignment and mid-participation and increased over time to a high degree of both as students and the teachers became more involved and empowered through active roles in the research process. This high degree of alignment demonstrates the importance of early and consistent relationship building and a match between the researcher and community visions and goals.

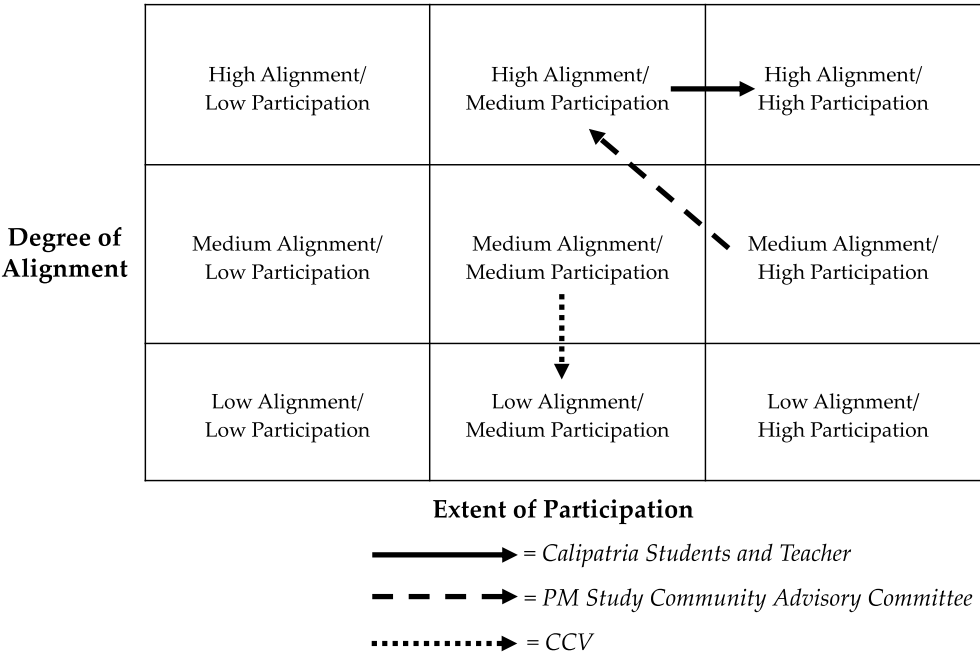


Figure 4. Extent and Alignment of Community Engagement: UC Davis Case Study

3.3. Case Study 3. *Preparing and Supporting Faculty for Community Engaged Research with Tribes:*
(University of Arizona)

3.3.1. Context

This case study is about how the CEC of the Southwest Environmental Health Sciences Center (SWEHSC) at the University of Arizona (UA) is working with researchers and tribal communities by seeking alignment within their joint projects of scale and scope, capacities, resources, and socio-political context. The SWEHSC is a collaborative and interdisciplinary research center, which is actively investigating the health effects of environmental factors in the desert southwest and serving as a resource for general and tribal communities, primarily in Arizona.

About one-quarter of Arizona is made up of American Indian communities, largely in rural areas of the state, serving as home to twenty-two federally recognized tribes³. The majority of the members of the Navajo Nation, the largest American Indian nation in the United States, and of the Tohono O'odham Nation, the second largest, are located in Arizona. The state has the third highest number (and the sixth highest percentage) of American Indians of any state in the Union. Approximately 286,680 were estimated to live in Arizona, representing more than 10% of the country's total Native American population of 2,752,158. Only California and Oklahoma have more.

Arizona has a beautiful and fragile natural environment, compounded by questions of water shortage and distribution. With varied climate southern Arizona is arid, with very hot summers and mild winters. Middle Arizona is mountainous with milder weather. Northern Arizona is high plateau with four seasons. Residents of Arizona are exposed to environmental chemicals, naturally occurring metals, airborne particulate matter, and organic solvents through economic activities such as agriculture, building and road construction, and mining waste. Climate factors are drought, strong UV sunlight and strong winds that carry mobile air pollution as well as natural and agricultural dust. Heat waves of extraordinarily high summertime temperatures for extended periods of time are becoming more common. Other problems are low river flows and water pollution. Ozone and smog

³ While the formal term for is American Indian other terms such as Native American, Indigenous, and Tribal are used interchangeably by these populations and this practice is followed in this case study.

concentrations are on the rise with higher air temperatures and growing energy use. Smoke from fires and dust from dry arid landscape have raised particulate matter (PM) concentrations. Investigators of the SWEHSC are conducting research to determine how these environmental factors are related to such diseases as chronic pulmonary disease and other types of lung problems, skin cancer, reproductive problems, and liver and kidney disorders, among others.

3.3.2. Aligning Project Scale and Scope

The CEC involvement with tribal communities began in 2003, when the Inter-Tribal Council of Arizona (ITCA) approached the CEC to explore involvement of the SWEHSC in the Air Toxics Project in the Phoenix, AZ area. The project included three tribes in close proximity to Phoenix and the South Phoenix area community as well, which is largely Hispanic and urban tribal members. All these communities are considered to be underserved and marginalized. The project included regular meetings over three years that resulted in positive relationships, trust for the SWEHSC, and new materials about lung health and environmental exposures. The ITCA eventually secured a US EPA-funded Community Action for a Renewed Environment (CARE) project with one of the communities, which led to sixteen years of regular involvement of the CEC with environmental professionals in the tribes in Arizona, regular community engagement with six tribes, and community research projects between the SWEHSC and three tribes in Arizona.

Over the past sixteen years the CEC has hosted three Tribal Forums about the environment and human health in collaboration with tribal partners, regularly participated in Earth Day events in six communities, and provided environmental health information upon request about arsenic exposures, perchlorate, forest fires, air pollution and asthma. CEC staff and interns support tribal summer camps and other youth activities. In addition, the CEC and SWEHSC members are supporting two research projects based on tribal community questions about environmental public health around air pollution and health and one about educational principles for working with tribal transfer students.

The Air Toxics Project and the air quality and education citizen science projects represent a strong alignment between the SWEHSC and area tribes through trusted relationships with individual professionals who represent the interests of tribal nations and with community members actively involved with tribal environmental, educational, and health departments.

However, there is also a legacy of misalignment related to the deep-seated distrust of research in tribal communities in Arizona because of past abuse and neglect by university researchers. In the Havasupai case, researchers at Arizona State University collected blood samples from the people to study genetic links to diabetes and used the samples for other studies, thus violating ethical human subjects research [47]. As a consequence, Arizona universities [48] created data sharing, tribal consultation and research guidance policies. A more recent example was a medical educational researcher divulging tribal data concerning low academic achievement at a conference presentation without proper permission from the associated tribe. To address this general distrust of universities, the SWEHSC CEC has taken a collaborative approach that has led to researchers being invited to communities and to community-led research in collaboration with researchers. Three recent research projects mentioned above have provided the opportunity for capacity-building among tribal professionals, students, and community members. The agreements with each tribal entity preclude providing more details in this article as the projects are all in early stages and the data regarding these projects belongs to the tribes and has not been approved for dissemination.

3.3.3. Aligning Partnership Capacities and Resources

SWEHSC members have been actively involved with the research projects identified above at different levels, which has led to capacity-building for researchers and their students. In one case, researchers and their students have taken air samples, in another case researchers have provided advice concerning using the International Study of Asthma and Allergies in Childhood (ISAAC) [49] approach to assessing the prevalence of asthma in the community, and in all cases researchers and their students are participating in science café presentations in the communities. The continuum of involvement includes:

4. "Passive involvement" such as allowing graduate students and post docs to participate in tribal community engagement, informational materials review, co-development of materials, educational activities and social media posts based on their research programs. For example, students from one lab assisted the CEC at an Earth Day event by learning and delivering lessons from NIH curriculum "Chemicals, the Environment, and You" [50]. They reached over one hundred Tohono O'odham students from five grades. Thus, the researcher provided the time and talent of his students to the event without regard to the research time missed. Ultimately the students had an interesting anecdote to share as they applied for future education and jobs.
5. "Active involvement" by researchers and lab staff, such as materials development on subjects requested by community partners, presentations to youth groups, and providing research internships to native students. One example of this was providing internships to six students from the Navajo Nation as they completed the KEYS High School Student Research Internship [51]. This example shows the commitment of the researchers and lab students to provide their time, talent, and treasure to the community engagement enterprise, with no expectation of reward. Graduate students share that these experiences provide real world supervision experience and researchers express that such students reawaken their enthusiasm for the research initiative.
6. "Direct engagement" with tribal members by researchers, such as science café discussions on topics requested by communities (and not necessarily their current research program), presentations and participation in tribal forums on health and the environment, providing advice and input to citizen science projects, and active partnerships with research program development with tribal communities based on the tribe's research questions. One example of this a skin cancer researcher providing an introductory talk about how environmental hazards enter the body and subsequently cause cancer. He was more than happy to provide the basic information and to answer community member's questions. The community members who attend science cafés tell us that they now see scientists as approachable people who have important information to share.

This continuum was developed to include as many researchers as possible who have different capacities and abilities to translate their research to the public. This is important because SWEHSC membership includes bench and mechanistic researchers as well as public health researchers. Many students from multiple disciplines have also participated in CEC activities in communities.

In order to understand the research of members, the CEC conducts three types of activities. The first approach involves interviewing researchers periodically to develop an understanding of their research and their career development. The CEC writes profiles about the researchers that include short bios and plain language descriptions of their research. These profiles also include suggestions for articles to read. The second approach is for the CEC to meet with the entire lab group to learn more about the research and to teach grad students and researchers to speak and write about their research in plain language. The third approach is to discuss the research with high school students placed into laboratory internships. These students communicate about their experiences in abstracts, posters and presentations, which helps the CEC gain a better understanding of the research, both the foundational understanding and the current cutting-edge research.

To train students and researchers to be effective in working with communities, the CEC adopted a one-to-one approach, which builds on the approaches to learn about their research. The CEC comes to understand the capacities and interests of the SWEHSC researchers and from that understanding does capacity building, suggesting how to present to youth and community audiences and how to conduct science cafés in the SWEHSC model. In these science cafés the researchers or students give a short presentation, which includes a little personal or family information, their career path, and a little about their research in plain language. Then the researcher and community members have a conversation about the general topic based on a questions and answers approach. Both community members and researchers enjoy this approach. For example, a genetics researcher was hesitant about participating in the science café because he was concerned that there would be strong disagreements about his research. However, that did not occur and he said, "I was pleased that the community

members were so interested and asked such good questions ... I felt at ease in the way the event was set up."

Another approach to capacity-building is to have researchers, grad students and post docs review or co-create public information materials. The process the CEC uses is to understand information generated by research and then to transform that information into plain language, which creates materials that are easy to read with short sentences and no words of more than two syllables [52]. The goal is to meet the principles of good environmental health literacy promotion by educating scientists to provide accurate information that is consumable by the general public with only a high school education.⁴

3.3.4. Aligning with the Sociopolitical Context

The most important socio- political issues that the CEC must address revolve around tribal sovereignty. This means that each tribe is a separate government entity with individual cultural practices and organizational structures. The SWEHSC also operates under Arizona Board of Regents Tribal Consultation Policy & UA Guidelines for relationships with tribes. The CEC developed and uses an Indigenous Research Framework [53] as a tool for program development and to help researchers understand important aspects to consider when engaging in collaborative projects with Indigenous communities. It identifies common themes within Indigenous communities that might be relevant and adaptable to individual tribal circumstances. It is comprised of three rings of influence for Indigenous communities. The outer ring represents the aspects of communities that researchers should understand and be respectful of when engaging in projects. The second ring represents the inherent sovereignty of Indigenous communities that researchers should respect. The center of the framework includes the four key components of collaborative projects with Indigenous communities: relationship-building, project planning, project execution, and evaluation. These four concepts follow a continuous circular pattern to represent that the process is never-ending, and are constantly cycling throughout the course of a project.

3.3.6. Synthesis and Lessons Learned: Alignment of Goals, Capacities and Sociopolitical Context

By following the above approaches, the SWEHSC's CEC has increased both the extent of the community partner participation and the alignment of this work with the overall context (including partner goals, capacities and socio-political context). This is represented in the following table that illustrates changes in the alignment in participation over the past 16 years (2003-2019).

The CEC has increased both the extent and alignment of participation through following the above-mentioned Indigenous Inquiry Framework as an essential guide for researchers and program staff in carrying out collaborations and partnerships with Tribal communities. All community collaborations require excellent communication, commitment, and consciousness of community politics. However, relationships with Tribal communities need to place those qualities within the context of Tribal Sovereignty and self-governance. The characteristics listed below [54] have proven useful for long-term productive relationships.

Active listening to tribal partners means that it is essential to begin with listening and not talking in meetings, thinking and taking a pause before responding and thinking if a response is even required. It is important to respect the partners' abilities and point of view and realize that the tribal communities have been successful in sustaining themselves for many generations and therefore know more than the academics about their needs and interests. Therefore, the academics need to be

⁴ This attention to aligning communications with formal education level is an important consideration because the graduation rate for Native American students is lower than that for all other races and ethnicities. For the cohort year 2016, the graduation rate was 75% of Native American students in high-density schools (where more than 25% of students are Native American). However, only the rate was only 68% in low-density schools (with student bodies that are less than 25% Native American. (Arizona Department of Education, 2017).

present in the community frequently in order to build trust and have social interactions as learners as much as or more than as teachers.

On a logistical level, transportation plans need to be in place to sustain a relationship with monthly or more frequent meetings and in-person engagement. This is expensive in terms of the time and the costs of paying for motor pool vehicles that cannot be minimized. Virtual contact such as Zoom, Google Hangout, Facetime meetings are not equivalent replacements, but they can be a supplement.

Committing to longevity of collaborations and making a long-term commitment is essential. Developing relationships takes years not weeks or months and cannot be rushed. Researchers should expect and plan to stay engaged long after a specific grant for best results. Best practices include meeting with tribes at least a year before grant submissions, developing follow-up projects and continuing to attend meetings after the grant concludes. Developing relationships with multiple contacts with the tribes is important because there are frequent staff changes and without such contacts the team’s intentions will have to be reestablished or risk being frozen out.

Understanding tribal systems and chain of command is essential. Tribes are government bodies and have elected leaders who should be approached first to consider resolutions to support the engagement program. Memoranda of Agreement (MOAs) will need to be established and renegotiated to reflect the changing nature of the work. MOAs are essential to make sure that the researchers are meeting tribal priorities to ensure mutual benefit.

Publishing should not be a primary goal and in some cases publishing may not be possible. To be successful with publications, equal authorship must be offered; the benefit of the project to the tribe must be clearly stated. Plans for publication need to be made at the beginning and not assumed. The tribal partner and the researcher or university staff members need to clearly understand what data will be collected and reported. It is good practice to engage tribal students in the studies and to provide stipends to tribal members who participate. Overall, projects need to collect, analyze, and report data in culturally appropriate ways, as defined by the partner and their community. For example, education projects as defined by “Himdag” the Tohono O’odham cultural practices [55] can be a source of strength; such projects can serve as a protective factor contributing to wellness which is aligned with Tohono O’odham culture.

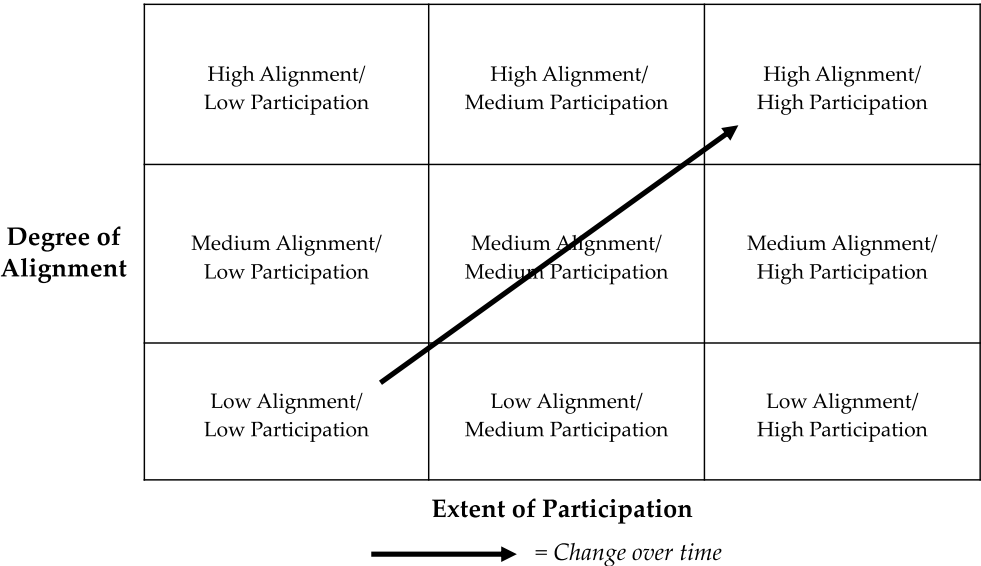


Figure 5. Extent and Alignment of Community Engagement: Arizona Case Study

4. Conclusions

The three case studies presented above illustrate a number of important lessons about the design and implementation of CBPR projects. While partners in all three projects had common overarching

goals—the building of mutually-respectful and beneficial relationships, community empowerment and benefit, and a strong research to action translation—they approached the projects in distinct ways that affected the outcomes and impacts of the work.

In short, taken together, the three case studies demonstrate that the success of CBPR projects is based on several key components. At the broadest level, success is shaped not only by the extent of participation, but by the alignment of the three levels of context: scope/ scale, capacities and resources, and socio-political environment. Because all projects exist in and are influenced by different contexts, there is not a one-size-fits-all model of CBPR that can achieve its intended outcomes. Second, the degree of success of CBPR projects/initiatives changes over time in response to changing internal and external circumstances. Adaptability to these changes is key to success. Finally, a focus on building-relationships in the early stages of the project can help ensure success in the longer term. This allows for a collaborative development of the scope and scale of the project, assessment of the capacities/ resources and socio-political environment and adjustments of the project to fit these contexts.

To illustrate these overall points we turn to the specifics of the case studies. In the case of Harvard University's community partnerships on the asthma/ obesity connection, the scale and scope of the project's goals did not start off as having all of the relevant partner capacities and resources but became increasingly well-aligned as new partners were added with the requisite types of expertise and networks. The project also brought together partners who were working on different parts of the issue (asthma and obesity) but who had not worked in a collaborative way on the interconnections between these issues. This allowed for a greater alignment with the socio-political environment and furthermore, helped shape this environment by translating research into health care protocols to address the asthma and obesity connection.

The UC Davis asthma and air quality study selected a topic that was very well-aligned with the socio-political environment of the Imperial Valley where such concerns were of great interest to local partners. The project also was well-aligned with the technical expertise of the research team and the community-engagement capacities of the main community partner. However, there was less of a connection between the partners on their emphasis on translating research to action, with both the partners expecting the other one to take on this element of the project. On the other hand, the project developed a very successful youth-engagement process with the local high schools, where the STEM pathway focus of the schools and the mentoring capacity of the researchers was closely matched. These experiences of challenge and success have led to important improvements in the programs of the UC Davis CEC.

Finally, the case of the tribal partnerships with the University of Arizona's CEC highlights the value of focusing on university-community relationship building with close attention to both the fraught histories of such partnerships (in Arizona and elsewhere) and the specific contexts of Tribal Sovereignty and governance. The CEC's emphasis on building the capacity of university researchers to engage respectfully and effectively with tribal residents and the development of community-based science communications programs both enhanced trust and facilitated the development of new environmental health projects and the broader application of existing ones. The provision of a continuum of engagement model (from passive to active to sustained engagement) allowed for options that fit the scope and scale of a range of different projects. Overall, the CEC's strategy of building an on-going partnership that supported a diversity of projects allowed for a continued improvement of both extent and alignment of projects over time.

Together, these case studies offer, not a blueprint, but a framework and a menu of options that those interested in building community-university partnerships can draw from as they seek models that align their internal and institutional capacities with their external contexts.

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