A Review of the Federal Emergency Management Agency's Community Rating System Program

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Abstract

This study presents the first systematic literature review of academic research on the Federal Emergency Management Agency's (FEMA) Community Rating System (CRS) program. The CRS is a voluntary program created in 1990 as a means to incentivize communities in the United States to implement floodplain management activities that surpass those required under the National Flood Insurance Program. In exchange for adopting additional flood mitigation measures, communities receive reductions in their flood insurance premiums. To identity studies for inclusion, the authors searched three academic databases using the keywords "Community Rating System" and "Federal Emergency Management Agency" and "Community Rating System" and "FEMA." We discovered 44 studies that met our selection criteria (e.g., peer-reviewed, focus on CRS, and are empirical) and are included in the review. The findings provide significant insights into the current state of research on the CRS. This paper concludes by providing some recommendations to policymakers aiming to strengthen and increase participation in the CRS program, and reduce the impacts of floods on communities, and by outlining a future research agenda for the academic and practitioner communities.

INTRODUCTION

In the United States, floods cause the most significant economic impact and affect more individuals annually than any other natural hazard (Cigler 2017; Michel-Kerjan, Atreya, and Czajkowski 2016). In fact, from 2000-2017, the United States experienced 49 significant flood events—a flood event that results in 1,500 or more paid losses—with 17 of the events exceeding more than one billion dollars in damages (Federal Emergency Management Agency [FEMA] 2018; National Oceanic and Atmospheric Administration [NOAA] 2018a). In addition, NOAA (2018b) notes that the 30-year flood loss average is $7.96 billion in damages per year and 82 fatalities per year. The mounting costs of floods in recent years stems from a number of interrelated factors, including persistent development along the nation's coastlines and floodplains as well as changes in the climate that has resulted in increased precipitation and rising sea levels (Bouwer 2011; Brody, Kang, and Bernhardt 2010; Melillo, Richmond, and Tohe 2014).

Amid rising flood costs and forecasts suggesting that the number and severity of flood events will surge in the coming years (Intergovernmental Panel on Climate Change [IPCC] 2013), scholars have increasingly examined how communities can better manage their flood risks. For example, scholars have explored why some communities are more vulnerable to floods than others (Consoer and Milman 2017; Zahran, Brody, Peacock, Vedlitz, and Grover 2008), the flood planning process (Bailey 2017; Kang 2009), and the effectiveness of a variety of community-level flood mitigation strategies (Brody, Zahran, Maghelal, Grover, and Highfield 2007a; Brody, Zahran, Highfield, Grover, and Vedlitz 2007b; Brody, Blessing, Sebastian, and Bedient 2014; Brody, Kim, and Gunn 2013). Furthermore, one area of research under the community flood risk management umbrella that has received substantial empirical attention in

recent years is FEMA's Community Rating System (CRS) program. The CRS is a voluntary program that was created in 1990 as a means to incentivize communities to implement floodplain management activities that surpass those required under the National Flood Insurance Program (NFIP) (FEMA 2017a). Specifically, under the CRS program, communities are rewarded for engaging in flood management activities that go beyond the NFIP's purpose of regulating the construction of new homes and buildings to national standards (FEMA 2017a). In exchange for adopting additional flood mitigation measures, communities receive reductions in their flood insurance premiums.

Scholars have examined various aspects of the CRS program over the past two decades, including the determinants of participation (Asche 2013; Landry and Li 2011; Li 2012; Li and Landry 2018; Paille 2016; Sadiq and Noonan 2015a, 2015b) the CRS activities that result in the greatest reduction in flood losses (Highfield and Brody 2013) as well as the CRS activities that are valued the most (Fan and Davlasheridze 2014). Moreover, studies have assessed the effects the CRS program has on insured flood losses (Highfield and Brody 2017), residential choice location (Fan and Davlasheridze 2015), and poverty and income inequality (Noonan and Sadiq 2018). The steady increase in the number of studies on the CRS is likely attributable to the perceived benefits of participation (i.e., reduced flood risks and lower flood insurance premiums), the minimal number of communities that participate in the program, and the need for more effective community flood risk management (FEMA 2017a; Highfield and Brody 2017; Sadiq and Noonan 2015a, 2015b).

Given the substantial body of research on the CRS program, there is a need to establish the current state of knowledge, synthesize extant research findings, and identify directions for future research. The present study addresses this need by conducting the first systematic literature

review of academic research on the CRS program. The findings provide significant insights into the current state of research on the CRS. This paper concludes by providing some recommendations to policymakers aiming to strengthen and increase participation in the CRS program, and reduce the impacts of floods on communities, and by outlining a future research agenda for the academic and practitioner communities.

The remainder of this paper is organized as follows. The next section provides a background on the CRS program. The third section outlines the methods used to identify studies for inclusion as well the selection criteria. The fourth section presents the results from the review and identifies recommendations to strengthen the CRS program. Finally, this paper concludes with a discussion of study findings and directions for future research on the CRS program.

BACKGROUND ON THE CRS

Since the inception of the NFIP in 1968, its purpose has been to reduce the impact of flooding on public and private infrastructures, promote the development of flood protection activities in communities, and provide affordable insurance to property owners (FEMA 2017a). However, to acquire flood insurance through the NFIP, the property must be located in a community that participates in the NFIP. Participating NFIP communities are required to adopt and enforce floodplain ordinances that regulate development in flood risk areas. As of 2017, over 22,200 communities in the United States and its territories participate in the NFIP (FEMA 2017a).

To further the mission of the NFIP, FEMA implemented the CRS in 1990 as a voluntary program to incentivize communities to surpass the expectations of the NFIP. Indeed, under the CRS, communities are rewarded for engaging in flood management activities that go beyond the NFIP's purpose of regulating the construction of new homes and buildings to national standards

(FEMA 2017a). The three goals of the CRS are to reduce flood damage to insurable property, strengthen and support the insurance aspects of the NFIP, and foster comprehensive floodplain management (FEMA 2017a). When communities develop flood management activities that reflect these three goals, they receive varying levels of discounts in flood insurance premiums based on their CRS class and whether or not they are located in a Special Flood Hazard Area (SFHA)—an area with a 1% chance of flooding in any given year. However, despite the benefit of flood insurance premium reductions, as of 2017, only 1,444 (6.5%) of communities that participate in the NFIP also participate in the CRS (FEMA 2017a). Nevertheless, over 69% of flood insurance policies are in CRS communities (FEMA 2017b). Figure 1 shows the location of the CRS participating communities.

Communities participating in the CRS are organized into 10 classes based on their credit points (FEMA 2017a). These rankings are based on the number of credit points a community has achieved in 500 point increments such that a community can range from 0-499—a Class 10 community—to 4,500(+)—a Class 1 community. Class 10 represents communities that do not participate or do not possess the minimum number of credit points to enter the program, thus, not receiving any discount on flood insurance premiums. Class 1 represents communities with exceptional floodplain management activities who enjoy a 45% discount on flood insurance premiums (if they are located in a SFHA) (see Table 1). The intermediate classes receive discounted flood insurance premiums in increments of 5%. In other words, a Class 9 community receives a 5% discount; a Class 8 community receives a 10% discount and so on and so forth until a community reaches a Class 1 receiving the 45% discount. A vast majority of community's participating in the CRS program fall in the class range of 8 and 9 (56%) and 5 through 7 (44%)

(CRS Resources 2012). Only seven of the nearly 1,500 communities participating have obtained the class 1 ranking (FEMA 2017a).

[Fig. 1 about here]

[Table 1 about here]

Communities accumulate credit points as they adopt any of the 19 creditable activities that advance the CRS's goals and span across one of the four categories: public information, mapping and regulations, flood damage reduction, and warning and response (see Table 2) (FEMA 2017a). Activities that promote public information include advising individuals about flood hazards and advocating property owners to purchase flood insurance. Mapping and regulation activities center on preserving open spaces, protecting natural floodplain measures, enforcing standards, and managing storm water. FEMA also awards credit points to communities that endorse flood damage reduction activities such as creating a comprehensive floodplain management plan, relocating or retrofitting structures, and maintaining drainage systems, which help prevent repetitive losses (Landry and Li 2011). Lastly, communities receive points for implementing measures that protect life and property in the event of a flood disaster through warning and response programs. The amount of credit points given to communities varies by the mitigation activity in each category. Furthermore, although the CRS attempts to identify a comprehensive list of credited activities, it recognizes that communities might engage in activities that are not specified as a credited activity. An Insurance Services Office (ISO) specialist reviews these instances on a case-by-case basis. The ISO also administers the day-to-

day operations of the CRS program on behalf of FEMA and is responsible for assisting communities with the CRS application process.

[Table 2 about here]

In order to participate in the CRS program, a community must be in full compliance with the rules and regulations of the NFIP for at least one year (FEMA 2017a). The application process begins with the community submitting a letter of interest and proof that their flood protection activities would credit them more than 499 points to their state's ISO specialist. The request is then forwarded to the Regional FEMA Office who assesses the community's request based on their NFIP compliance and additional actions taken to reduce the impact of flood disasters. If FEMA approves the request, the ISO specialist schedules a community verification visit to determine the community's class by assessing the number of flood protection activities deserving of credit. ISO then submits the findings to FEMA who will verify the ISO specialist's findings and notify the requesting community of its initial classification in the CRS. To ensure communities continue to implement flood protection activities, the CRS requires communities to recertify every year. Based on this recertification, communities who are adding additional credited activities can advance to a higher ranking. However, communities who are not implementing credited activities properly or fully may receive a lesser ranking.

Regardless of a community's ranking, the benefits of the CRS can be enticing for communities who are exceedingly vulnerable to flood disasters. The most compelling benefit of participating in the CRS is the reduction in flood insurance premiums. However, participation can also yield non-monetary benefits (FEMA 2017a). For example, the implementation of robust flood mitigation measures that can reduce property and infrastructure damage, as well as

minimize economic disruptions and reduce human suffering is arguably the most significant long-term benefit of participating in the CRS (Noonan and Sadiq 2018). An additional benefit of participation in the CRS is the ability to join CRS User Groups. These groups provide a mechanism of support for communities as they implement their flood protection activities. Furthermore, CRS program managers provide training and technical assistance for participating communities to design dynamic flood protection measures at no cost. For additional information regarding the benefits of the CRS, see Stiff (2017).

However, despite the aforementioned benefits of participating in the CRS, some scholars have expressed concern over the potential negative consequences and fairness of the CRS program. Dixon, Clancy, Seabury, and Overton (2006), for example, argue that CRS activities designed to improve structural flood mitigation might also reduce community's perceived risk, thus, refuting the effects of decreased insurance rates and public education. Moreover, Zahran et al. (2010) question the fairness of the program in term of the classes and the associated discounts in flood insurance premiums. Specifically, these authors disagree with the fact that a community possessing 1501 credit points receives the same discount in flood insurance premiums as a community with 1999 points who has spent more time, money, and effort in reducing flood disasters. Furthermore, CRS discounts for participating communities are offset by premium increases in non-CRS participating communities. Finally, Noonan and Sadiq (2018) consider some of the unintended consequences of CRS participation and find evidence that participation in the CRS encourages income inequality. Considered together, these concerns call for a greater understanding of the effectiveness of CRS program, the benefits of participating in the program, and some of the unintended consequences of participation.

METHODS

Search Strategy

To identify studies that examined the CRS program, we adopted a three-stage approach. The first stage involved searching three academic databases—Google Scholar, Science Direct, and Web of Science—for relevant studies (Bubeck, Botzen, and Aerts 2012; Thompson, Garfin, and Silver 2017). We began this search in April of 2018 with the keywords "Community Rating System" and "FEMA." This keyword search yielded 988 documents. Of these 988 documents, 36 studies met the selection criteria (discussed below), 909 studies did not meet the selection criteria, and 43 studies were found multiple times within the same database or in a different database (i.e., study was indexed in both Google Scholar and Web of Science). We also searched the three databases with the following keywords "Community Rating System" and "Federal Emergency Management Agency." This keyword search generated 895 documents with the majority (N=773) of the studies having been identified in the first keyword search. Nonetheless, this keyword search led to the identification of six new studies that met the selection criteria. Although we completed the keyword searches in early May, we utilized Google Scholar alerts to receive any recently published studies that contained any of the keyword searches. As of July 11, 2018, Google Scholar Alerts yielded an additional eleven studies, none of which matched the selection criteria. In sum, at the end of the first stage, we screened 1,883 studies, reviewed 1,067 studies, and identified 42 studies that met the selection criteria.

In the second stage, we carried out a backward citation search of all 42 studies found in stage one. By backward citation search, we mean reviewing the references of each study to determine if any relevant studies were not identified during the keyword searches. Through this

process, we identified two additional studies that met the selection criteria. At the end of stage two, the number of studies included in the review increased to 44.

The third and final stage consisted of sending the 44 studies found in the previous two stages to six scholars that are experts on the CRS program. These experts come from a variety of disciplines (e.g., urban and regional planning, economics, and sociology) and have extensively investigated various aspects of the CRS program as well as other topics related to community flood risk management. Three of the six experts we contacted responded to our request; these three experts were asked to review the initial 44 studies to confirm that they met the selection criteria and to offer any additional studies that may have not been included in our keyword searches or that are forthcoming in a peer-reviewed journal. The three experts validated the initial 44 studies and did not offer any additional studies. At the conclusion of this final stage, we had 44 studies that met the selection criteria and are, thus, included in the review.

Selection Criteria

Studies were selected for inclusion so long as they met the following criteria: (1) written in English; (2) peer-reviewed journal article, conference paper, conference proceeding, or dissertation; (3) focus on the CRS program (e.g., include the CRS program as a dependent, independent, or control variable); and (4) are empirical, thus, relying on experience or observations (studies might use primary and/or secondary data as well as quantitative and/or qualitative data). For organizational purposes, we developed a spreadsheet to track studies that met and did not meet the specified selection criteria. Specifically, for every study generated by each keyword search, one of the authors reviewed the full-text version of the study to determine if it met the criteria for inclusion. If this author determined the study met the selection criteria, we listed the study in a spreadsheet for coding purposes. If the researcher determined the study

did not meet the criteria, this author listed the study in a separate spreadsheet and coded the reason for exclusion such as not written in English, is not a peer-reviewed journal article, conference paper, conference proceeding, or dissertation, does not focus on the CRS program, or is not empirical. Of the 1,067 studies reviewed, 23 were excluded for not being written in English; 700 were excluded for not being a peer-reviewed journal article, conference paper, conference proceeding, or dissertation; 278 were excluded for not focusing on the CRS program; and 24 were excluded for not being empirical. Figure 2 illustrates the search strategy and the selection process used for this study.

[Fig 2. about here]

Article Review Strategy

Two of the authors reviewed the 44 studies included in the review and identified the purpose, methodological qualities, and major findings of each study. To maintain inter-coder reliability, these two individuals separately reviewed and coded 10 randomly selected articles. After reviewing and coding the 10 articles, these two individuals compared their codes and discovered only one discrepancy in codes, which we resolved by consensus. The authors evenly distributed the remaining studies, reviewed them, coded them individually, and found no additional issues.

RESULTS

Methodological Qualities

Table 3 provides an overview of the methodological qualities we coded for the 44 studies included in this review. The first methodological quality we coded for was the research

objective. We organize research objectives based on each study's research question(s) and/or purpose. Of the 44 studies included in the review, a large number focused on effective community flood risk management in general (*N*=17) or the CRS program in particular (*N*=16). Additional studies examine flood insurance policies and claims (*N*=5), enhancing disaster resilience (*N*=3), and planning for floods (*N*=3). We also identified the geographical focus (e.g., coastal, inland, or both) and the location of each study. In terms of geographical focus, a large number of studies examine coastal communities (*N*=17) or a combination of both coastal and inland communities (*N*=26); no study solely examined inland communities. Furthermore, the majority of studies were conducted, at least in part, in Florida (*N*=11) or Texas (*N*=10). Other coastal states, including Mississippi (*N*=7) and Louisiana (*N*=7) also experienced empirical attention. Furthermore, we coded whether each study employs quantitative or qualitative methodologies, uses cross-sectional or panel data, and relies on primary or secondary data. Upon reviewing the 44 studies, we find that the vast majority of studies included in this review employ quantitative methodologies (*N*=42), use panel data (*N*=28), and rely on secondary data (*N*=37). We also find that the average response rate of the six studies that reported a response rate is 48.9% (the highest and lowest response rates are 97% and 17%, respectively). In addition, just over half of the studies (*N*=26) use the CRS as an independent variable and scholars generally rely on a variety of analytical approaches to examine their data, though the most prominent is regression (*N*=24). Finally, we recorded the authors' discipline for each study to determine what disciplines are studying the CRS. We measure author discipline as the discipline of the highest degree obtained by each author and find that social scientists (*N*=99) make up the vast majority of scholars studying the CRS.

[Table 3 about here]

Findings

Table 4 displays the findings related to the CRS for the 44 studies included in this review. We organize findings based on eight themes: (1) factors enhancing and inhibiting CRS participation; (2) planning for floods under the CRS; (3) effectiveness of the CRS in reducing flood losses; (4) flood insurance policies; (5) impact of CRS on disaster recovery outcomes; (6) value of CRS activities; (7) predictors of CRS points/ratings/scores; and (8) perverse incentives and unintended consequences of the CRS. We discuss the findings included under these themes in the subsequent paragraphs. However, before doing so, it is important to note that a handful of scholars use the same data for similar publication purposes (N=6), and as result, produce similar findings. Generally, this was a result of a dissertation or conference paper being turned into a published journal article. It is also important to recognize that while 44 studies met the selection criteria and are included in the review, only 41 studies explicitly reported findings regarding the CRS. Hence, Table 4 only includes the findings related to the CRS for 41 studies.

Factors Enhancing and Inhibiting CRS Participation

Eleven of the 44 studies included in this review provide evidence of the factors enhancing and inhibiting CRS participation. Considered together, results indicate that participation in the CRS is greater in places with higher flood risks, population sizes, incomes, owner occupied housing, educational attainment levels, and proportions of senior citizens (Asche 2013; Fan and Davlasheridze 2014; Landry and Li 2011; Li 2012; Li and Landry 2018; Posey 2008, 2009; Sadiq and Noonan 2015b). Furthermore, studies suggest that places are more likely to engage in more flood mitigation activities when a greater number of nested municipalities participate in the CRS (Landry and Li 2011; Li 2012). Results also demonstrate that CRS participation is lower in places with higher unemployment, poverty, and crime rates and minority populations (Landry

and Li 2012, Li and Landry 2018; Li 2012; Posey 2008, 2009). A few studies, however, found conflicting results with regards to the determinants of CRS participation. For example, some scholars (e.g., Sadiq and Noonan 2015b) found a significantly negative relationship between property tax revenues and CRS participation while other scholars found a significantly positive relationship (Landry and Li 2011; Li 2012; Li and Landry 2018). A possible explanation for these divergent findings is that Sadiq and Noonan (2015b) employ Census places (cities, towns, or townships) as their unit of analysis whereas Li (2012) and his colleague (2012, 2018) analyze counties. Finally, a few studies reveal that while CRS participation remains considerably low (Bailey 2017), communities in Texas and Florida makeup a large proportion of the communities that participate in the program (Husein 2012; Mayunga 2009). Perhaps, this is because Texas has the highest flood-related fatalities in the United States (Zahran et al. 2008) and Florida is routinely affected by major hurricanes that lead to substantial flooding (Brody et al. 2007).

Planning for Floods Under the CRS

Three studies included in this review demonstrate the impact the CRS has on the quality of mitigation and recovery plans. Although one study included in this review indicates that state mitigation plans generally focus on the CRS (Bailey 2017), other studies suggest that the CRS program does not significantly improve the quality of mitigation and recovery plans (Berke et al. 2014; Berke, Lyles, and Smith 2014). For example, Berke, Lyles, and Smith (2014) find that the CRS program's incentive scheme does not encourage local government to support more preventative land use actions in the policy element of mitigation plans. Furthermore, Berke et al. (2014) find that CRS participation only had a significant impact on one plan quality principle—public participation. This suggests that CRS participating communities are more likely to include public participatory processes in their recovery plans.

Effectiveness of the CRS in Reducing Flood Losses

Fourteen of the 44 studies produced findings related to the effectiveness of the CRS in terms of reducing flood losses. The majority of these studies indicate that participation in the CRS program does indeed lead to significant reductions in flood losses, measured as less property damage (Brody et al. 2007a, 2007b; Davlasheridze 2013; Highfield, Brody, and Blessing 2014; Li 2012), property and crop damage (Kim 2015), flood claims (Asche 2013; Highfield and Brody 2017; Kousky and Michel-Kerjan 2017; Michel-Kerjan and Kousky 2010), and flood casualties (Zahran et al. 2008). Furthermore, Asche (2013) finds that the interaction between a community's flood risk and CRS score is a significant, negative predictor of flood losses. This indicates that the CRS is effective at achieving its goal of reducing flood losses in communities with high flood risks. It also suggests that if flood risks increase throughout the United States, the benefits associated with participating in the CRS will become more apparent. It is important to recognize that one study (e.g., Brody, Peacock, and Gunn 2012b) included in this review finds that participation in the CRS has no significant effect on reducing flood losses. The authors (e.g., Brody, Peacock, and Gunn 2012b) do, however, recognize this inconsistent finding and maintain that the CRS is generally effective at reducing flood losses.

Flood Insurance Policies

Four studies provide evidence on the relationship between the CRS and flood insurance policies. The results from these studies suggest that individuals residing in communities with higher CRS scores or in better CRS classes are significantly more likely to be flood insurance policyholders (Brody et al. 2017; Brody, Lee, and Highfield 2017; Petrolia, Landry, and Coble 2013; Zahran et al. 2009). However, interestingly, Petrolia, Landry, and Coble (2013) found that this is not the case for residents in the State of Florida, where better CRS classes are not

associated with higher levels of flood insurance purchases. This suggests that residents in the State of Florida might not be motivated by the reductions in flood insurance premiums (Petrolia, Landry, and Coble 2013).

Impact of CRS on Disaster Recovery Outcomes

Only two studies included in this review explore the impact the CRS has on disaster recovery outcomes. Nonetheless, both of these studies provide evidence that participation in the CRS program leads to positive recovery outcomes (Burton 2012, 2015). Indeed, when examining recovery to Hurricane Katrina, Burton (2012, 2015), finds that CRS participating communities are significantly more likely to experience better recovery outcomes (measured as the reconstruction of the built environment) one, three, and five years after the storm. This suggests that communities who put more forethought into flood risk management are better equipped to experience positive recovery outcomes.

Value of CRS Activities

Nine studies provide evidence on the value of CRS activities (Fan and Davlasheridze 2014, 2016), the activities that result in the greatest reduction in flood damage (Brody and Highfield 2013; Highfield and Brody 2013; Highfield, Brody, and Blessing 2014) and flood casualties (Zahran et al. 2008) as well as the activities communities tend to persistently invest in (Li and Landry 2018) and the activities that lead to increases in the number of NFIP flood insurance policyholders (Petrolia, Landry, and Coble 2013). Concerning the CRS activities individuals value most, Fan and Davlasheridze (2014) find that people in general tend to place the highest value on CRS activities aiming to reduce repetitive flood losses. Public information disclosure about community's flood risks is the second highest activity valued under the CRS

(Fan and Davlasheridze 2014). These authors also find that retirees and college graduates value CRS activities related to flood damage reduction and public information (Fan and Davlasheridze 2014, 2016). Furthermore, results indicate that a variety of CRS activities, including open space protection, freeboard requirements, and flood protection (Brody and Highfield 2013; Highfield and Brody 2013) as well as additional activities included under CRS Series 300 (public information), 400 (mapping and regulation), and 500 (flood damage reduction) (Highfield and Brody 2014) result in significant reductions in flood losses. Relatedly, Li and Landry (2018) find evidence to suggest that communities tend to persistently invest in activities under CRS Series 400 (mapping and regulation) and 500 (flood damage reduction) more than activities under CRS Series 300 (public information) and 600 (flood preparedness). This finding is interesting as it is contrary to other studies that find CRS communities tend to invest in "low-hanging fruit" (Brody et al. 2009; Sadiq and Noonan 2015a). Indeed, Brody et al. (2009) find an under pursuit of series 500 and 600 activities and an over pursuit of series 300 and 400 activities. Finally, in terms of the number of NFIP flood insurance policyholders, Petrolia, Landry, and Coble (2013) find that structural flood mitigation activities under the CRS are more effective at increasing the number of NFIP flood insurance policyholders while information-based activities under the CRS are not.

Predictors of CRS Scores/Ratings/Points

Six of the 44 studies included in this review contribute to our understanding of the predictors of CRS scores, ratings, and points. Interestingly, the majority of the studies are at odds with one another. For example, Brody, Lee, and Highfield (2017) find that higher CRS scores are correlated with greater flood experience and being located within a 100-year flood plain as well as longer household tenures. Yet, Paille et al. (2016) and Sadiq and Noonan (2015b) find that flood risk does not appear to affect CRS scores. Furthermore, Brody et al. (2009) find that

426 moving from zero land area in the floodplain to 100% overlap decreases CRS scores by 4.65%.
427 Findings are also inconsistent with regards to the effect of property and housing values on CRS
428 scores. For example, while Paille et al. (2016) find that communities with higher housing values
429 tend to have higher CRS scores, Sadiq and Noonan (2015b) find that higher property values tend
430 to reduce CRS scores.
431
432 ***Perverse Incentives and Unintended Consequences of the CRS***
433
434 Finally, six studies included in this review provide information on some of the perverse
435 incentives and unintended consequences associated with the CRS. For example, concerning
436 perverse incentives, Brody et al. (2007a) find that the CRS might encourage development in
437 areas that are vulnerable to flooding. This is because the discounts in flood insurance premiums
438 make it less expensive for individuals to reside in a 100-year floodplain. This result is supported
439 by Noonan and Sadiq's (2018) finding that, in general, the CRS attracts both the poor and
440 individuals in the highest income brackets. Noonan and Sadiq (2018) also find that the CRS
441 encourages income inequality, in general. In additions, results from other studies indicate that
442 CRS participating communities behave strategically and are driven by the non-linear incentive
443 structure of the CRS program (Brody et al. 2009; Sadiq and Noonan 2015a; Zahran et al. 2010).
444 For example, it appears that communities are pursuing a "low-hanging fruit" strategy when it
445 comes to accumulating credit points. Indeed, CRS participating communities appear to engage
446 more in activities under CRS Series 300 (public information) and 400 (mapping and regulation),
447 which are generally less expensive and have a lower loss reduction potential than activities under
448 CRS Series 500 (flood damage reduction) and 600 (warning and response) (Brody et al. 2009).
449 In addition, Sadiq and Noonan (2015a) find that CRS participating communities engaging in less

flood mitigation generally have lower flood risks, property values, government payrolls, and population densities.

[Table 4 about here]

DISCUSSION

Future Research Directions

This systematic and comprehensive review of the CRS literature warrants an opportunity to develop a set of recommendations for future research. In the paragraphs below, we discuss a few areas that would benefit from additional inquiries: (1) the determinants of CRS participation; (2) the predictors of CRS scores, ratings, and points; (3) the relationship between the CRS and disaster recovery; and (4) negative impacts associated with participation in the CRS.

Determinants of CRS Participation

The recommendation for future work on the determinants of CRS participation is not due to a lack of attention to this topic. In fact, 11 of the 44 studies included in this review provide insights on the factors facilitating and inhibiting CRS participation. These studies, however, have relied on quantitative methodologies and have primarily employed secondary data to determine the relationship between CRS participation and a variety of community-level variables (e.g., population size, median household income, and tax revenues). Although these studies have contributed to our understanding of the determinants of CRS participation, they do not provide insights into the decision-making process regarding why communities decide to initially and continue to participate in the CRS. Furthermore, they do not reveal the obstacles that hinder participation in the CRS. For example, it is likely that communities choose not to participate in

the CRS because of the large amount of paperwork and evidence it takes to document that the community is engaging in any of the 19 creditable activities. Similarly, it is plausible that communities that do not have the funds to hire a full-time floodplain manager or who are unable to contract an outside agency to manage the documentation required will be less likely to participate in the program. In addition to the management of the CRS program, it is likely that the commitment of local flood management decision-makers will influence CRS participation. For instance, it is plausible that communities with floodplain managers, community development directors, and emergency managers that are more motivated and committed to reducing flood risks will be more likely to participate in the CRS. Furthermore, there is evidence to suggest that participating CRS communities tend to cluster together (Landry and Li 2011; Li and Landry 2018). However, scholars have yet to determine whether this clustering is a function of similar community composition, flood risks, or policy learning. Hence, to better ascertain why communities do or do not participate in the CRS, the extent to which local capacity and commitment influences CRS participation, and whether clusters of CRS participating communities is a function of community composition, flood risk, or policy learning, in-depth interviews are needed. Specifically, scholars should conduct intensive interviews with CRS coordinators in CRS participating communities and floodplain managers, community development directors, and/or emergency managers in non-CRS participating communities.

Predictors of CRS Scores, Ratings, and Points

Similar to the need for additional scholarship on the determinants of CRS participation, there is a need for more research on the predictors of CRS scores, ratings, and points as the extant research produces mixed findings. For example, some studies have found that a community's flood risk affects their CRS score (Brody, Lee, and Highfield 2017) while others

have found no such relationship (Paille et al. 2016; Sadiq and Noonan 2015b). Findings are also inconsistent with regards to the effect of property and housing values on CRS scores, with some finding that communities with higher housing values tend to have higher CRS scores (Paille et al. 2016) and others finding that higher property values tend to reduce CRS scores (Sadiq and Noonan 2015b). These mixed results warrant additional studies to better understand the predictors of CRS scores, ratings, and points.

An additional area included under this theme that would benefit from more research relates to the "low-hanging fruit" hypothesis. Recall, the "low-hanging fruit" hypothesis suggests that CRS participating communities generally engage in less expensive flood mitigation activities (i.e., those under CRS Series 300 and 400) (Brody et al. 2009). The questions that arises is what factors are responsible for communities' decision to engage in "low-hanging fruit" as opposed to "high-hanging fruit"? Sadiq and Noonan (2015a) provide some insights into the question, finding that CRS participating communities engaging in less flood mitigation generally have lower flood risks, property values, government payrolls, and population densities. Although insightful, more research is needed to better understand communities' decision to engage in "low-hanging fruit" and the consequences of that decision. One consequence could be that those communities participating in the CRS at lower levels (e.g., Class 9 through 6) and through less costly flood mitigation activities may not reap the same benefits as CRS communities participating at higher levels (e.g., Class 5 through 1) or engaging in costlier flood mitigation activities. The findings associated with planning for flood events provides some evidence to support this assumption. For example, Berke, Lyles, and Smith (2014) find that the CRS program's incentive scheme does not encourage local government to support more preventative land use actions in the policy element of mitigation plans. In sum, more scholarship is needed to

better understand communities' decision to engage in "low-hanging fruit" as opposed to "high-hanging fruit" and the consequences associated with that decision.

CRS and Disaster Recovery

Understanding the relationship between the CRS and disaster recovery represents an additional area that would benefit from more scholarship. Only two studies included in this review provide some indication of this relationship. Perhaps, the lack of research on this topic is due to the inherent assumption that communities engaging in additional flood mitigation and preparedness measures as measured by the CRS will naturally experience fewer disaster impacts and therefore a quicker recovery. A recent report by Tyler (forthcoming) provides some evidence to support this assumption. For example, using data gathered from 19 interviews with businesses affected by Hurricane Irma, the author finds that businesses located in higher CRS participating communities sustained less impact and recovered faster than businesses located in lower CRS participating communities. However, given the small sample size and the limited number of studies, more research is needed to understand the extent to which CRS participating communities experience better recovery outcomes in comparison to non-CRS participating communities. Scholars should also examine which of the 19 CRS activities facilitate a quicker recovery. It would be interesting to know whether the same CRS activities that result in significant reductions in disaster losses are the same activities that facilitate a speedy recovery.

Negative Impacts Associated with CRS Participation

Although a handful of studies assessed some of the perverse and unintended consequences related to the CRS, more research is needed to better understand a few of the negative impacts associated with CRS participation. One area that deserves significant attention

553 relates to Brody et al.'s (2007) study that found the CRS might be encouraging development in
554 high-flood hazard areas by subsidizing insurance premiums. This is because the discounts in
555 flood insurance premiums make it less expensive for individuals to reside in a 100-year
556 floodplain. Other scholars have expressed similar concerns. Dixon, Clancy, Seabury, and
557 Overton (2006), for example, argue that CRS activities designed to provide structural flood
558 mitigation may also reduce community's perceived risk, thus, refuting the effects of decreased
559 insurance rates and public education. These concerns and findings suggest that more scholarship
560 is needed to better understand some of the negative impacts associated with participating in the
561 CRS.

562 **Policy Recommendations**

563 Based on our review of the CRS literature, we offer three policy recommendations. First,
564 there is a need for policymakers to take a critical look at the unintended consequences of the
565 CRS such as the extent to which it promotes development in hazardous areas as well as its effect
566 on poverty and income inequality. In doing so, the CRS is likely to be more effective achieving
567 its intended programmatic goals without leading to unintended problems. Along the same line, it
568 is apparent that communities participating in the CRS are disproportionately engaging in
569 activities that require the least amount of effort like information-based activities, despite
570 empirical evidence that shows that information-based activities are not as effective at in reducing
571 flood damages or increasing NFIP policy-in-force when compared to structural mitigation
572 activities. As a result, we recommend that when policymakers review the CRS, they should
573 consider reallocating more points to structural-based activities to encourage their adoption
574 relative to information-based activities. This reallocation of points may also encourage

communities participating in the CRS at higher classes (e.g., classes 6 to 9) to consider increasing their participation intensity and improve their class ratings.

Second, there needs to be more emphasis on the importance of the CRS in reducing flood losses. Policymakers should collaborate with the academic community to more effectively communicate the significance of participating in the CRS. Such a collaboration could be in the form of an outreach-based partnership that would be responsible for disseminating academic findings on the CRS, including case studies of CRS success stories, with non-CRS communities. Such outreach efforts could be targeted to non-CRS communities with high unemployment rates, poverty rates, crime rates, or minority populations.

Third, policymakers should provide more information on the costs and benefits associated with each of the 19 creditable activities. In doing so, communities considering joining the CRS and current participants can make better-informed decision about joining or increasing participation levels, respectively. This recommendation is particularly relevant in the light of FEMA's advice to communities to consider the costs and benefits of participating in the CRS prior to joining.

CONCLUSION

The purpose of this study is to conduct the first systematic literature review of academic research on the CRS program. Specifically, this study establishes the current state of knowledge on the CRS, identifies research gaps and recommends future research areas, and outlines a set of policy recommendations for emergency and floodplain managers as well as policymakers aiming to strengthen and increase participation in the CRS program. The findings from this review provide a comprehensive understanding of the determinants of participation, the predictors of

CRS scores, ratings, and points, the relationship between the CRS and disaster recovery, and the perverse and unintended consequences associated with CRS participation.

A limitation of this study is that our comprehensive search approach may have missed other eligible studies. This limitation notwithstanding, this study is a first step in understanding where the research on the CRS program is and where it ought to be. We urge researchers to build on this review by exploring the areas identified above in need of additional investigation. In doing so, we would be able to have a better understanding of the effectiveness of the CRS as well as the impacts it has on reducing flood losses. Similarly, we hope that practitioners and policymakers would consider our recommendations with a view towards improving the design and implementation of the CRS program, and reducing the impacts of floods on communities.

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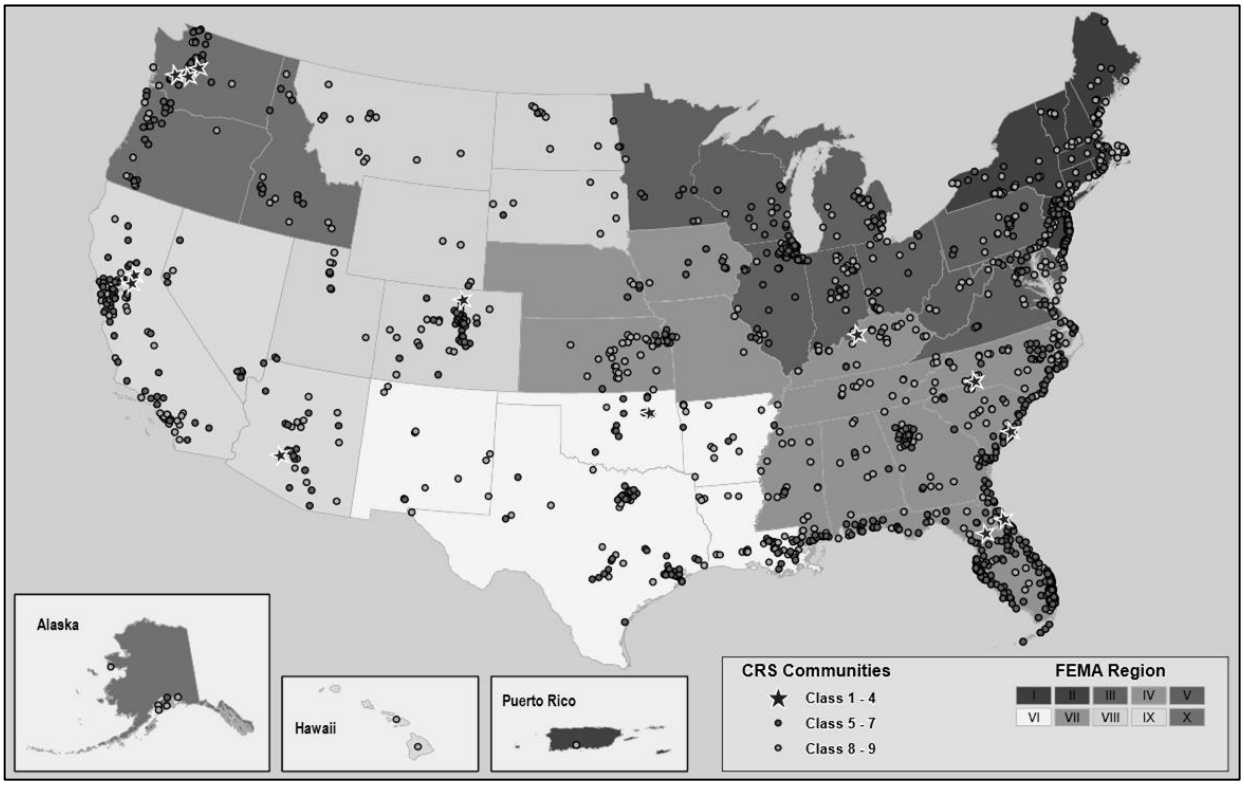

Fig. 1. Map of CRS participating communities organized by class (as of October 2017) (CRS Resources 2018)

Table 1. CRS Classes, Credit Points, and Premium Discounts based on Location in or Outside an SFHA.

CRS Class	Credit Points	Premium Reduction	
		In SFHA (%)	Outside SFHA (%)
1	4,500+	45	10
2	4,000-4,499	40	10
3	3,500-3,999	35	10
4	3,000-3,499	30	10
5	2,500-2,999	25	10
6	2,000-2,499	20	10
7	1,500-1,999	15	5
8	1,000-1,499	10	5
9	500-999	5	5
10	0-499	0	0

Source: FEMA (2017a)

Table 2. Credit Points Awarded for CRS Activities

Activity	Maximum Possible Points	Percent of Communities Credited
300 Public Information Activities		
310 Elevation Certificates	116	96
320 Map Information Service	90	85
330 Outreach Projects	350	93
340 Hazard Disclosure	80	84
350 Flood Protection Information	125	87
360 Flood Protection Assistance	110	41
370 Flood Insurance Promotion	110	4
400 Mapping and Regulations		
410 Floodplain Mapping	802	55
420 Open Space Preservation	2,020	89
430 Higher Regulatory Standards	2,042	100
440 Flood Data Maintenance	222	95
450 Stormwater Management	755	87
500 Flood Damage Reduction Activities		
510 Floodplain Mgmt. Planning	622	64
520 Acquisition and Relocation	2,250	28
530 Flood Protection	1,600	13
540 Drainage System Maintenance	570	43
600 Warning and Response		
610 Flood Warning and Response	395	20
620 Levees	235	0.5
630 Dams	160	35

Source: FEMA (2017a)

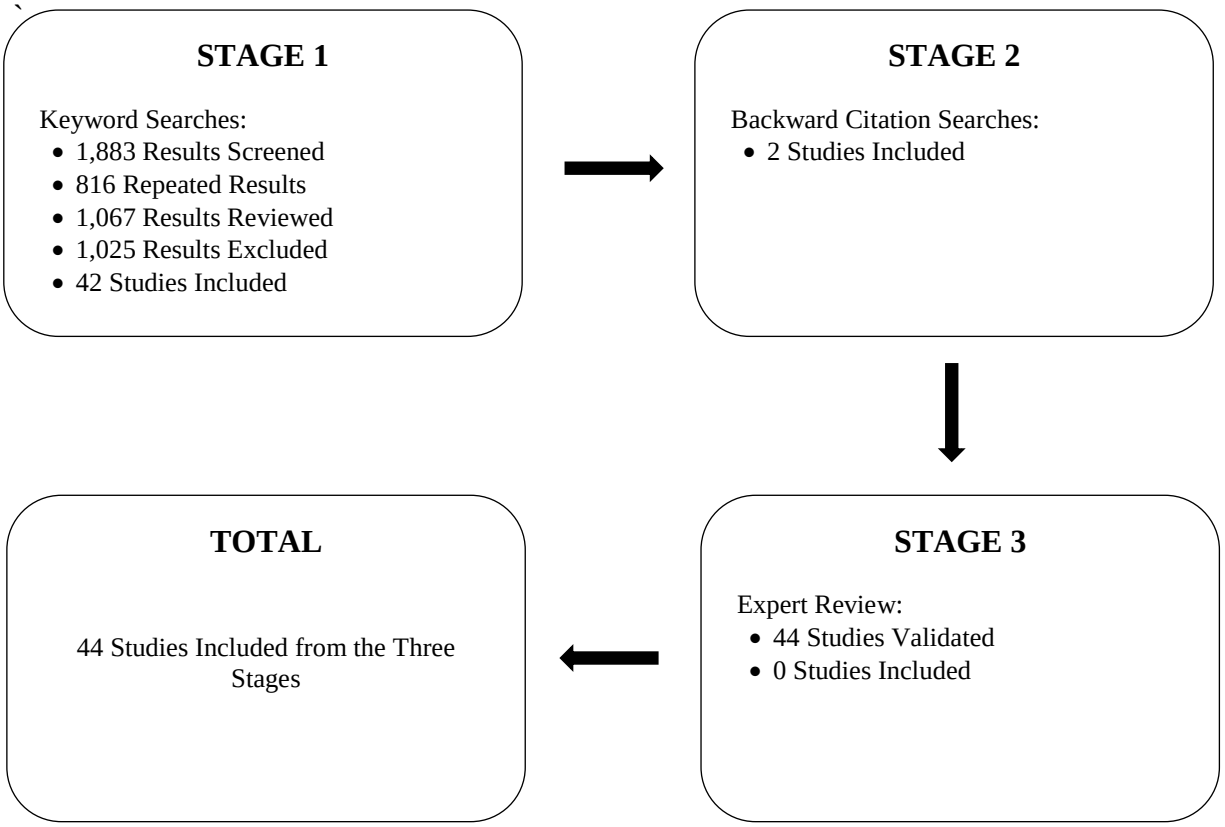

Fig. 2. Search strategy and selection process utilizing the three-stage approach

Table 3. Summary of Study Qualities, Descriptions, and Results

Study Quality	**Description**	**Result**
Research Objectives	We organize the research question(s) and/or the primary purpose of each study into five objectives.	CRS (*N*=16), Effective community flood risk management (*N*=17), Flood insurance policies and claims (*N*=5), Enhancing disaster resilience (*N*=3), Planning for floods (*N*=3)
Geographical Focus	This is measured as whether a study focused on a coastal area, inland area, or both.	Inland (*N*=0), Coastal *N*=17), Both (*N*=26), Not reported (*N*=1).
Study Location	This is the specific state(s) studied (excludes the *N*=9 studies that focused on all 50 states)	Florida (*N*=11), Texas (*N*=10), Mississippi (*N*=7), Louisiana (*N*=7), North Carolina (*N*=5), Alabama (*N*=3), Georgia (*N*=3), Arkansas (*N*=2), Illinois (*N*=2), Iowa (*N*=2), Kentucky (*N*=2), Missouri (*N*=2), New Jersey (*N*=2), Tennessee (*N*=2), Wisconsin (*N*=2), California (*N*=1), Colorado (*N*=1), Connecticut (*N*=1), Delaware (*N*=1), Kansas (*N*=1), Maine (*N*=1), Maryland (*N*=1), Massachusetts (*N*=1), Minnesota (*N*=1), Montana (*N*=1), Nebraska (*N*=1), New Hampshire (*N*=1), New York (*N*=1), North Dakota (*N*=1), Oklahoma (*N*=1), Pennsylvania (*N*=1), Rhode Island (*N*=1), South Dakota (*N*=1), Virginia (*N*=1), West Virginia (*N*=1)
Type of Study	This is measured as whether a study conducted quantitative analysis, qualitative analysis, or both.	Quantitative (*N*=42), Qualitative (*N*=0), Both (*N*=2)

Length of Study	This is measured as whether the study employs cross-sectional or panel data.	Cross-sectional (*N*=15), Panel (*N*=28), Not reported (*N*=1)
Data Type	This is measured as whether a study utilized primary data, secondary data, or both.	Primary (*N*=1), Secondary (*N*=37), Both (*N*=6)
Response Rate	This is the response rate reported by a study.	Only six of the 44 studies reported a response rate. The highest and lowest response rates are 97 and 17 percent, respectively. The average response rate is 48.9 percent.
Variable Type	This is measured as whether the CRS was used in a study as a dependent, independent, or control variable.	Dependent (*N*=13), Independent (*N*=26), Control (*N*=2) Three studies were descriptive in nature and did not include variables.
Analytical Approach	We organize the analytical approaches into seven groups—univariate/bivariate analysis, regression analysis, multiple equation models, spatial analysis, any combination of the previous four groups, qualitative analysis, and a combination of any of the first four groups and qualitative analysis.	Univariate/Bivariate Analysis (*N*=2), Regression (*N*=24), Multiple Equation Model (*N*=3), Spatial Analysis (*N*=1), Any combination of the previous four groups (*N*=9), A combination of any of the first four groups and qualitative analysis (*N*=5)
Authors Discipline	This is measured as the discipline of the highest degree obtained by each author.	Social Science (*N*=99), Natural Sciences (*N*=8), Engineering (*N*=1), Medical (*N*=2)

Table 4. Major CRS Findings from Each Study (*N*=41)

CITATION	FINDINGS RELATED TO THE CRS
THEME 1. FACTORS ENHANCING AND INHIBITING CRS PARTICIPATION	
Asche (2013)	Population size, income, amount of owner occupied housing, and historical flood risk positively influence participation in the CRS at the county level.
Bailey (2017)	Participation in CRS program is not popular within the study sample. In fact, only nine out of the 108 counties included in the sample participate in the CRS program. Furthermore, the nine counties that do participate in the program have low classifications.
Fan and Davlasheridze (2014)	Communities with higher levels of educational attainment are more likely to participate in the CRS.
Husein (2012)	Approximately 65 percent of local jurisdictions in coastal Texas participate in the NFIP a great deal while approximately 19 percent somewhat participate in the NFIP. Furthermore, approximately 37 percent of eligible NFIP communities participate in the CRS a great deal, 23 percent somewhat participate in the CRS, and 11 percent participate in the CRS a small deal.
Mayunga (2009)	Counties in the State of Florida maintain higher CRS scores, indicating that most counties have implemented the required flood management measures under the NFIP.
Landry and Li (2011)	Participation in the CRS is greater in counties with higher tax revenues, educational attainment levels, and proportions of senior citizens. Furthermore, counties are more likely to engage in flood mitigation activities when a greater number of nested municipalities participate in the CRS. Finally, results indicate that windows of opportunity immediately following disasters influence counties' decision to participate in the CRS.
Li (2012)	Counties with higher educational attainment levels and proportions of senior citizens are significantly more likely to participate in the CRS. In addition, counties are more likely to engage in flood mitigation activities when a greater number of nested municipalities participate in the CRS.

Li and Landry (2018)	Communities are more likely to participate in the CRS when they have higher tax revenues and lower crime and unemployment levels.
Posey (2008)	Communities with higher average incomes and education levels are more likely to participate in the CRS. In addition, communities with higher numbers of persons living in poverty and larger concentrations of minorities are less likely to participate in the CRS.
Posey (2009)	Communities with high income populations are more likely to participate in the CRS whereas communities with moderate-income populations and higher minority populations are less likely to participate in the CRS. Furthermore, results indicate that communities with a higher flood risk are significantly more likely to participate in the CRS. Interestingly, findings were not affected by the form of government observed or budgetary factors.
Sadiq and Noonan (2015b)	Local capacity, flood risk, socioeconomic characteristics, and political economy factors are significant predictors of CRS participation.
THEME 2. PLANNING FOR FLOODS UNDER THE CRS	
Bailey (2017)	State mitigation plans generally focus on addressing repetitive loss properties as well as promoting both the NFIP and the CRS. In fact, of the 10 states included in the study, only one state did not mention the CRS when discussing non-structural mitigation measures in their state mitigation plan.
Berke, Cooper, Aminto, Grabich, and Horney (2014)	CRS participation does not have a significant impact on five of the six recovery plan quality principles. Indeed, the CRS only influences the public participation principle, indicating that CRS participating communities are more likely to include public participatory processes in their recovery plans. • Enrollment in the CRS only influenced the public participation principle, but does not affect the remaining principles.
Berke, Lyles, and Smith (2014)	Unexpectedly, the authors found that the CRS program's incentive scheme does not encourage local government to support more preventative land use actions in the policy element of mitigation plans.

THEME 3. EFFECTIVENESS OF THE CRS IN REDUCING FLOOD LOSSES	
Asche (2013)	Communities with higher flood risks and that participate in the CRS experience higher insured losses. However, the interaction between a community's flood risk and CRS score is a significant, negative predictor of flood losses. This indicates that the CRS is effective at achieving its goal of reducing flood losses in communities with high flood risks. It also suggests that if flood risks increase throughout the United States, the benefits associated with participating in the CRS will become more apparent.
Brody, Peacock, and Gunn (2012b)	Participation in the CRS does not have a significant effect on flood losses.
Brody, Zahran, Highfield, Grover, and Vedlitz (2007b)	Counties with higher CRS scores experience less flood damage. In fact, an increase in CRS class corresponds to a $38,989 reduction in average costs per flood. Furthermore, findings indicate that CRS participation leads to a greater reduction in flood damage than dams, which are more expensive for communities to implement.
Brody, Zahran, Maghelal, Grover, and Highfield (2007a)	Nonstructural mitigation activities measured by CRS class are twice as more effective at reducing flood damage than dams. In fact, a one unit increase in CRS rating leads to a $303,525 reduction in the average amount of flood damage. This suggests that nonstructural mitigation activities and implementing local land use policies reduce property damage incurred from floods. This is likely due to the movement away from vulnerable areas. However, despite the benefits of the CRS, wetlands appear to reduce property loss from floods more so than dams and CRS class.
Davlasheridze (2013)	On average, counties with a CRS class of seven or better will experience $2.02 million less property loss in any given year. Results indicate that this is attributed to effective code enforcement. Results also suggest that activities worth 500 credit points—leading to a better CRS class—lead to a $1.6 million property loss saving, on average. In addition, counties with more CRS credit points are more resilient to local labor market shocks. Finally, results indicate that counties that are less dependent on external assistance and better equipped to manage disaster with their own resources are also better equipped to implement a sustainable hazard mitigation approach as evident from the CRS program.
Deegan (2007)	The CRS policy mix, which refers to a policy mix that included all four activities in the community rating system: public information, mapping and regulations, flood damage reduction, and flood preparedness) was the most effective policy in terms of managing flood damage and vulnerability.

Highfield and Brody (2017)	Participation in the CRS significantly reduces the amount of insured flood losses incurred by communities. In fact, on average, participating CRS communities experience a 41.6 percent reduction in flood claims compared to non-CRS participating communities.
Highfield, Brody, and Blessing (2014)	Participation in the CRS significantly reduces flood losses at the parcel level. Specifically, results indicate that CRS participating communities experience an 88 percent reduction in mean flood damage when compared to communities that do not participate in the program. Furthermore, for every point increase in a community's total number of CRS points, there is a 0.06 percent reduction in property damage at the parcel level.
Kim (2015)	Participation in the CRS coupled, adopting building regulations, and implementing structural hazard mitigation measures are negatively associated with disaster losses, indicating that these measures are effective at reducing losses.
Li (2012)	The CRS is effective at reducing average property damages incurred from flood events.
Kousky and Michel-Kerjan (2017)	Communities that participate in the CRS at a Class 9 and Class 8 experience approximately 13.5 percent fewer individual flood claims when compared to communities that do not participate in the CRS. This suggests that communities implementing a minimal number of mitigation activities under the CRS still see reductions in individual flood claim amounts. Furthermore, results indicate that a 100 point increase in CRS class reduces flood claims by approximately 2.5 percent.
Michel-Kerjan and Kousky (2010)	Participation in the CRS program can lead to reduced individual flood claim amounts. Yet, results indicate that the most significant reductions in flood claim amounts occur in communities that participate in the CRS at a Class 5 or better.
Petrolia, Landry, and Coble (2013)	Implementing activities included under the CRS results in lower prices of flood insurance and reduced likelihood or magnitude of loss.
Zahran, Brody, Peacock, Vedlitz, and Grover (2008)	Participation in the CRS significantly lowers the risk of a community experiencing a flood-related casualty.

THEME 4. FLOOD INSURANCE POLICIES	
Brody, Highfield, Wilson, Lindell, and Blessing (2017)	Individuals residing in communities with higher CRS scores are significantly more likely to purchase flood insurance under the NFIP. In fact, respondents are 2.3 times more likely to have a flood insurance policy if they reside in a better CRS class.
Brody, Lee, and Highfield (2017)	Individuals residing in jurisdictions with higher CRS scores are significantly more likely to have adopted a range of information-based flood adjustments, including the decision to purchase flood insurance.
Petrolia, Landry, and Coble (2013)	Individuals residing in communities with a better CRS class are significantly more likely to purchase flood insurance, In fact, a one unit increase in CRS class increases the likelihood of community members holding a flood insurance policy by 3 percent. However, this is not the case for the State of Florida, where better CRS classes are associated with lower levels of flood insurance purchase.
Zahran, Weiler, Brody, Lindell, and Highfield (2009)	Counties with higher CRS scores also contain higher numbers of flood insurance policyholders. In fact, a one percent increase in CRS points earned (from the mean) results in an increase of 0.13 to 0.23 percent in the number of NFIP policies per 100 households.
THEME 5. IMPACT OF CRS ON DISASTER RECOVERY OUTCOMES	
Burton (2012)	The presence of a mitigation, participation in the NFIP, CRS, and Citizen Corps may lead to a more positive recovery. In fact, with regards to the CRS, there is a positive and significant relationship between CRS participation and the odds of moving from one recovery category to the next recovery category.
Burton (2015)	Communities participating in the CRS experience significantly better disaster recovery outcomes one, three, and five years after Hurricane Katrina.

THEME 6. VALUE OF CRS ACTIVITIES	
Brody and Highfield (2013)	Open space protection is an effective strategy for reducing flood losses. Indeed, a point increase in the open space protection activity under the CRS significantly reduces insured flood damage in floodplain areas. Findings also indicate that other mitigation activities under the CRS such as warning programs, housing relocation, drainage maintenance, etc. lead to reductions in flood damage.
Brody, Zahran, Highfield, Bernhardt, and Vedlitz (2009)	CRS participating communities appear to favor activities under CRS Series 300 (public information) and 400 (mapping and regulation).
Fan and Davlasheridze (2014)	People tend to place the highest value on CRS activities aiming to reduce repetitive flood losses. Public information disclosure about community's flood risks is the second highest activity valued under the CRS. Results also indicate that retirees and college graduates value CRS activities related flood damage reduction and public information. Finally, results suggest that the CRS program influences individual's location choices.
Fan and Davlasheridze (2016)	In general, households are willing to pay a significant amount of money to improve community flood risk management. In fact, the marginal willingness to pay per additional credit point is $25 for CRS series 300 (public information), $169 for CRS 400 (mapping and regulation), and $129 for CRS 500 (flood damage reductions. Furthermore, people place a higher value on activities related to public information and flood damage reduction. Furthermore, more educated individuals tend to value the CRS program more than less educated individuals. Finally, results indicate that the long-term benefits of CRS participation could be greater than the immediate benefits (e.g., insurance premium discounts). This indicates that individuals prefer communal flood protection in addition to discounts in flood insurance premiums.
Highfield and Brody (2013)	The adoption of three CRS activities—freeboard requirements, open space protection, and flood protection—leads to significant reductions in flood damage.
Highfield, Brody, and Blessing (2014)	Activities included under CRS Series 300 (public information), 400 (mapping and regulation), and 500 (flood damage reduction) lead to significant reductions in property damage. Yet, findings indicate that activity 430 (higher regulatory standard) which includes development restrictions in floodplains, implementation of freeboard requirements, and increased requirements for V-zone properties, generates the highest savings.

Li and Landry (2018)	Communities tend to persistently invest in activities under CRS Series 400 (mapping and regulation) and 500 (flood damage reduction) more than activities under CRS Series 300 (public information) and 600 (flood preparedness).
Petrolia, Landry, and Coble (2013)	Structural flood mitigation activities under the CRS are more effective at increasing the number of NFIP flood insurance policyholders while information-based activities under the CRS are not.
Zahran, Brody, Peacock, Vedlitz, and Grover (2008)	Communities that engage in public information, mapping and regulation, and flood damage reduction CRS activities experience significantly lower levels of flood-related casualties.
THEME 7. PREDICTORS OF CRS SCORES/RATINGS/POINTS	
Blessing, Sebastian, and Brody (2017)	Flood claims located within 100-year floodplains had significantly more CRS points.
Brody, Lee, and Highfield (2017)	Higher CRS scores are significantly correlated with longer household tenure, more flood experience, and being located within a 100-year floodplain.
Brody, Zahran, Highfield, Bernhardt, and Vedlitz (2009)	Flood history significantly increases communities' overall CRS scores. This suggests that communities react to hazard events. Furthermore, results indicate that moving from zero land area in the floodplain to 100 percent overlap decreases overall CRS score by 4.65 percent.
Li and Landry (2018)	Communities with higher median household incomes and higher population densities also have more CRS points.
Paille, Reams, Argote, Lam, and Kirby (2016)	Communities with higher median housing values also have higher CRS scores. Furthermore, higher CRS scores are found in counties that have more local communities that participate in the CRS program. However, the number of floods in the past five years as well as the revenue base of the county does not appear to affect CRS scores.
Sadiq and Noonan (2015b)	Communities' property values appear to reduce CRS scores. Furthermore, flood risk does not appear to be a significant predictor of CRS scores.

THEME 8. PERVERSE INCENTIVES AND UNINTENDED CONSEQUENCES OF THE CRS	
Brody, Zahran, Highfield, Bernhardt, and Vedlitz (2009)	CRS participating communities appear to be pursuing a "low-hanging fruit" strategy when it comes to accumulated credit points. Indeed, CRS participating communities appear to activities under CRS Series 300 (public information) and 400 (mapping and regulation), which are generally less expensive in comparison to activities under CRS Series 500 (flood damage reduction) and 600 (warning and response). Furthermore, results indicate that the factors influencing CRS policy learning differ by activity series. For example, results indicate that increases in overall CRS scores are stunted for communities with a quarter of land area in the floodplain.
Brody, Zahran, Maghelal, Grover, and Highfield (2007a)	The CRS offers a perverse incentive for individuals to reside in high-flood risk areas. Specifically, the discounts in flood insurance premiums makes it less expensive for individuals to reside the 100-year floodplain. Hence, it could be argued that the CRS system might actually encourage development in areas that are most vulnerable to flooding. This makes sense given that the finding from this study indicate that the CRS is not as effective at reducing high-damage floods when compared to wetlands.
Noonan and Sadiq (2018)	The CRS appears to attract poor residents but relocates them out of floodplains. Furthermore, the CRS tends to attract top earners, including in floodplains. These findings suggest that the CRS encourages income inequality outside floodplains but discourages income inequality inside floodplains.
Sadiq and Noonan (2015a)	Communities that react to the CRS program's nonlinear, tiered incentives are different from communities that do not. Specifically, CRS participating communities that engage in less flood mitigation generally have lower flood risks, property values, government payrolls, and population densities. Furthermore, results indicate that at lower levels of CRS participation, communities tend to adopt more passive or non-structural mitigation measures.
Schechtman (2016)	Communities are less likely to be motivated by the incentives associated with the CRS when it comes to taking actions to protect against climate change. Yet, in a few towns, respondents reported that the CRS is the key adaptation tool and has significant support among elected officials.
Zahran, Brody, Highfield, and Vedlitz (2010)	Communities appear to behave strategically and are driven by the non-linear, tiered incentive design of the CRS program. In addition, communities seem to be motivated by the easy gains embedded in the CRS program.