Unintended consequences of nature-based solutions: Social equity and flood buyouts

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ABSTRACT:

Nature-based solutions (NbS) can serve as effective strategies to promote the resilience of both people and ecosystems in the face of climate change. However, these solutions can exacerbate existing social inequities if they fail to adequately consider the complex social contexts in which they are implemented. To better understand the equity implications of NbS, and how to design and deliver such strategies more equitably, this study applies a conceptual framework of 4 equity pathways (distributional, procedural, recognitional, and structural equity) to a flood buyout program case study. We utilized document analysis and semi-structured interviews to conduct an equity analysis of a flood buyout program in a rural community in the Catskills region of New York. While many aspects of the flood buyout program aimed to empower local municipalities and landowners, local residents perceived a lack of decision-making power, negative long-term impacts to community well-being, and tension regarding the current and historical power differentials between these rural communities and New York City. Our results indicate individual equity pathways interact with one another in complex ways. They highlight the importance of comprehensive planning and evaluation of community impacts to better address the systems-level relationships that shape the equity implications of buyout programs.
INTRODUCTION:
As climate change becomes an increasingly pressing challenge for communities across the United States, actors at multiple scales are looking towards nature-based strategies to help adapt to and mitigate climate impacts. According to the National Oceanic and Atmospheric Administration, the U.S. experienced 360 ‘sustained weather and climate disasters’ since 1980, costing more than 2.57 trillion dollars. Further, the average number of disasters per year was 8.1 from 1980-2022, whereas from 2018-2022, the average increased to 18.0 (1). In response to these trends, the Biden-Harris administration has promised an investment of over $5 billion through The Inflation Reduction Act for ecosystem restoration, which includes actions such as protecting forests from deforestation for their carbon sequestration potential and restoring coastal wetlands to buffer coastal communities from storm surge and flooding (2,3). These nature-based solutions are frequently characterized as a win-win strategy for both people and nature. The term nature-based solution (NbS) refers to “actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits” (4, p2). While research highlights the promising potential of NbS for climate adaptation, these strategies do not exist in an ecological vacuum. They interact with dynamic social systems, resulting in outcomes that are more nuanced and complex than the popular ‘win-win’ terminology indicates (5). One example of such complexity is the interaction between nature-based climate adaptation strategies and issues of social equity.
Adaptation strategies can provide opportunities to address inequities and achieve social justice. In one study, a Health Equity Impact Assessment concluded that publicly accessible green infrastructure led to positive physical and mental health outcomes for vulnerable communities in Ontario, Canada, demonstrating how green infrastructure can address both stormwater challenges and improve public health outcomes (6).

Additionally, adaptation planning can engage and prioritize the voices of communities that have historically been excluded from urban and municipal planning processes. Another study showed how city officials in Barcelona, Spain are centering women and low income and minority residents in plans to increase access to urban green amenities (7). Despite these successful examples, adaptation strategies can also exacerbate or create new inequities. In Philadelphia, for example, a climate adaptation program aimed at increasing green infrastructure in at-risk neighborhoods led to gentrification and the emigration of minority communities (8). Furthermore, without actively working to dismantle the pre-existing equity issues that create barriers for certain social groups from engaging in community planning processes, adaptation planning can further exacerbate exclusion in local decision-making as a result of conscious and unconscious cognitive racial bias and normative and institutional barriers (9). When used thoughtfully, NbS can be used to achieve equitable adaptation, but when this interaction is ignored, the unintended consequences of such strategies can exacerbate the vulnerability of marginalized groups.

Scholars are paying increasing attention to this adaptation and equity nexus. However, the literature is relatively nascent and often conceptually rather than empirically focused (10,11). To better understand the equity implications of climate
adaptation and design more equitable adaptation strategies, data-driven studies in a
diversity of geographic and hazard contexts are needed. To help fill this gap, this study
investigates the equity implications of a flood buyout program in a rural community in
the Catskills of New York. We conduct an equity analysis of the program, creating a
case study which highlights the complex and place-based ways in which equity can
manifest and interact with a nature-based climate adaptation strategy. Further, we make
recommendations for how buyout programs can more effectively address equitable
adaptation.

As scholars exploring the intersection of equity and NbS, we believe it is
necessary to articulate how we conceptualize and define the concepts of equity and
justice. These terms get used frequently in the human-environment interactions
literature, yet their use often lacks the conceptual clarity necessary to synthesize and
apply work being done in this field. We want to recognize the plurality of accurate and
helpful definitions for the terms equity and justice. These vary by discipline, and often
between academia and practice. In the context of this paper, we will refer to equity as
the ‘fairness’ of a current state with respect to various social groups and justice as an
action taken to address issues of equity. We use a prioritarian or needs-based criteria
for equity and consider equity to be met (in the context of climate adaptation) when the
needs of the most vulnerable are prioritized (12). We further outline our conceptual
approach to understanding the complexity and characteristics of equity and situate it
within the broader environmental justice literature in the following paragraphs.
Conceptual approaches to studying equity and justice in climate change contexts

Scholarly efforts to study the equity and justice implications of climate change are multi-disciplinary and rely on a wide body of literature (10,11). Climate justice scholarship investigates the fair and meaningful treatment of all social groups with respect to the benefits, risks and costs associated with climate change. Well known work by Thomas and Twyman often grounds conceptual understandings of equity and justice in climate change scholarship – “equity and justice, or ‘fairness’, in climate change can be considered in terms of processes, which largely relate to emissions issues, and outcomes, which relate to impacts, vulnerability and adaptation” (13, p116). While this broad definition facilitates a conceptual thread throughout much of the literature, the applied and grassroots foundation of the environmental justice movement cannot be overlooked. Specifically, the ‘Principles of Environmental Justice’ created at the First National People of Color Environmental Leadership Summit, has guided both grassroots social justice work and environmental justice research since their creation in 1991 (14). The ‘Principles of Environmental Justice’ provide guidance on how equity and justice apply in a variety of different environmental contexts (e.g. pollution, worker’s rights, nuclear waste, etc.) (14). A framework posed by the political theorist David Schlosberg offers additional clarity in how and why issues of equity and justice materialize in environmental contexts (15).

Schlosberg's multidimensional framework of environmental justice (15) separates justice into three dimensions: the distribution of costs, risks and benefits (distributional justice); the meaningful inclusion of affected groups in decision-making (procedural
justice); and the prioritization of the well-being, knowledge and perspectives of affected
groups (recognitional justice). Other scholars have adapted this work and added a
fourth dimension – structural justice, which includes the institution and systems that
shape people’s ability to participate in decision-making processes (16,17). For linguistic
consistency and conceptual clarity, this paper applies these four dimensions, referring
to them as ‘equity pathways’, to guide our study design and analysis (see Figure 1).

Figure 1. Conceptual framework of equity pathways that guide this study

Trends and gaps in the adaptation and equity literature

Recent efforts have sought to systematically review and synthesize scholarship
investigating the equity implications of adaptation efforts and have found a clear need
for empirical investigation of how issues of equity manifest in climate adaptation efforts,
particularly beyond the distributional and procedural equity pathways. A systematic map
by Coggins et al. found that only 4.9% of the articles included in their search empirically
investigated the equity implication of climate adaptation (10). In a forthcoming scoping
review, authors found that 40% of adaptation and equity papers were conceptual in
nature, as opposed to empirical and data-driven (11). These reviews, in combination
with reviews of specific types of adaptation strategies (18,19), point to the importance of
scholarship that clearly investigates the ‘on the ground’ equity implications of climate
adaptation. Such scholarship is needed in combination with broader conceptual work to
reach a nuanced and evidence-based scientific understanding of adaptation and equity
interactions.
Flood buyouts as nature-based solutions for adaptation

Buyouts (also called strategic or managed retreat) involve purchasing risk-prone properties to move infrastructure and people out of harm’s way. Flood buyouts are often facilitated by government agencies and have been historically used in communities across the U.S. to address the issues of both riverine and coastal flooding (20,21). They can function as NbS due to their potential to restore and protect the ecological integrity of floodplains (22,23).

Research reviewing the complexities of buyout programs identify several potential equity implications. An analysis of eight U.S. buyout programs highlighted a lack of transparent decision-making and reliance on financial cost-benefit analysis that may “promote disproportionate retreat in low-income or minority communities” (24, p1). Additionally, multiple studies point to limited access to buyout funding mechanisms for communities with low financial resources or municipal capacity (21,25). In a 2022 review, authors note that buyouts simultaneously have the potential to build community climate resilience and negatively impact individual households (26). To further understand such potential equity implications, these scholars underscore the need for multi-scalar, multi-dimensional and place-based analyses of buyout programs.

The aim of this study is to use a clear conceptual framework to analyze the equity implications of a buyout program. This work provides a case study analysis of how equity and adaptation interactions manifest in a single municipality while explicitly recognizing the multi-scalar nature of this regional buyout program involving multiple communities. The research question that guides this work is: How does a regional
buyout program, designed as a NbS to reduce flood risk and improve water quality,
interact with multiple equity pathways (distributional, procedural, recognitional,
structural) to produce a community’s local experience with the program?

METHODS:

Case study community:

Community selection

This case study research was conducted using a transdisciplinary approach (see Steger et al., 2021 for further discussion of transdisciplinary environmental research). As such, the community at the center of this research was selected based on several criteria. First, as The Nature Conservancy in New York is both the funder and practitioner partner in this research, the selected community has a pre-existing relationship with The Nature Conservancy in New York’s climate adaptation team. Such relationships are critical to conducting effective community-based research that adds to both theory and practice (27). Second, the selected community is actively engaged in a flooding adaptation strategy. Third, the community is home to diverse social groups with increased potential for pre-existing inequities. For this criterion, we relied on indicators from census data such as the diversity index, percent of households below the poverty line, Gini index, median household income, median age, median rent costs, percent of population with documented disability, and percent of people with English as a first language. Based on these criteria, we narrowed down potential communities to a handful of locations, and selected the final community based on local leadership interest
and capacity. Throughout this article, we refrain from naming the specific community or providing identifying information to protect the anonymity of participants.

Community and watershed background

The case study community is located in the Catskills region of New York State and is home to under 5,000 residents with a density of less than 1,000 people per square mile (28). This New York City ‘bedroom community’ was hit hard by the housing market impacts of the COVID-19 pandemic. Housing costs have increased by 27 percent between 2020 and 2022 and had a vacancy rate of 1.81% in 2020 (29). In addition, issues of transportation access, food security and healthcare access significantly impact the lives of the most vulnerable residents, a pattern of challenges familiar to many rural communities across the U.S. (30,31).

The case study community is located within the New York City Watershed, which is:

“... the largest unfiltered water supply in the United States, serving 9 million New Yorkers with about 1.3 billion gallons of clean drinking water each day. The New York City Watershed spans nearly 2000 square miles, extends 125 miles north and west of New York City, and includes 19 reservoirs. It is also home to nearly 1 million inhabitants” (32).

To protect water quality and maintain their ability to use unfiltered water (see Pires, 2004 for discussion about New York’s Filtration Avoidance Determinations (FAD) from the Environmental Protection Agency), New York City spends significant resources to avoid point source pollution, such as flood water runoff, within the watershed. One
strategy is their Land Acquisition Program, which is mandated to protect both water
quality and the vitality of local communities in the watershed. NYC officials estimate that
without the FAD, building the necessary water treatment facilities would cost upwards of
1 billion dollars USD, with annual costs of over 100 million dollars to provide the drinking
water for 8.5 million consumers (33).

NYC’s Department of Environmental Protection (DEP) has a controversial history
in the region due to its rapid land acquisition and subsequent control over land use in
the region. Since 1997, the percentage of total city and state protected land within the
west-of-Hudson watersheds has “increased by at least 18%, with over 154,000 acres
acquired through fees or easements, at a cost of almost $500 million” (34, p201).

Additionally, the initial creation of multiple reservoirs in the watershed occurred through
extminent domain in the early 1900’s (35). Multiple families in this case study community
have ancestors that were forcibly removed from their farms and communities to build
the reservoirs.

Flooding and buyouts in the NYC watershed

Many rural communities in the Catskills are experiencing the effects of climate change,
particularly from increased flooding. As major storms and subsequent floods in the last
two decades (such as Hurricane Irene (2011) and Hurricane Sandy (2012)) have
caused significant damage to infrastructure and property, national, state and local
efforts have focused on improving the flood resilience of local communities. One of the
programs that emerged from these efforts is the New York City Funded Flood Buyout
Program (NYCFFBO), a subprogram of the DEP’s Land Acquisition Program. The
The purpose of this regional program is to support buyouts of residential and commercial properties in the 100-year floodplain located in the New York City Watershed. The program seeks to get people and property out of harm’s way and simultaneously reduce the risk of point source pollution created from flood damaged properties (36).

To qualify for the program, the property must be at high risk for flood damage according to local flood analyses and receive municipal government approval to participate. After the property is sold, it is transferred to local government ownership and a reuse plan is established, preventing future development but allowing for conservation and recreation activities. The program attempts to address issues of relocation by making some funds available to relocate housing and businesses within the region.

The history of eminent domain, the multi-scalar nature of the program, the dual intended outcomes of the program, and the pre-existing equity concerns that challenge rural communities make this buyout program a salient case study for an equity analysis of NbS climate adaptation effort.

**Data collection:**

To investigate the equity implications of this regional buyout program in the case study community, we used a combination of document analysis and semi-structured interviews..

**Document Analysis**

We first conducted a document analysis of all online publicly available media covering the NYCFFBO program and the case study communities’ engagement with the program. Our process was guided by Grant’s guidelines for social research with
documents (37) and Hancock and Alogzzine’s guidelines for case study research (38).

Table 1 lists inclusion and exclusion criteria for our document analysis. The document search was conducted in May of 2022 and utilized broad search engines as well as specific searches on municipal websites, DEP’s website and websites of related organizations and institutions. In total 68 documents and 20 media articles were included in our document analysis, with over 4,000 pages of text.

**Table 1.**

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>● Available to the public</td>
<td>● Drafts of a document</td>
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<tr>
<td>● Have a listed author - Author can be an individual or the name of the publication or organization</td>
<td>● Email exchanges</td>
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<tr>
<td>● Be specific to DEP land acquisition program facilitation of flood buyouts in the case community or the land acquisition program, more broadly</td>
<td>● Documents published prior to 2011</td>
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<tr>
<td>● Can include but is not limited to policy documents, program evaluations, MOUs between program stakeholders, reports about specific buyouts, funding agreements, public communications, online press articles, etc.</td>
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<tr>
<td>● Documents published in 2011 or later (after hurricane Irene which spurred the establishment of NYCFFBO)</td>
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In addition, we conducted semi-structured interviews with three groups of community members. The first group included community members who owned properties that were eligible for a buyout and had either participated in the program or been
approached about the program. The second participant group included community members with a decision-making or facilitation role in the buyout program. These included elected municipal leaders, town board members and individuals working for the institutions that had a management role in the buyout program. The third participant group included community members living near bought out properties but did not own flood-prone properties that qualified for a buyout.

In total, 17 members of the community were interviewed, relatively evenly across the three participant groups. We relied on a combination of snowball and strategic sampling for participant recruitment. These interviews lasted between 1 to 3 hours in length and occurred via video call, phone call, or in-person meeting, based on participant preference and needs. Interviews were audio recorded and then transcribed using Otter AI software (2022), and then manually checked for accuracy. Interview data was collected between November 2023 to February 2024.

Ethics statement

This research was approved by the institutional review boards at the University of Colorado Boulder (21-0497) and The Nature Conservancy. Written consent was obtained from all interview participants.

Data analysis

Interview transcripts and documents were coded using a thematic analysis process (39). The environmental justice framework outlined above (15–17) was used to deductively guide coding. The data was coded for the following themes:
(1) Distributional Equity: How are the cost and benefits of the program distributed across different actor groups?

(2) Procedural Equity: Whose perspectives and input are included in program processes and decision-making?

(3) Recognitional Equity: What outcomes does the program really prioritize? Whose experience does it prioritize?

(4) Structural Equity: What pre-existing equity issues influence the processes and outcomes of the program?

RESULTS:

Distributional Equity: How are the cost and benefits of the program distributed across different actor groups?

Conditions supporting distributional equity

When discussing impacts of the buyout program, interviewees and data from the document analysis described both beneficial and harmful impacts (see Figure 2). With respect to beneficial impacts, interviewees characterized the program as an effective strategy for reducing risk to flooding and in some cases, alleviating the financial distress experienced by property owners (either from flood damage or flood insurance costs). One participant reflected on the impacts of the flooding prior to the establishment of the buyout program.

“The flood buyout didn't come in time for those people and they lost their place and I still can see them sitting there crying with their head in their hands... they lost their family house and business”.

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Some participants used these examples to describe the buyout as the only option to get people who were financially struggling with the flood damage, out of the floodplain.

“… I just think that was it (the only option). That was the savior. It was a lifeline that was thrown to those people, because there was nothing else. What else could there be? I mean, what else had the money, finances behind it and the legal ability to do it? No, that was the… that was the only option for them. Either that or drown. Yeah, that was it…sink or swim”

Conditions reducing distributional equity

While participants positively reflected on the program’s ability to reduce flood risk in watershed communities, they also discussed more indirect impacts that they felt disproportionately negatively impacted their watershed community. These negative impacts fell into three primary categories: i) impacts to essential services, ii) impacts to housing affordability, and iii) impacts to community cohesion. While related, these three categories represent distinct ways that the buyout program has manifested at the community scale. Participants also expressed that the buyout has had uneven impacts across individual residents of the community, based on one’s tenure in the community and other factors such as age and income.

Impacts to essential services were primarily discussed as threats to healthcare services, emergency response services and food security. One of the properties that had received a buyout was a local healthcare clinic that had been significantly damaged by Hurricane Irene. Although there were significant efforts to relocate the clinic in the community but outside of the floodplain, regional scale development pressures and
healthcare industry trends that threaten rural healthcare access prevented the
relocation of the facility. This left residents both within and outside of the municipality
with extremely limited access to medical services. One interview participant noted:
“they're [larger medical companies] pushing out the most essential service to hundreds
of square miles here. I mean, it's really, it's a huge area with no doctor. It's really big.
Because we had people from X County, from X County, from X, we had people from far
away coming here”.

An emergency response station was also approved for the buyout but has
experienced extreme difficulty in securing the funds to rebuild updated infrastructure on
a nearby property outside of the floodplain. Until relocated, this leaves critical
emergency response services at extremely high risk of flooding, hindering capacity to
respond to emergencies in a storm or flood event.

The local grocery store also meets the qualifying criteria for the buyout, and while
there are seemingly no current plans for the buyout of this property, it highlights the
complexity of buyouts in communities with concentrated essential services in the
floodplain. Interviewees acknowledged that the loss of the grocery store would turn the
community into a food desert, expressing that this loss would be the “nail in the coffin”
for the community.

When asked about the impacts of the buyout program, participants also indirectly
discussed issues of housing affordability. As a ‘bedroom community’ of NYC struggling
with a surge in second home purchases, short term rentals and a post-Covid housing
market crisis, community leaders described the difficulty of supporting buyouts while
simultaneously addressing issues of housing affordability. Data from the document
analysis indicates that completed and slotted properties for buyouts have or will remove a handful of housing units (with the exact number dependent on ongoing negotiations) in the community. While participants noted the difficulty in quantifying the impact of these losses on the housing market, they highlighted the need for the buyout program to have a more explicit focus on potential impacts to housing. Due to the steep topography of the area and the significant amount of land dedicated to conservation for the purpose of water quality, participants described any buyout of a residential property as a multiplier of local challenges with housing affordability and availability. When referencing the plans and analyses required for a community to be eligible for buyouts, one interviewee referenced a lack of focus on housing:

“They were talking about properties and moving buildings, and reuse of land. I had to make them go back, and just change the language to address tenants and people. So there’s a natural inclination for people that do some of this analysis, especially engineering firms, to just look at it from a very technical moving pieces around kind of a thing. But again... what gets lost? The community. The people, you know? I couldn’t believe it. I’m like, you know, you didn’t include any housing!”

Furthermore, the buyout program negatively impacted community cohesion and culture in the study community. Several interview participants expressed concern about what would be left of the community in the future as a result of the buyouts. One individual wondered, “what does it do to a community when there’s nothing left?” and described their sadness at living through the “decay” of their community. These concerned residents suggested that the buyout program does not do enough to
acknowledge these losses and "make the community whole" again after buying out properties. They urged for a more holistic approach to community needs and an acknowledgement that the program isn’t just about property values and money, but that it’s also about the social fabric of the community. One of the residents whose family had lived in the community for multiple generations and had relocated out of the area after a buyout reflected that they have not been able to regain the sense of community in their new location.

It is important to note the intersecting impacts of losing essential services and losing community cohesion. This is particularly salient when considering a community the size of this study community, where the loss of a single business can have an outsized impact, compared to larger or more densely populated communities. Several participants described the local grocery store not only as an essential service, but also as a gathering place that contributes to the town’s sense of community. One individual mentioned that seeing neighbors at local businesses “kept everybody going” during the COVID-19 pandemic. Many of the commercial properties involved in the buyout program were described through this lens by participants, which highlights both the tangible economic benefit they bring to the community and the intangible benefits to community culture and cohesion.

Interviewees also highlighted that the program impacts in the community do not affect all residents equally. One interviewee noted that those residents located on the western side of town are more vulnerable to the potential loss of services, as they are significantly farther from other services. Residents without access to reliable transportation, such as low-income households or elderly residents are also especially
vulnerable to the loss of businesses and services. Another individual described the loss
of community culture, and transition of the community from a cohesive village to a
“highway with plazas,” as particularly detrimental to children and the school community,
as a regional school sits at the center of many of the buyouts. Further, the buyouts were
described as a “line in the sand” between newer and longer-term residents. One
participant noted, “I think it’s harder to let go of something that’s been in your family for
generations.” In general, longer-term residents were described as having deeper place
attachment and a more difficult time adjusting to the changes in the community.

INSERT FIGURE 2

Figure 2. Subthemes of distributional equity

Procedural Equity: Whose perspectives and input are included in program
processes and decision-making?

Conditions supporting procedural equity

Data from the document analysis and participant interviews create a picture of a
program that is both seemingly designed around prioritizing local community decision-
making and also inadequately takes into consideration the complexities of community
engagement and power. In terms of effective program design, notable components
include municipalities having the final say on both their participation as a community
and individual property agreements. Additionally, outreach to eligible property owners
about the potential of a buyout is conducted by municipal representatives, and the
communities are encouraged to take ownership of the property once structures have
been removed. Further, the program had recently discontinued using a monetary cost-benefits analysis as an eligibility criterion for properties, in an effort to acknowledge the difficulty in capturing the non-monetized benefits and costs of buyouts. All of these process components of the program were mentioned by participants as critical for supporting community level decision-making and authentic engagement in the program.

Conditions reducing procedural equity

However, interviewees also indicated that the program still had some significant challenges with respect to centering local community decision-making. One interviewee stated that opportunities to provide input felt superficial and intentionally limited, as though the decision-making process already had a “predetermined outcome.” They specifically cited limited community meeting agendas, which hindered constructive debate, and majority opinions ignoring dissenting voices at meetings. Some participants describe this as creating an environment which provided limited opportunity for individual voices to provide feedback and feel heard.

Additionally, participants reflected on how much decision-making power individual property owners actually had, given the lack of other affordable adaptation options available for a property owner who rejects a buyout offer. One individual noted that, when a homeowner rejects a buyout offer, there “doesn’t appear to be any good options” for that individual. There was a sense that residents who participate in the buyouts are lucky to receive the “opportunity” to get paid market value for their properties. Other interviewees noted that, after Hurricane Irene, an initial FEMA buyout process (prior to the establishment of the NYCFFBO program) left participants
exhausted and had negative emotional impacts equal to those of the hurricane itself. Overall, residents agreed that the buyout program was a better option for residents than a FEMA buyout or than doing nothing, but that it wasn’t ‘good’ option for residents. Participants also highlighted a need for a more holistic approach to buyout program planning and decision-making. The buyout program was implemented as a response to immediate needs, which inevitably led to a short-term planning approach. One individual noted that it would have been beneficial to “look at the program as a whole” further in advance, and develop more robust decision-making structures, rules and definitions. Another interviewee expressed that there is a need for the buyout program to be more aligned with community development planning and compared early property buyouts as equivalent to “running with scissors”. Specifically, participants cited a need for science, including climate change projections, and local knowledge to be more incorporated into buyout planning efforts. While participants struggled with the fast speed of the buyout planning process, they also lamented the lengthy buyout approval process. The continued risk of living in areas highly susceptible to flooding, as well as the need for the money the buyout will provide, prompted many participants to believe that the current process is too slow. One individual noted, “Money is at the top of [people’s] minds…if it can’t happen in the timeframe they need, and they can’t be given a fair price, they might try to sell it...” One reason cited for the length of the process is a gap in needed technical assistance. Since the program requires many organizational steps, there are currently limited resources and individuals with the capacity to support property owners through the many steps of the process. However, participants strongly underscored the importance of the local
people currently in facilitation roles and expressed gratitude to multiple buyout program
managers with long-standing connections and relationships in the area.

Recognitional Equity - What outcomes does the program really prioritize? Whose experience does it prioritize?

Recognition of watershed community needs versus New York City needs

The tension between buyout program priorities was apparent in the analyses of both public document and interview data. The most obvious tension is between the dual outcomes of the larger Land Acquisition Program to both improve water quality for the city of New York and safeguard the vitality and well-being of the rural communities in the watershed. While the program’s objective of reducing flood risk manifests by getting people and structures out of harm’s way, multiple interviewees described water quality as the ultimate priority of the program above any impact on rural community well-being.

In describing this fundamental challenge of the program, one participant stated:

“We need to try really hard to represent the people in the conversations happening at the higher level... I don’t know that everybody’s thinking about the actual people in this whole scenario. They’re seeing buildings and they are seeing water quality and they’re seeing things in their way”.

Such a perspective is supported by a lack of publicly available program evaluation metrics used to assess community impact. However, program facilitators indicated that the program is working towards including more community impact metrics as a recent assessment by the National Academies of Sciences, Engineering and Medicine (2020) highlighted the need for such indicators. Additionally, this shift is seemingly supported
by the recently dropped cost-benefit analysis eligibility criterion. Participants described this change as an important recognition of the hard-to-monetize costs and benefits associated with community resilience and well-being.

Recognition of differing needs within the community and across time

Tensions between quality of drinking water for NYC and watershed community’s well-being is not the only recognitional equity tension at play. Additionally, participants highlighted a tension between the well-being of a single property owner and the well-being of the community as a whole. When describing the difficulty in weighing multiple needs and scales, one interviewee explained:

“When you start to see and weigh the benefits of community assets versus personal loss and personal tragedy, that becomes a very difficult decision and a compelling decision... I mean, are you going to say to a property owner that has had a business in your town for 5, 10, 20 years, that you’re not going to let them leave and they’re going to have to stay there and suffer and they won’t be able to sell their property, you’re going to have to continue to pay flooding insurance they can’t afford? There’s been an eventual inevitable into that story. And it's... it's devastating”

Structural Equity: What pre-existing equity issues influence the processes and outcomes of the program?

History of eminent domain
Multiple interviewees brought up the history of eminent domain in the watershed and the injustices created by forced relocation of communities in the early 1900’s to build the reservoirs that make up the New York City drinking water system. Participants discussed how this injustice shapes the interactions between the local community and DEP: “What my ancestors and the communities went through... And then to have it happening in real time. It was just really weird... it felt like it was happening again”.

Another interviewee explained the current tension went beyond that of between rural communities and DEP but between members within the same community:

“I do think in some ways that the history of the reservoir has exacerbated the tension between people who are from here and people who come here, because they think that there are really good reasons for that tension. People were displaced when that reservoir was built, and the reason that reservoir was built, everyone knows, it’s because New York City folks needed water...”

However, participants also discussed the lack of recognition of this history. Our document analysis supports this perspective none of the publicly available documents explaining the buyout program explicitly recognizing the historical use of eminent domain and the resulting tensions.

Present day resource disparities between rural municipality and NYC

Simultaneously, interviewees discussed the more recent history of litigation between NYC and watershed communities, specifically referencing the significant power differentials – both in terms of their financial resources available and the role NYC plays as a significant landowner in this case study community. Interviews identified NYC’s
seemingly endless ability to engage in litigation and local communities’ limited ability to hold the DEP accountable for the buyout program:

“You know, the city is king here, whether we like it or not, and we, in my town have reaped the benefits of that, which is that our taxes are lower and we have the incredible reservoir in our area. The base side, is that they’ve take a lot of land that didn’t belong to them and now people’s homes are flooded, but you know, that happened 100 years ago... and [Community name] benefited from the city, in many ways... someday we would have to pay the piper so the buyouts seemed pretty much in tune with that.”

Pre-existing challenges facing rural communities

In addition to historical and present-day issues surrounding land ownership, pre-existing equity concerns specific to rural communities have the potential to significantly influence the buyout program. As mentioned above, these challenges include equitable access to essential services, and potential impacts on available housing. The pattern in how/if these properties have taken a buyout, and whether they will be relocated, is mixed and property-specific. However, the potential impact of such buyouts is deeply influenced by insecurities around food and healthcare that plague rural communities across the country. Participants explained that these pre-existing issues make each property buyout that much more contentious.

Discussion:
These results paint a picture of a community’s complex experience with a climate adaptation strategy. While the benefits of the buyout program far outweigh the costs for NYC, a comparison of costs versus benefits for the study community is less clear (distributional equity). While the program removes people from harm’s way and out from underneath the financial strain of living in a floodplain, more indirect costs such as loss of essential services, housing units and community cohesion complicate any cost-benefit analysis. With respect to program decision-making (procedural equity), some process components center local decision-making power, and other process components limit the agency of community members. To complicate matters, the program must contend with competing goals (recognitional equity) and is seemingly designed to prioritize water quality over community well-being, short term over long term outcomes, and individual property rights over community wide resilience. All of this is occurring with an undercurrent of historical use of eminent domain, significant power differentials between NYC and rural local governments, and pervasive economic and social challenges already facing rural communities in the region (structural equity).

These findings highlight the multitude of ways equity and adaptation can interact to produce how a community experiences a buyout program. The manifestations of this interaction provide applied examples that can be leveraged to reach equitable adaptation outcomes rather than exacerbate inequities. Notably, we think this data underscores a combination of theoretical and applied implications, further discussed below: i) the importance of diversity of ways that individual equity pathways can interact with one another, ii) the power of procedural equity and its relationship with agency, and
iii) the need for future research that investigates the efficacy of using equity frameworks
to proactively design equitable adaptation.

Interactions between equity pathways

A significant amount of research applies adapted versions of Schlosberg’s
environmental justice framework. However, much of this work focuses on distributional
and procedural equity pathways. The literature that does expand to structural and
recognitional equity pathways often discusses them in isolation from one another
(Walker et al., in press). Notably, our results explicitly highlight the interactions between
equity pathways and provide concrete examples that prove powerful in supporting a
clearer conceptual understanding of such interactions in a climate adaptation context.

For example, the data suggest a clear link between structural and distributional
equity. Systemic rural inequities such as access to housing, healthcare and food
security (structural) interact with the buyout program to make the loss of properties that
house these essential services incredibly salient, particularly with community members
already struggling with these issues (distributional). In this example, the structural
inequities make the buyout program a ‘threat multiplier’, exacerbating the distributional
impacts. While the loss of a handful of residential properties or a healthcare clinic might
not be a significant impact on its own, when it occurs in a community already struggling
with essential service access, these buyout impacts are amplified. This is especially the
case for low-income community members who already experience these challenges
more significantly.
The data further highlight a relationship between structural and procedural equity. The use of eminent domain in the early 1900’s to construct one of the reservoirs for the New York City drinking watershed resulted in the removal of the ancestors of present-day community members from their land and livelihoods. Participants discussed the forceful removal and lack of compensation given to property owners as the building blocks for the mistrust community residents have with NYC DEP. All three groups of participants talked about this mistrust as a barrier dissuading community members from engaging in planning and community engagement opportunities around the buyouts. This structural and historical inequity means that even if opportunities for meaningful engagement are provided (procedural), they will struggle to achieve authentic engagement, because the often unacknowledged and contentious history between DEP and the community dissuade community members from engaging.

Data from both the interviews and document analysis also point to the influence that the recognitional equity pathway has on both distributional and procedural pathways. As mentioned in the results section, recognitional inequities result from a tension in program priorities: NYC water quality versus community well-being, private property owners versus the broader community and short term versus long term outcomes. Arguably, the program strongly prioritizes one side of each of these tensions: water quality, private property and short-term outcomes. This is unsurprising, as the program is nested within a larger societal system that also tends to prioritize these more tangible and measurable priorities. However, these choices mean that program impacts disproportionately benefit the residents of New York City and property owners within the community (distributional). They also shape the effectiveness of efforts to authentically
prioritize local decision-making power (procedural). Attempts to engage community

members in planning and feedback have muted impact when residents feel like the

program is stacked against their interests. Figure 3 illustrates these connections in

addition to the procedural-distributional interaction discussed in previous literature.

INSERT FIGURE 3

Figure 3. High-level interactions between equity pathways

Acknowledging these interactions is a critical step towards moving conversations

about equity and adaptation from vague, conceptual and overly simplistic mental

models to more concrete and nuanced understandings. Equity pathway interactions can

help us understand why and how adaptation strategies can result in equitable versus

inequitable outcomes.

Salience of procedural equity – a pathway to agency and adaptive capacity?

Interviewees from all three participant groups discussed the importance of procedural

equity in multiple ways: 1) in the lengths the program design goes to prioritize local

decision-making power, 2) in the lack of comprehensive planning and 3) the lengthy

timing of the program. One of the most striking references to procedural equity was the

discussion of meaningful choices or agency. Scholarship in the climate adaptation

spaces frequently talks about agency, or the ability to make choices and ensure those

choices have meaningful impact on one’s life (40) as an important component of

adaptive capacity (41). The buyout program is voluntary, and the local officials make the

final say on eligible properties – this sounds like decision-making power. But when a
resident or community’s options include ‘bad option 1’ or ‘bad option 2,’ it begs the
question of whether this reflects real agency and if the decision feels like an actual
choice. And, if not, is an artificial choice equitable? While the long-term implications of
buyouts on property owners and community well-being is a critical gap in the literature,
the results of this study encourage us to think about the power that authentic procedural
equity might play in supporting these long-term outcomes. Further, the concept of
agency calls us to move beyond a superficial understanding of procedural equity. We
cannot just ask, ‘who’s included in decision-making processes?’ but also, ‘do these
processes include meaningful choices?’ Such a holistic notion of agency provides a
useful indicator for equitable adaptation.

**Recommendations for equitable buyouts and climate adaptation**

These insights point to meaningful and actionable steps that adaptation practitioners
and municipal leaders can take to make their buyout programs more equitable. First,
investing more resources into comprehensive planning would better address the
complex, systems-level relationships that buyout programs have with the equity
pathways, as well the larger social-ecological system in which they are embedded.
These planning efforts should consider not only how the buyout program influences
flood resilience, but also how it influences broader resilience and equity challenges
related to accessing essential services. For example, comprehensive planning, led by
empowered and trusted community members, might enable a community to identify
which structural inequities (e.g., rural challenges with healthcare) would be exacerbated
by the impacts of a buyout program for certain residents (e.g., loss of a clinic on older
residents or residents with transportation challenges). Increased financial and human resources dedicated to planning would allow for the time and information needed to consider how the buyout program could proactively address these distributional impacts. Such a planning process would allow for the time and information needed to proactively think through complex equity implications, consider the interactions between different equity pathways and avoid unintended consequences.

Second, the findings underscore the importance of local people who are trusted and have the technical expertise on how the program works. This is an important strength of the buyout under study, and these individuals serve as important information brokers and critical linkages to acknowledging and addressing structural inequities (such as the history of eminent domain) and providing local knowledge to program facilitators. By investing in relationship building and program facilitators who are trusted in the community, programs can achieve equity via multiple pathways.

Our third recommendation is to include the impacts to community resilience to economic and social shocks more broadly within the ‘cost’ of the program. Secondary impacts of the program on health outcomes, sense of community, food security or housing affordability are natural results of the complex system buyouts occur within. But it is only by tracking these impacts, and explicitly considering them a ‘cost of the program’ rather than an externality, that we can begin to leverage the resources needed to mitigate them and reduce potential inequities.

Relatedly, more holistic program evaluation would help better prioritize equitable outcomes. Such efforts should seek to measure impacts to flood resilience, overall
resilience and process engagement. Distributional and procedural equity provide framing for these indicators, while structural and recognitional pathways provide an understanding of why and how these indicators occur. If equity is both a means and an end for adaptation, these data-driven recommendations point to potential leverage points for designing buyout programs.

Limitations and future directions

While we believe our research yields powerful lessons for both the theory and practice of equitable adaptation, we do not want to overstate the generalizability of our case study. The place-based nature of this research is both one of its biggest strengths and limitations. It has allowed us to collect data that richly describe a rural community’s experience with a buyout program and analyze how equity shapes that experience. The patterns in this data have the potential to function as ‘signposts’ for future equity analyses and give concrete examples of how equity pathways manifest in applied adaptation contexts. However, this also means that the applicability of our findings to other buyouts programs, other communities and broader adaptation work should be critically considered. Additionally, there is a potential for sampling bias in our interviewing process. Significant resources were spent to ensure we reached out to every single participant of the buyout program in our study community, as well as neighbouring community members. Further, our research collaborators had existing relationships within the community, and we relied on local leadership to ensure our work was relevant and took into consideration local context. However, the primary researcher was an ‘outsider’ to the community, and the time availability of participants and their
relationships with our collaborators may have influenced whether people were willing to engage with the study.

Despite these limitations, the findings and associated implications of this work point towards some important next steps for the research community. First, this work begins to fill a gap in the literature that investigates the equity implications of climate adaptation in rich detail and at a local scale, specifically in the context of a rural community where economic inequity is a salient characteristic. While macro-level studies looking at broader patterns in buyouts have focused on racial equity, more local-level studies are needed to thoroughly understand the unique experiences of communities of color and how equity pathways materialize. Secondly, this study uses the equity pathways as a conceptual tool for understanding the impacts of a buyout program after the buyouts have occurred. Our team thinks this conceptual tool may also be useful in helping adaptation practitioners proactively think through the equity implications of their adaptation work, and as a result, design more equitable adaptation programs. However, minimal work has been conducted to confirm this hypothesis, and research that robustly evaluates the use of equity analysis tools and associated training would make an important contribution to equitable adaptation.

CONCLUSION

Nature-based solutions can serve as effective strategies to promote the resilience of both people and ecosystems in the face of climate change. However, it is important to incorporate social equity considerations into the design, implementation, and evaluation of these strategies to avoid maladaptation or exacerbating the marginalization of
vulnerable groups. While much of the scholarship investigating social equity and climate change adaptation is conceptual and abstract in nature, this research provides an opportunity to consider the ‘on the ground’ implications of a flood buyout program on social equity within a case study community. Further, this work applies an equity analysis using a four pathways framework grounded in the justice and equity literature. Our findings point to the nuanced and varied ways in which different equity pathways interact to produce a community’s experience with adaptation and underscores the importance the concept agency plays in our understanding of procedural equity. Our analysis points to specific recommendations to improve the equity of the buyout program we examined, but also leverage points that can be applied to increase the equity of NbS strategies more broadly.
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Previous scholarship highlights the influence that ‘who is at the decision-making table’ has on how costs and benefits are distributed.

**Distributional**
- The distribution of costs, risks, and benefits
  - The design and model of the program prioritize certain outcomes, which determines how the costs and benefits are distributed

**Procedural**
- The meaningful inclusion of affected groups in decision-making
  - Pre-existing inequities create barriers to participating in decision-making opportunities
  - The recognition of institutions and systems that shape people’s ability to participate in decision-making

**Recognitional**
- The prioritization of the well-being, knowledge, and perspectives of affected groups
  - Preexisting inequities in exacerbated the impacts of the distribution of costs and benefits

**Structural**
- When programs fail to prioritize the needs of people, they are discouraged from engaging in decision-making opportunities
**Figure 2**

**Distributional ‘Costs’ of Buyout program**
- **Impacts on essential services**: Properties that have either been bought out or qualify for buyout reduce access to healthcare services, food security and emergency response services.
- **Impacts on housing affordability**: Community struggling with lack of affordable housing and residential properties have been a part of the buyout program.
- **Impacts on community cohesion**: Concern that loss of business and residents damage ‘social fabric’ of the community.

**Distributional ‘Benefits’ of Buyout program**
- **Reducing flood risk**: Fewer business and residents are located in the most flood-risk area of the community.
- **Alleviating financial distress**: Buyout provided a ‘way out’ for residents struggling with flood damage and flood insurance costs.
**Figure 1**

**Distributional**
- The distribution of costs, risks, and benefits

**Procedural**
- The meaningful inclusion of affected groups in decision-making

**Recognitioninal**
- The prioritization of the well-being, knowledge, and perspectives of affected groups

**Structural**
- The recognition of institutions and systems that shape people's ability to participate in decision-making