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A Review of Funding Mechanisms for US Floodplain Buyouts

Kelsey Peterson [1], Emily Apadula [1], David Salvesen [1], Miyuki Hino [2], Rebecca Kihslinger [3] and Todd K. BenDor [1,2,*]

1   Institute for the Environment, University of North Carolina at Chapel Hill, Campus Box #3140, Chapel Hill, NC 27599, USA; kels9090@live.unc.edu (K.P.); emilyapa@live.unc.edu (E.A.); dsalv@email.unc.edu (D.S.)
2   Department of City and Regional Planning, University of North Carolina at Chapel Hill, Campus Box #3140, Chapel Hill, NC 27599, USA; mhino@email.unc.edu
3   The Environmental Law Institute, 1730 M St. NW #700, Washington, DC 20036, USA; kihslinger@eli.org
*   Correspondence: bendor@unc.edu; Tel.: +1-919962-4760

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Abstract: Increases in extreme weather events have caused extensive flooding across the United States. In response, federal, state, and local governments have broadened their flood mitigation strategies to include acquisition and demolition of flood-damaged homes ("buyouts"). Little work has documented or analyzed the range of strategies for funding buyouts. Federal programs provide the bulk of funding, but these programs are often slow. Also, state and local governments struggle to meet cost-match requirements. We present and analyze a nationwide census of buyout funding programs (n = 34), which draw on five primary funding mechanisms. We find that state and local governments are using a range of traditional and innovative financial mechanisms, including municipal/green bonds, revolving loan funds, local option sales taxes, and stormwater utility fees, as viable tools for funding buyouts. These tools may promote more autonomy from federal government mitigation programs, and ultimately, faster buyout processes.

Keywords: floodplain buyouts; environmental finance; hazard mitigation; climate adaptation; floodplain management; municipal finance

1. Introduction

Over the last 30 years, government-led acquisition and removal of flood-prone residential properties (known as "floodplain buyouts") has become a popular method for reducing future flood damages in the United States [1]. The attraction of buyouts is that they can permanently remove vulnerable homes from flood hazard areas. Buyouts most frequently occur in areas with well-funded local governments that have city planners and resilience officers, as well as the capacity to fund administrative fees [2].

The magnitude of buyout use is frequently limited by the availability of funds [3]. The two main sources of funding for buyouts are federal grant programs administered by the Federal Emergency Management Agency (FEMA) and the US Department of Housing and Urban Development (HUD). However, buyouts funded through these grant programs can take over five years to complete, and funding is only available after a major disaster occurs; most buyouts are reactive rather than proactive [4]. This long time lag, which extends from the flood event that triggered the buyout process to the buyout's completion, can create severe hardships for many homeowners and municipalities [5].

This timing issue with federal programs is exacerbated by acute, post-disaster demand for additional buyout funding, beyond what is federally available [6,7], and beyond expected future buyout demand growth, due to increases in climate-driven hazards [8]. Given the shortcomings of

the federal grant programs, some local and state governments have begun funding their own buyout programs, drawing on a variety of both established and innovative funding mechanisms. However, little work has comparatively documented the frequency and geography of these programs, the range of funding mechanisms used, or the number of buyouts they implement [3,9]. How are local and state governments funding buyouts? How do their programs interact with available federal funding?

In this paper, we conduct a census (or as close to one as feasible) of buyout funding programs in the United States, documenting the extent of their use and creating a typology of funding mechanisms. We review scholarly literature, news articles, and government documents to describe buyout programs and the unique local, state, and federal funding tools used to implement them. Our findings suggest that state and local governments have access to a variety of financial mechanisms, including municipal bonds, revolving loan funds, local option sales taxes, and stormwater utility fees, which offer pathways for funding buyouts or for meeting the cost-share requirements of federal grant programs.

Understanding the structure and implementation of different financing mechanisms will help state and local governments in multiple ways. First, unlike most federal grants for buyouts, state and local governments can be proactive, acquiring properties before the next disaster occurs. Second, alternative funding mechanisms for the cost-share requirement of federal grants can allow state and local governments to maximize the amount of funding available for acquiring properties and therefore assist as many homeowners as possible.

2. Background

2.1. Federal Buyout Processes

Recent work by Weber and Moore (2019) [4] documents common, federally-led floodplain buyout processes, whereby state and local governments coordinate with federal agencies—usually either FEMA or HUD—to purchase flood-damaged homes from willing sellers, who receive pre-flood, fair market value for their properties. The majority of buyout funding in the United States is provided through FEMA's Hazard Mitigation Assistance program (HMA), which provides funding for mitigation planning and projects that reduce disaster losses and protect life and property from future disaster damage [10]. The HMA consists of three main programs, (Table 1), including the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Grant Program (PDM; which is being replaced by the Building Resilient Infrastructure and Communities (BRIC) program; [11]), and the Flood Mitigation Assistance Grant Program (FMA; [12]). Under these programs, FEMA has funded over 40,000 buyouts across the United States since the 1980s [2]. It is worth noting that while FEMA-funded buyout programs require participating properties to be located in the 100-year floodplain (the "Special Flood Hazard Area" with a 1% annual risk of flooding; [13]), many non-FEMA programs do not, making the term "floodplain" buyout sometimes a bit of a misnomer.

Table 1. Common federal buyout funding mechanisms. "Eligible applicants" identify the organizations able to directly receive funding. Funding is indicated for entire program, not just for buyout purposes. "N/D" = data not readily available, and "NGOs" = non-governmental organizations. PDD = Presidentially Declared Disaster.

Federal Agency	Program Name	Date Program Founded	Eligible Applicants	PDD Requirement	Recent Funding	Cumulative Funding	Funding Source	Cost Sharing	Buyouts
FEMA	Hazard Mitigation Grant Program (HMGP)	1989	Local, state, territorial, and tribal governments	Yes	N/D	$13.8 billion (as of Feb. 2017)	Post-disaster appropriation	Non-FEMA: 25%	>37,000
FEMA	Flood Mitigation Assistance (FMA) Grant Program	1994	Local, state, territorial, and tribal governments	No	$210 million (2019)	N/D	Annual appropriation	Non-FEMA: 25%	N/D
FEMA	Pre-Disaster Mitigation (PDM) Program	1998–2020	Local, state, territorial, and tribal governments	No	$250 million (2019)	N/D	Annual appropriation	Non-FEMA: 25%	N/D
FEMA	Building Resilient Infrastructure and Communities (BRIC)	2020	Local, state, territorial, and tribal governments	No	$500 million (2020)	N/D	Annual appropriations	Non-FEMA: 25%	N/D
HUD	Community Development Block Grant-Disaster Recovery (CDBG-DR)	1974	State governments, NGOs, economic development agencies, citizens, and businesses	Yes	N/D	$89 billion	Annual appropriation	None; often used to match other federal funds.	N/D

Funding from HMA programs may be used for property acquisition and structure demolition or relocation, among other types of mitigation activities [10]. HMA programs typically require a 25% cost match from eligible applicants including state, local, tribal or territorial governments where buyouts are to occur. Individual home and business owners are unable to directly apply for HMA funds and must instead have an eligible applicant, such as a state, local, or tribal government, apply on their behalf [10].

The largest and longest running of the HMA programs, the Hazard Mitigation Grant Program (HMGP), is used to assist in creating long-term hazard mitigation planning and projects, including buyouts. Studies of the HMGP have shown that for every $1 spent, $4 of future damages are avoided or mitigated [14]. The HMGP is also the only program under HMA that requires a Presidential major disaster declaration for funding to be made available; FMA and PDM funding depend instead on annual appropriations made by Congress [12]. The FMA grant program is designed to reduce long-term risk of flood damage to structures. Grants under this program are limited to properties insured under FEMA's National Flood Insurance Program (NFIP; [15]).

Finally, the PDM program's goal has been to reduce the risk posed by future natural disasters to people and structures, while also reducing the demand for federal funding in future disasters. The BRIC program pulls an estimated $300–500 million per year from FEMA's Disaster Relief Fund (instead of using PDM's yearly congressional appropriations, which were more unpredictable; [16]). While BRIC program activities are intended to remain similar to those under PDM, BRIC places a greater emphasis on improving local building codes and incorporating nature-based solutions, as well as training and technical assistance to local governments [16]. Grants may also be used for mitigation planning and projects, including buyouts. Mitigation planning is viewed by FEMA as a key policy tool step for ending the cycle of disaster damage, reconstruction, and repeated damage [17].

Another major federal source of funding for buyouts is provided by HUD's Community Development Block Grant-Disaster Relief (CDBG-DR) appropriation. Like the HMGP, CDBG-DR funding requires a Presidential Declaration of a Disaster in a specific area before funds become available [14,18]. Congress may decide to distribute funds to HUD when there are significant unmet needs from other funding sources (e.g., HMGP) for long-term recovery, especially in low-income areas [19]. CDBG-DR funds a wide range of projects, as long as they meet at least one of three national objectives [18,20]: (1) benefit low- and moderate-income persons, (2) help prevent or eliminate slums or blight, and (3) address urgent risks that pose a serious and immediate threat to the health and wealth of the community where other financial resources are unavailable.

Neither individuals nor communities can apply directly for funds. Instead, HUD will notify eligible states, cities, and counties if they are able to receive CDBG-DR funds. These funds cannot duplicate funding made available from other sources, but may be used to match federal resources and may be used in combination with other grants. CDBG-DR funding has often been used to fund buyouts directly or to meet the 25% match required by HMA funding [19].

2.2. Impetus for Non-Federal Funding Mechanisms

While these federal programs provide most of the funding for floodplain buyouts [20], they have also been criticized as being time-consuming, lacking transparency, and not providing sufficient funding to acquire the total number of qualifying properties [4]. For example, the HMGP requirement of a Presidential disaster declaration makes it difficult for local governments to be proactive in acquiring at-risk and repetitive flooded structures prior to floods. This frames floodplain buyouts instead as a reactive tool for mitigating future risk to property and residents.

Weber and Moore (2019) [4] reviewed 30 years of buyouts funded through FEMA, finding a median completion time of approximately five years. This lengthy timeline leaves local governments and residents in limbo during that period. The buyout process can be fraught with uncertainty about application approval and timing. As a result, homeowners often face a difficult decision: wait for possible buyout funding to arrive, rebuild their flood-damaged home, or sell to real estate speculators at a loss [4,21].

Limited evidence suggests that local and state governments with their own funding sources can complete buyouts faster than through federal programs, without waiting for a Presidential declaration [4]. An example of this can be seen in the City of Charlotte, North Carolina, where the City created a "Quick Buy" program that purchases properties using funding generated from its stormwater utility fee. Through this program, buyouts can be completed within ~6 months after a flood event, a significant decrease from the timeframe often seen in federal programs [4,22]. Local programs also provide the flexibility to acquire homes in advance, rather than waiting until after a disaster occurs. Local governments may also be able to be more strategic in how they invest acquisition resources. For example, they may prioritize buyouts in areas where public amenities, such as a park or community garden, are in short supply. In addition, if local governments are paying to acquire flood-damaged homes, they may be more inclined to see the connection between local approval of building in flood hazard areas and the creation of a future liability.

3. Materials and Methods

In order to understand the range of techniques that local and state governments (and even non-traditional federal programs) use for funding buyouts, we conducted a census of all programs (at least all those programs that could reasonably be identified through public data sources) that currently fund buyouts in the United States. We sought to document each unique form of funding mechanism (e.g., environmental bonds; stormwater utility fees). We differentiated each of these mechanisms by documenting how they function and the scale of their use (i.e., the number of programs using the mechanism). To do this, we drew on a two-phase process for identifying different mechanisms used to fund buyouts.

We began by reviewing previous efforts to document buyout funding strategies, including work by the Environmental Law Institute [3], which documented a number of novel financing mechanisms, as well as the Natural Resource Defense Council's "Blueprint of a Buyout" article series, which identified buyout projects and their financing mechanisms around the country [22].

Next, we used the Google, Google Scholar, and ProQuest search engines to comb through news articles, blogs, expenditure and other government reports, government announcements, and state and local stormwater management outlets to identify relevant information on buyout projects and programs. Using these engines, we searched by key phrases, including "floodplain buyout," "floodplain acquisition," and "hazard mitigation plan." When we found information about a geographically-specific buyout program, we added that geography or jurisdiction into the search terms for further searches.

Within these news sources and reports were references to buyout plans or mitigation plans (that included buyouts). Within available buyout and mitigation plans was the contact information of professionals involved in buyout or planning processes. We identified missing information not provided in publicly accessible documentation of buyout processes, and contacted these professionals, obtaining information on the progress and status of the programs, scale of their use, adoption date, and current funding status (when available).

Together, these two phases of our search allowed us to identify all (or as many as possible) buyout funding programs at the local and state levels in the United States, as well as to understand the range of funding mechanisms used and whether or not (and how) they interface with federal funding programs.

4. Results

We identified 34 separate buyout funding programs, including the five federal programs shown in Table 1, which employ five types of financial mechanisms. As shown in Figure 1, these programs span across 17 municipalities in 17 US states.
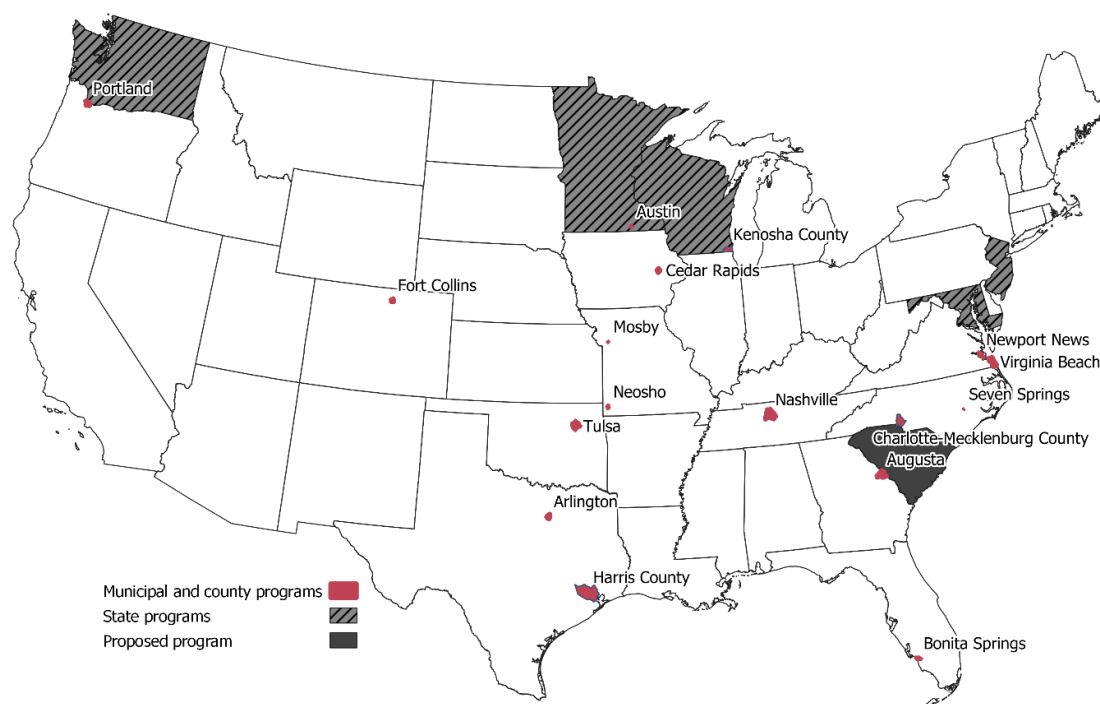
Figure 1. Map of state and local buyout funding programs in the United States. Municipal and county programs are labeled.

On the federal level, we identified a total of nine buyout funding programs, including the HMA and HUD programs discussed earlier (Table 1), as well as one lesser-used program, two now-repealed programs, and one proposed program (Table 2). At the state level, we found six programs using three different financing mechanisms, including grants, revolving loan funds, bonds, and—to some extent—tax credits and incentives. At the local level, we found 19 programs in 17 municipalities using four financing mechanisms, including stormwater utility fees, local option sales taxes, and municipal bonds. Among these state and local funding programs, 88 percent (22 of 25 programs) were aimed (at least in part) at creating a source of local or state funding that could be used as a federal cost-match or otherwise combined with federal funding sources in order to maximize the number of homes acquired.

4.1. Federal Funding Mechanisms for Floodplain Buyouts

We begin by summarizing each of the funding mechanisms we identified in our search, starting with the lesser-used federal programs. The USDA's Natural Resource Conservation Service's (NRCS) Emergency Watershed Protection Program-Floodplain Easement (EWP-FPE) program is designed to restore land to its natural condition [23], placing easements on enrolled areas to prevent future damage. Land eligible for these permanent easements include parcels that have been damaged by flooding at least once during the previous calendar year (or twice or more during the previous ten years), that contribute to the restoration of flood water storage and flow, that offer erosion control, that improve the management of floodplain easements, or that would be adversely impacted as a result of a dam breach [23].

Table 2. Non-traditional, expired, and proposed federal mechanisms for funding floodplain buyouts. Funding is indicated for an entire program, not just for buyout purposes. N/A = "not applicable.".

Federal Agency/Division	Program Title	Year Started	Eligible Applicants	Funding Information	Cost Sharing	Total Buyouts	Source
USDA Natural Resources Conservation Services (NRCS)	Emergency Watershed Protection Program-Floodplain Easement (EWP-FPE)	1996	Cities, towns, counties, conservation districts, or any federally-recognized Native American tribe or tribal organization	$217.5 M (in 2019)	May cover up to 100% cost of the easement, structural value or relocation, and restoration	1608 easements or 185,137 acres or enrolled permanent easements (through the end of 2017)	[23,24]
FEMA National Flood Insurance Program (NFIP)	Repetitive Flood Claims Grant Program (RFC)	2004–2012	Structures insured under the NFIP that have had one or more claim payments for flood damages.	Up to $10 M annually (2008)	All grants are eligible for up to 100% cost assistance	123 properties (2008–2012)	[25,26]
FEMA	Severe Repetitive Loss Program (SRL)	2004–2012	Individuals with ≥4 NFIP claims, payments over $5000 each, and cumulative amount of such payments exceeds $20,000 or two separate claim payments with cumulative amount exceeding market value of building		100% grant funded up to $150,000	586 properties (2008–2012)	[27,28]
FEMA Revolving Loan Fund	Resilience Revolving Loan Fund Act of 2019	Proposed in 2019	State and federally-recognized tribal governments	$200 M (2020–2021)	Up to $100 M low interest loan	N/A	[29,30]

Some of the restoration efforts under this program have included projects to restore storage of floodwaters, control erosion, improve management of easements, and implement easements in agricultural or residential areas. The latter of these strategies can result in floodplain buyouts, whereby the NRCS pays 100% of the pre-flood, fair market value for a structure and or property while also paying for the land restoration [23]. In the buyout context, residents volunteering for the program may choose to either demolish or relocate residential structures. Unlike other federal programs, landowners who participate in the EWP-FPE retain their ownership of the land. Landowners are required to provide a permanent conservation easement for the property that prohibits the building of new structures, but they retain the right to quiet enjoyment of the land and to control public access [23].

In the wake of Hurricane Sandy, the National Resource Conservation Service made $124.8 million available in the EWP-FPE to five affected states. For example, the City of West Haven, Connecticut, received approximately $7 million through this program, using some of the funds to purchase 13 homes and restore 34 acres of open space on the easement acquired [31]. More recently, West Haven had additional plans to use a second round of funding to purchase 19 more repetitively flood damaged homes [23,31].

The other federal programs we identified include two repealed programs and one proposed program, both of which reflect mechanisms that we now see at the state and local levels. The former, the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) grant programs, were created in 2004 to reduce long-term risk to NFIP-insured structures that had filed at least one flood damage claim along with other criteria [25,32]. Although both of these programs were eliminated by the Biggert Waters Flood Insurance Reform Act of 2012 [33], during their operation, funds were used to flood-proof non-residential structures, as well as elevate, acquire and demolish, or relocate residential structures, converting the underlying property to open space [32]. This funding was also used in cases where local governments could otherwise not meet the FMA cost-match requirements or did not have the capacity to manage buyout activities [32].

The latter federal program, which has not yet been approved, is the proposed Resilience Revolving Loan Fund Act of 2019, which has drawn support from a coalition of 80 mayors in eight states along the Mississippi River, after extensive flooding in 2019 [29,30]. If approved, the Act would appropriate $214 million to FEMA, which would distribute funding to individual states through an application process. States would then administer loans to local governments for resilient infrastructure, including floodplain buyouts for severely damaged structures and those suffering repetitive losses. By devolving implementation of loan funds to states, this program could decrease federal involvement, the complexity of the buyout process, and the time taken to complete buyouts [29].

As we will discuss more in the next section, revolving loan funds are a common tool for federal, state, and local governments to fund long term risk mitigation and meet climate adaptation goals. The initial funding or "capitalization" for this type of loan program normally originates in the form of a grant issued by a federal (in the case of the proposed federal legislation) or state agency [34]. The interest and principal payments from older loans are then used to fund new loans, a strategy called "gap funding." The low interest nature of these loans can facilitate repayment from state and city governments using savings generated by mitigation projects [26,35].

4.2. State Buyout Funding Programs

Our review revealed six state-level programs using three mechanisms, including grants, revolving loan funds, and bonds (which we discuss in the next section on local funding programs).

4.2.1. Grant Programs

Grant Programs have been used by several state governments to help fund buyout projects. Funding may be granted on an annual or biannual basis to municipalities within a given state and commonly requires some form of cost share with the local government.

An example of a state grant program is Minnesota's Flood Damage Reduction (FDR) Grant Assistance Program, which was created in 1987 to provide both technical and financial assistance

to local governments [36]. Grants under the FDR program require a 50/50 cost share between the Minnesota Department of Natural Resources and a local government (or federal grant) and typically fund buyouts (acquisition and demolition), relocations, and construction of floodwalls, levees, and other flood mitigation measures.

Under the FDR program, any local government (including conservation and watershed districts) in Minnesota may apply for small or large grants. Small grants (<$300,000) are appropriated by the Minnesota Department of Natural Resources from general funds allocated by the legislature, while large grant (>$300,000) applications must be approved by the Governor and Legislature for consideration in a capital bonding bill.

Similarly, the Wisconsin Municipal Flood Control (WMFC) program offers grants to cities, villages, towns, tribes, and metropolitan sewage districts for a variety of flood mitigation projects. Funds are distributed every other year through Wisconsin general obligation bond revenue and require a 50% cost match from local governments [37]. Projects include buyouts, as well as efforts to flood-proof homes, restore bodies of water, acquire vacant land, create flood control detention ponds, and develop flood maps. The extent of projects is limited by regulations that no single project may receive a grant equal to more than 20% of available funds.

The Wisconsin Municipal Flood Control grant program funding can also be used as a match for HMGP and CDBG funding. In 1994, the City of Kenosha created the Fox River Flood Mitigation Program to respond to flood damages along the Fox River in April 1993 [38,39]. Unlike locally funded programs (described in the next section), the Kenosha program drew entirely on WMFC grant funding, alongside HMGP and CDBG grants, to purchase 103 homes on 165 parcels along the Fox River out of a list of 178 "high risk flood locations" [38–40]. While the Fox River Flood Mitigation Program technically still exists, funding from the WMFC program has dwindled, and 20 homes in high risk flood locations remain on a buyout waiting list [39,40].

4.2.2. Revolving Loan Funds

Similar to the federally proposed 2019 Resilience Revolving Loan Fund Act, in 2018, the state of South Carolina proposed the "SC Resilient Revolving Loan Fund" (SC SB S.259, 2019–2020) in the aftermath of the unprecedented amount of flooding in the state during Hurricane Florence [41]. The bill was a reaction to the struggles experienced by many coastal counties in providing cost-matching funds for HMGP funding, with much of the financial burden falling on local governments and homeowners. For example, homeowners in Conway, SC were required to pay 25% of the demolition costs during a buyout and only offered 75% of the pre-disaster, fair market value of their homes [42].

The proposed revolving loan program would provide funding for the 25% cost share match that local governments are required to pay when receiving HMA grants from FEMA. By providing the cost share match, this program would relieve the financial barriers to buyout programs for local governments and homeowners, incentivizing participation and expanding the scope of the buyout program. Under the proposed legislation, the state would seek to capitalize the fund with $2 million, aiming to secure an additional $25 million in CDBG funds in the future [41] (SC SB. 259, 2019–2020).

4.3. Local Buyout Funding Programs

We discovered a somewhat different set of buyout funding mechanisms at the local level. These included 19 programs in 17 municipalities covering four different funding mechanisms, including grant programs, stormwater utility fees, local-option sales taxes, and municipal and green bonds. Local financing mechanisms were used in jurisdictions of all sizes, ranging from the City of Bonita Springs, Florida (pop. 50,000), which relies on a stormwater utility fee to fund buyouts, to Harris County, Texas (pop. ~4.7 million; encompassing the City of Houston), which recently implemented a large-scale green municipal bond program after Hurricane Harvey.

Likewise, programs are located in communities with a wide range of economic situations, including the Town of Seven Springs, NC, where the $25,417 median household (HH) income is less than half

that of the State of North Carolina, to Nashville, TN, where the $63,462 median household income is ~25% higher than the State of Tennessee's.

4.3.1. Stormwater Utility Fees

Municipal permitting requirements established under the US Clean Water Act have incentivized many jurisdictions to establish stormwater utilities [43], whose fees create a dedicated stream of funds to pay for projects necessary to achieve compliance with federal permits [44]. Stormwater utility fees allow municipalities to assign financial responsibility for stormwater-related expenses to property owners. Revenues generated from these fees are used to fund large scale infrastructure projects, as well as to cover utilities' administrative expenses [45]. Some communities assign fees based on the total square footage of impervious surfaces, while others charge a flat fee or tiered fee [44].

Our review identified seven communities—Charlotte-Mecklenburg County, North Carolina; the City of Tulsa, Oklahoma; Nashville, Tennessee; Arlington, Texas; Fort Collins, Colorado; Newport News, Virginia; and Bonita Springs, Florida—that have directed or are intending to direct portions of their stormwater fee revenues to perform buyouts in flood-prone areas. In 1997, Charlotte-Mecklenburg County (encompassing the City of Charlotte; we will refer to as "Charlotte, NC") established a tiered fee based on impervious cover and property use [46]. Through the revenue generated by the fees, the county almost entirely funds its Quick Buy program (mentioned previously), which has acquired over 400 properties, returned 185 acres (~75 ha) of floodplains to open space, and avoided an estimated $25 million in damages since 2003 [22].

Similarly, the City of Tulsa established a stormwater utility fee in 1986, which—along with funding other infrastructure—helps to provide the 25% cost match required of HMGP funding [47]. Along with municipal bonds and a special purpose local sales tax (defined and discussed in the next section), this program has helped Tulsa remove 900 homes and businesses from floodplains since 1986. Tulsa imposes a flat fee, meaning every property pays the same amount per month. The fee generates approximately $9 million/year and $70 million since its conception [46].

The seven different stormwater utility fee programs identified in our census vary in the distribution of resulting revenue, as well as the structure in which the fee is applied. While Charlotte, NC utilizes only ~5.55 percent of the revenue from its utility fee to conduct floodplain buyouts, this provides up to ~$4 million in funding for buyouts annually through the City's Quick Buy program. Charlotte's use of its fee is unique in that it is the only utility-involved buyout funding program that entirely funds some of its buyout projects (all other utility mechanisms involve some form of federal funding). Charlotte, NC and Newport News, Virginia are the only cities in which a portion of the utility fee is explicitly (under law) dedicated to a buyout program, with Newport News dedicating $200,000 for the acquisition, relocation, and elevation of flood-prone structures. Conversely, stormwater utility fee revenue in Arlington, Texas, Ft. Collins, Colorado, and Nashville, Tennessee, was used to address funding needs to match federal dollars after flood events and have no set amount of fee revenue dedicated to buyouts.

4.3.2. Local Option Sales Taxes

A local option sales tax (LOST) is a special purpose financial tool used by city and county governments to fund specific categories of projects and financial needs, including buyouts. The small tax, normally ranging from 0.05–2%, must be approved by municipal or county voters before it is added to the established state sales tax [48]. LOSTs currently account for 10% of all local tax revenue across the country, having been authorized in 33 states [49]. Revenue from a LOST program is collected by the county or municipal government and is typically used to ease reliance on property tax revenue and to bolster municipal general revenue funds [48]. This form of tax carries a "sunset" date, which can be based on a timeframe or amount of revenue generated, and requires renewal legislation by voters or a tax phase out [49]. This funding mechanism represents an important financial tool for local and

state governments to distribute the funding burden (or federal cost matching) of high cost projects like buyouts across residents.

In 1995, Neosho, Missouri adopted a 3/8ths percent local option sales tax in order to finance a $1.5 million municipal bond to fund a number of capital improvement projects, including the purchase of 27 repetitive flood damaged homes, which had not been purchased through a previous buyout funded by the state's Emergency Management Agency, HUD, and NRCS [50]. The sales tax generated $600,000 annually and was split evenly between parks development, the city's recreation programs, and the buyout project.

In Austin, Minnesota, residents approved a 0.5% local option sales tax in 2007, aimed at funding flood mitigation projects [51]. Historically, Austin had relied on CDBG-DR and HMGP funds for a majority of its buyout funding, with the Minnesota Department of Natural Resources (MN-DNR) providing the 25% cost match [20]. However, after creating the LOST, the city has been able to rely on a 50/50 funding split with the MN-DNR for buyout projects, eliminating the need for federal funding [52]. The tax expires in 20 years or once it has reached its $14 million cap to obtain bonds which fund proposed flood mitigation projects [53]. The city has bought out 275 structures since its inception and most recently plans on conducting a $1,000,000 buyout project between 2017–2021 under this arrangement [52,53].

In contrast to Austin and Neosho, the City of Augusta, Georgia enacted a "Special Purpose" Local Option Sales Tax (or SPLOST), which is unique to the state of Georgia. Established in 1985 by the state of Georgia, SPLOST, in contrast to a LOST, is a county tax which can only be enacted through a local referendum [54]. In addition, SPLOST revenue can only be used for capital outlay projects, meaning the funding cannot be used for operation and maintenance cost or for any other county or municipal facility or service. Augusta-Richmond County established its 1 percent SPLOST in 2004 which has been renewed by voters seven times to date [55]. On the fifth renewal of the SPLOST, revenue from the tax was used to acquire 19 flood prone properties between 2012–2015 without utilizing federal funding.

4.3.3. Municipal and Green Bonds

A municipal bond is a low risk investment vehicle whereby an investor (bond holder) loans money to a government (bond issuer) in order to receive scheduled interest payments over time as well as the principal (face value) of the bond at the end of the bond term [56]. Municipal bonds are debt securities issued by states, cities, counties, or other governmental entities [57]. Bonds give the state or local government access to funding sufficient to implement projects that require large sums of capital, such as floodplain buyouts. Our review reveals that revenues from municipal and state issued bonds are normally used as leverage for federal dollars in order to maximize the scale of buyouts [3]. These bonds carry a low default risk and the interest payments to bond holders are normally tax exempt [58].

When a floodplain buyout program utilizes a municipal or state bond, it can earn the title of a "green bond," which is increasingly being used to market and fund resilient infrastructure. The term "green bond" suggests a bond that is directed towards a net positive environmental impact [59]. This net positive environmental impact is a result of green infrastructure, including infrastructure improvements in the water, buildings and industry, energy, land conservation, power, transport, and waste and pollution sectors [60]. The market for green municipal bonds has been growing ever since the first was issued in Europe in 2007 [59]. In 2018, the collective par (face) value of the municipal green bond market was $4.9 billion [61], and cumulative global issuance (bond demand) was estimated at $521 billion, with the U.S. leading the market with $118 billion issuances (~20% of the global market; [62]).

However, due to the relatively recent development of green bonds, there is no single standard or certification process to obtain the label. There are a number of independent organizations that offer backing to a green bond label such as the Climate Bonds Initiative's certification scheme and CICERO, an organization that offers second opinions on green bond labeling that are beginning to set the standard for transparency and definition within the market [63].

Green municipal bonds have been used to fund floodplain buyouts by local governments in Harris County, Texas and the City of Tulsa, Oklahoma, as well as the State of New Jersey. Harris County, Texas voters approved a historic $2.5 billion green bond program in 2018 after Hurricane Harvey

flooded over 200,000 homes and apartments [64]. Drawing $59 million in bond funds as cost-match leverage to obtain $159 million from the HMGP, Harris County plans on purchasing approximately 900 properties [65]. On a smaller scale, the City of Tulsa, Oklahoma uses a municipal green bond program created in the wake of a historic 1984 rainfall. Since then, the bond program has been used in conjunction with a special purpose local option sales tax, HMGP, and CDBG funding for buyout projects, including $1,300,000 for voluntary buyouts for fiscal year 2019–2020 [66].

In New Jersey, the State's Blue/Green Acres program is partially funded by bonds, which have generated $36 million to be used as leverage for HMGP and CDBG funding for the acquisition of 700 properties and structures as of 2019 (NJ Department of Environmental Protection, 2020; [67]).

4.4. The Extent of Local and State Buyout Programs

At the state level, we identified six state funding programs that have been used to help acquire ~5700 properties or structures (see Table 3) between 1976 and 2020 (this period reflects the start of the earliest state grant program). Within state programs where funding for buyouts was specified (Maryland's program only), we found an estimated $8 million in appropriations. Within programs where we were unable to distinguish financial expenditures on buyouts, we found an additional ~$735 million in state appropriations for flood mitigation measures, generally.

At the local level, we identified 19 programs in 17 municipalities that bought out ~3900 properties or structures between 1986 (when Tulsa, Oklahoma's flood mitigation program began) and 2020 using one or more of the four types of local funding mechanisms described in Table 3. Within local programs where funding for buyouts was specified, we found an estimated ~$7.6 million in appropriations corresponding to 448 buyouts. Within local programs where we were unable to separate the financial expenditures on buyouts from other flood mitigation measures, local governments appropriated ~$411 million corresponding to an additional 3435 buyouts.

Table 3. State and local buyout programs by funding mechanism. Total buyouts reported in terms of properties or structures.

Funding Mechanism	Scale	Location	Program Title	Year Founded	Funding Information	State/Local Agency Involved	Total Buyouts	References
Grants	State	Minnesota	Flood Damage Reduction Grant Assistance Program	1987	$521 M (total c. 2018) for buyouts and other structural flood mitigation measures	MN Department of Natural Resources	~3500 structures	[36,53,68,69]
	State	Washington	Floodplain by Design	2013	$165 M ($50.4 M 2019–2021)	WA Dept. of Ecology; Nature Conservancy; Puget Sound Partners	~700 properties	[70,71]
	State	Maryland	Comprehensive Flood Management Grant Program	1976	$8 M (2021–2023) specifically for buyouts	MD Dept. of the Environment	400 properties	[72]
	State	Wisconsin	Wisconsin Municipal Flood Control Grant Program (MFCGP)	1999	~$22 M (total between 2002–2018)	WI Dept. of Natural Resources and General Obligation Bond Revenue	140 structures (2002–2018)	[37]
	Local	Kenosha County, WI	Fox River Flood Mitigation Program	1994	~$3 M from MFCGP (1999–2008)	Kenosha Dept. of Planning & Developing	103 structures on 165 properties (as of 2016)	[38–40]
	Local	Seven Springs, NC	Golden Leaf Disaster Recovery Grant	2016	$1,621,000 (one-time grant)	Seven Springs Town Council and Fire Chief	1 fire station	[73]
	Local	Mosby, MO	Mid-America Regional Council	2016–2017	$147,506 (one-time grant for buyout admin. assistance)	Clay County, MO	42 structures	[74–76]
Revolving loan funds	State	South Carolina	SC Resilient Revolving Loan Fund	Proposed in 2018	$2 M to establish the fund	South Carolina Dept. of Natural Resources	N/A	SC SB S.259 (2019–2020)
Local option sales tax (LOST)	Local	Austin, MN	Local Option Sales Tax	2007	$14 M	Austin Department of Public Works	275 structures	[20,52,68]
	Local	Cedar Rapids, IA	Local Option Sales Tax	2009	~$70 M for acquisitions and rehabilitation ($17.7 M/yr for 5.25 yrs); 90% for buyouts and structural flood mitigation	Cedar Rapids Dept. of Public Works	167 structures; funds also used as HMGP/CDBG-DR cost-match for ~1300 properties	[77,78]
	Local	Augusta, GA	Special Purpose Local Option Sales Tax	2012	~$2 M total	Augusta Engineering Department	19 structures	[54,55]
	Local	Neosho, MO	Local Option Sales Tax	1997	~$1 M c. 2000 ($1/3$ of total tax revenue) to finance $1.5 M bond	Neosho Dept. of Stormwater Mgmt.	27 structures	[50,79]
	Local	Tulsa, OK	Local Option Sales Tax	1986	$120 M from tax and muni bond 1986–2019	City of Tulsa Engineering Services-Flood Control	(See stormwater utility Tulsa, OK entry)	[47,66,80]

Table 3. *Cont.*

Funding Mechanism	Scale	Location	Program Title	Year Founded	Funding Information	State/Local Agency Involved	Total Buyouts	References
Municipal and green bonds	State	New Jersey	Green/Blue Acres	2007	$12 M authorized (2007); $24 M more approved (2009)	NJ Dept. of Environmental Protection	~1000 (~700 since Hurricane Sandy)	[67,81]
	Local	Tulsa, OK	Local Option Sales Tax and Muni-Bonds	1986	(see local option sales tax Tulsa, OK entry)	City of Tulsa Engineering Services-Flood Control	(See stormwater utility Tulsa, OK entry)	[47,66,80]
	Local	Virginia Beach, VA	Bond Referendum	Proposed, Nov. 2020	$430 M bond with undisclosed amount aimed at buyouts	City of Virginia Beach, VA	Could accelerate the timeline of 36 projects	[82]
	Local	Portland, OR	Regional Greenspaces Bond Measures	1997	~$1,626,250	Portland Parks and Recreation; Metro [regional government]	30 structures	[83,84]
	Local	Harris County, TX	Flood Control Bond	2018	$53 M in bonds	Harris Co. Flood Control District; TX Water Development Board and Fund	512 properties in process; 3600 homes planned in total.	[1,21,64,65]
Stormwater utility fees	Local	Charlotte/ Mecklenburg County, NC	Quick Buy Program	1999	$2.5 M (2015–2018)	Charlotte Stormwater Services	67 structures (2003–2011)	[22,46,85]
	Local	Nashville, TN	Stormwater Utility Fee	2010	~$34.2 M (c. 2010) as 12.5% match + 12.5% match from TN Emergency Management Agency and 75% HMGP	Nashville Metro Water Services	246 structures	[86–88]
	Local	Arlington, TX	Stormwater Utility Fee	2016	$293,036 (c. 2016) as HMGP cost match	Arlington Stormwater Services	6 structures	[89,90]
	Local	Newport News, VA	Flood Assistance Program	1999	~$600,000 (2013–2015) for floodplain structure buyouts and elevation	Newport News Stormwater Management	40 structures (c. 2014)	[91–94]
	Local	Bonita Springs, FL	Stormwater Utility Fee	2019	$1.7 M c. 2020	Bonita Springs Dept. of Public Works	~300 properties in program (unknown properties in 2019)	[95,96]
	Local	Fort Collins, CO	Stormwater Utility Fee	1989	$5 M	Ft. Collins Division of Homeland Security and Emergency Management	86 structures	[97]
	Local	Tulsa, OK	Stormwater Utility Fee	1986	~$108 M (2015–2018) total revenue from stormwater utility fee	City of Tulsa Engineering Services-Flood Control	~900 structures	[47,66,80,98]

5. Discussion and Conclusions

This census of funding mechanisms demonstrates the prevalence and variety of state and local tools used to augment federal financing of floodplain buyouts. In sum, state and local funding programs have resulted in the purchase of some ~9600 flood-prone properties or structures. As most of these buyouts occur with funding from programs that share costs with FEMA, they represent nearly 25% of the over 40,000 total properties acquired with federal grants.

Half of the operating state and local funding programs (11 of 22) were established after 2006, with five being established since 2016. This recent trend towards program establishment suggests that many communities both recognize the value of floodplain acquisitions and are willing to invest in expanding their reach. For example, in using its stormwater utility fee to cost-match nearly $900,000 of HMGP funds, Arlington, TX observed that

> Acquisition of these homes will remove flood prone structures from the floodway and floodplain, thereby eliminating future damages and health and safety risks for those homeowners... This includes eliminating the need to provide emergency response services, subsidized flood insurance, and future federal disaster assistance [90].

Going forward, as state and local programs continue to emerge and evolve, they can address some of the shortcomings of federally-funded buyouts identified here, namely: funding, flexibility and uncertainty. First, the inability to provide the local contribution for federal funds can discourage local governments from participating in a buyout. At least one state, South Carolina, attempted to address this through its proposed Resilient Revolving Loan Fund (SC SB S.259, 2019–2020). State and local programs offer one path for streamlining cost matches to obtain federal funds.

Second, programs that are funded independently of federal programs can operate with more flexibility, buying homes more quickly than through federal programs: for example, six months in Charlotte versus five years for federally-funded buyouts [22]. Moreover, state and local governments can be proactive in acquiring flood-prone homes, rather than acting after-the-fact, as with federal grants. Also, as Weber and Moore (2019) [4] pointed out, state and local funding programs can be more flexible in their application of buyouts. For example, a local government could target an entire neighborhood for acquisition, even including homes that would not meet the federal government's cost/benefit criteria. In short, state- and locally-funded buyouts can be faster and more flexible than federal programs and can be proactive, rather than reactive.

Third, state and local buyout programs can reduce the complexity and uncertainty of federal programs; specifically, they can add certainty as to the timing and amount of funding availability, as well as which homes will be eligible. However, the extent to which these non-federal funding sources systematically increase the number of properties bought and reduce the timeline of buyout projects, are areas in need of further investigation. Additional research is needed to evaluate the relative cost-efficiency of state and local programs compared to federally funded programs. Such research is particularly timely given the projected increased changes in sea level and in the intensity of storms and frequency of flooding, which may increase the demand for buyouts.

Our analysis suggests possibilities for improving the interface between federal and state/local buyout funding programs. As buyout financing strategies continue to evolve, monitoring and evaluation of federal programs can help ensure equitable access to buyouts across communities of different size, wealth, and geography. For example, recognizing that the 25% cost-share can inhibit access to federal funds, existing federal programs could add flexibility to (or reduce or eliminate) the cost-share requirement for small and impoverished communities (e.g., BRIC allows cost shares of only 10% in these cases; [11]). While our analysis does not indicate a link between community wealth and program establishment, it is possible that increased self-financing of buyouts by states and municipalities could eventually lead to disparities in the communities that are able to access federal funds; smaller and lower-income communities might find it more difficult to impose a new sales tax or issue a bond, remaining heavily reliant on federal funds, but with limited local matching funds.

Additional research investigating the geographic, socioeconomic, and political drivers of use of these non-federal buyout funding mechanisms could also inform these concerns.

While our analysis can inform communities interested in exploring alternative funding for buyouts, the suitability of bonds, stormwater utility fees, or local taxes will depend on local context. Like any infrastructure program, communities inevitably vary in their ability to generate funds for buyouts and in their capacity to administer a buyout program. State and local governments might also consider using tax incentives and credits to promote buyouts. Tax incentives and credits have been used to motivate conservation programs. For example, the Arkansas Wetland and Riparian Zone Creation, Restoration, and Conservation Tax Credits Act (1995) grants a state income tax credit to taxpayers who develop, restore, or conserve wetland and riparian zones [99]. Qualifying activities include establishing permanent vegetation, stabilizing stream banks and controlling erosion, and installing water control structures. To our knowledge, such mechanisms have not yet been used explicitly in the context of floodplain acquisitions.

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