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A Note from the Editors

We are delighted to present the Spring/Summer 2023 issue of the Berkeley Public Policy Journal. Every semester, students across disciplines at the Goldman School of Public Policy (GSPP) gather weekly to enhance and elevate policy stories critical to the bettering of our society. The editing process is highly collaborative, from gathering and reviewing diverse submissions, working with authors and expert guest editors to finesse complex analysis, and ultimately sharing the work of our peers with the greater UC Berkeley community. This journal, the culmination of this extensive work, showcases policy analysis and recommendations that can contribute to solving today's most pressing challenges.

As we have learned in the classroom and as observers of the world, policy formulation and analysis is undoubtedly essential, but without effective implementation, even the most well-crafted solutions remain mere words on paper. We witnessed this locally when, on the tail of a significant win for UC graduate students' strike for fair pay, union representatives worked tirelessly to ensure that the UC followed through on their commitments and that the hard-won benefits seamlessly made their way into student-worker paychecks and contracts.

On the national level, we are also witnessing the implementation of a historic federal funding policy. The Inflation Reduction Act (IRA) provides a policy framework for unprecedented investment in climate solutions, healthcare benefits, and workforce development. However, the utilization of the IRA by federal agencies, states, and municipalities will determine the efficacy of the legislation in meeting its goals. These programs are the result of powerful advocacy campaigns and movements that must now direct attention to implementation.

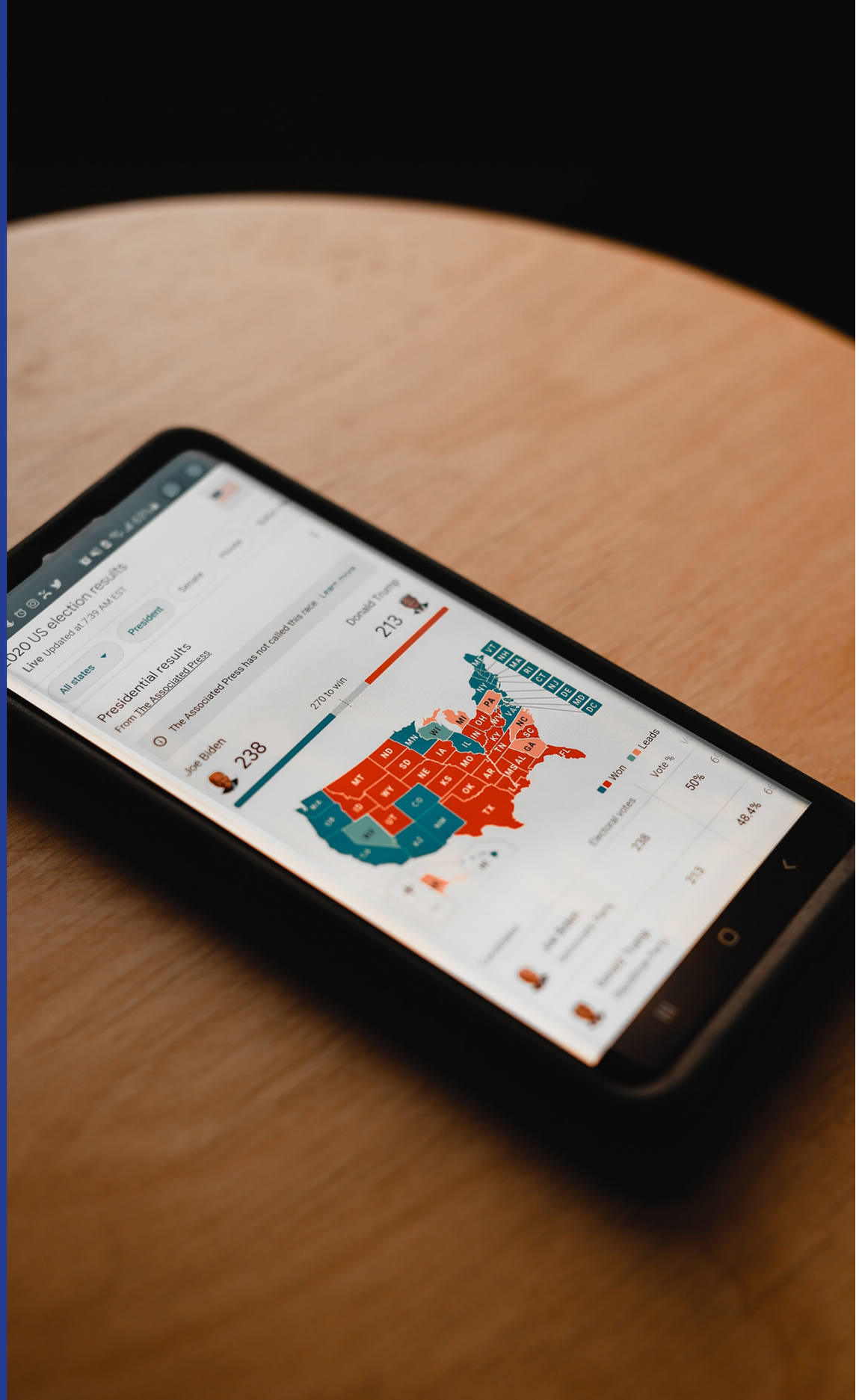
Throughout this issue of BPPJ, our authors present localized solutions to universal policy challenges and demonstrate the criticality of policy implementation. First, Quinn Wilson presents a proposal to strengthen the voice of American voters in national elections that can be easily administered. Then, Aparna Nellore describes strategies for improved access to contraception in the Philippines that are most effective when implemented together. Such strategies are needed to achieve the goals of an executive order that has gone unrealized.

Turning to environmental policy concerns, Sunny Singhal determines best practices for underground water storage in California, including key considerations for executing statewide deployment. Next, Ellen Kamps discusses the feasibility of programs that incentivize healthier and more environmentally-friendly pesticide technologies for California's agricultural industry. This edition ends with an inspiring interview with Dr. Michelle Reddy, an Assistant Adjunct Professor and Program Director of the Master of Development Practice at GSPP, who has extensive experience working internationally to empower local actors and organizations to deliver community services.

Policy implementation connects theory and practice, intentions and impact. Our authors recognize exactly how policies are translated into tangible actions that shape the lives of individuals and communities. We encourage readers to critically engage with the articles presented in this issue and hope you are inspired to see such innovative solutions enacted.

This is the last issue that we will publish as Editors in Chief of BPPJ. As May 2023 graduates, we are embarking in our careers as full-time policy creators, analysts, and implementers. We are grateful for our experience as Editors in Chief and proud to have elevated student voices in the two editions of this journal we have published. We also want to highlight the important contributions of Digital Editors Anita Alur and Bailey Schweitzer who adeptly oversaw the BPPJ blog. Finally, we are thrilled to introduce the new 2023 BPPJ Editors in Chief: Zoe Klingmann, Trishia Lim, and Amrutha Ramaswamy. With their vision and dedication, we are confident that BPPJ is in good hands for the year to come.

—Emily Jacobson & Jamie Matos



A Proposal for Improved Electoral Representation

— Quinn Wilson

Edited by:
Cynthia Avalos
Trishia Lim
Annabel Utz

Abstract

This article discusses the flawed structure of the Electoral College and the inadequacies of a commonly proposed alternative, the National Popular Vote (NPV). The author argues that neither system alone presents an acceptable method of electing the U.S. president and instead proposes a compromise that combines elements of the NPV and the Electoral College by allocating 51 electoral votes to the popular vote winner. The proposed system increases the importance of all voters, regardless of their state of residence, while preserving the voices and importance of less populous states. The choice of 51 electoral votes symbolically represents the existing voting districts in the United States at any given time, without introducing political bias and avoiding so-called "faithless" electors. The author argues that the proposed mixed-method approach has implications for improved campaign practices and voter representation, as no political party could afford to ignore any subset of the American constituency. Overall, this article posits that the proposed system would create a more democratic republic that better captures the will of the American people and upholds the value of each individual voice.

Introduction: An Imbalanced System

Today we are witnessing the decay of one of our most treasured rights: the vote. To say that we have free and fair elections in America would be a half-truth – free, but far from fair. During presidential elections, we are inundated with headlines describing the irrelevance of "safe states" in political campaigns, the weakening of voters' importance, calls for the abolishment of the Electoral College, accelerating hyper-partisanship, and meager reassurances that "every vote counts." Unless you happen to reside in a competitive swing state, your vote has become irrelevant.[1] Candidates respond by devoting resources to win the approval of a small cohort of voters in competitive states.

The basis for the imbalance lies in the inherent structure of the Electoral College. Scholars have pointed out the above problems for decades, and pollsters have published the effects. Even so, no viable alternative has surfaced to restore the power of the vote. Now more than at any other time in our nation's history, we are in need of an election system that upholds the value of each individual voice. We cannot afford to sit idle while our democracy disintegrates.

This article proposes a compromise between two systems: the National Popular Vote (NPV) method and the existing Electoral College. Rather than take one flawed system, I propose combining elements of the Electoral College and the NPV through the allocation of 51 electoral votes to the popular vote winner. In this manner, we may increase the importance of all voters and alter candidates' behaviors to benefit Americans. We may create a democratic republic that better captures the will of the American people.

Arguments Against the Electoral College

Significant flaws have become clear in the more than 200 years since the Electoral College's inception. While some issues were evident from the beginning, others have become more apparent and relevant in recent decades.

As the influence of political parties and organizations has strengthened and states have carved out political identities, the Electoral College has encouraged an intense focus on primarily "swing states." Such behavior makes sense from a campaign strategy perspective: populous states with no clear political leaning are expected to receive a disproportionate amount of candidates' time as they compete to garner the most votes. In the 2016 presidential election, both Hillary Clinton and Donald Trump spent a disproportionate amount of time in a handful of the largest battleground states.[2] During the 2004 presidential election cycle, the eleven states with the closest voting margins accounted for 92 percent of candidate showings and 96 percent of television advertising expenditures.[3] In contrast, partisan states typically receive limited campaign funds and attention from either party.

Additionally, critics argue that by failing to acknowledge the national popular vote in the Electoral College, voices are partially heard, and citizens are not equal.

One person's vote in Wyoming has nearly four times the strength as a vote cast in California.

To see this clearly, one may look to how votes are apportioned in California and Wyoming. In 2016, the estimated populations of California and Wyoming were 39.2 million and 584,290, respectively.[4] In 2016, California was allocated 55 electoral votes and Wyoming the minimum of three, rounding out to 712,909 people per electoral vote in California but just 194,763 people per vote in Wyoming. In other words, one person's vote in Wyoming has nearly four times the strength as a vote cast in California.

The unsettling nature of vote-strength imbalance has noticeable manifestations. In the history of the United States, there have been four definitive cases where the elected presidential candidate did not win the nation's popular vote, yet clinched victory through a majority of Electoral College votes.[5] Mathematically, a presidential candidate could secure the highest office by winning a plurality in merely the 11 most populous states. While the US has not seen an election quite so skewed, no mechanism prevents a candidate from performing such a feat.

Finally, the framers of the Constitution designed the Electoral College with features that are racist, unethical, and antiquated. The Three-Fifths Compromise represented the most glaring application of these features by providing slave-owning states the ability to increase their proportional representation of electors without the need to increase their voting population.[6] The Electoral College may not have explicitly supported slavery yet had the reprehensible effect of enabling its persistence.

Today, these restrictions take the form of strict voter ID laws and flagrant gerrymandering that diminish the influence of marginalized communities. North Carolina and Alabama, among other states, continue to see multiple State and Federal court cases regarding racial gerrymandering practices by the incumbent party.[8] These practices typically suppress minority voter influence in one of two ways – by grouping minority voters into a single bloc, thereby diminishing their voice to a single electoral vote, or by dividing minority voters into multiple districts so as to effectively silence their opinions.[8] Gerrymandering of any form, racial, partisan or otherwise, can only exist in a district-based electoral system such as the Electoral College. Disenfranchisement effectively reduces the voting population without decreasing electoral votes, thus providing a means for wrongful concentration of power to go largely unaddressed. The Electoral College's inability to address the incentive for voter suppression exposes a severe flaw in need of remediation.

A final flaw exposed in the Electoral College has made reform a necessity. In their 2011 book The Dictator's Handbook, Alastair Smith and Bruce Bueno de Mesquita demonstrate the extreme extent to which a candidate can leverage the Electoral College – in one of the world's largest democracies, an individual may be elected president with support from less than 10 percent of the population.[10] Were this flaw to be fully leveraged, the very nature of our republic would crumble. In 2016, indirectly referencing Smith and Bueno de Mesquita's original claim, NPR published an article detailing how a candidate could pull off such a feat. Table 1 displays data presented in the article.

In one of the world's largest democracies, an individual may be elected president with support from less than 10 percent of the population.

The tactic here plays off of the unequal voting power favoring smaller states. Carrying that trend forward, amassing electoral votes in a stepwise fashion by winning just over half of the votes in each state, one could feasibly obtain the presidency with only 23.1 percent of the US's electing body, a mere 9.51 percent of the US population. Such a process blatantly undermines fundamental definitions of democracy by hijacking free and fair elections. In alarmingly clear numbers, the data show just how much the Electoral College can skew the outcome of the presidency.

Although such an election remains unlikely, this disturbing attribute of the Electoral

TABLE 1 ELECTORAL MAJORITY WITH THE LEAST POPULOUS STATES
(SOURCE: KURTZLEBEN 2016)[10]

STATE	VOTES CAST (2012)	VOTES NEEDED TO WIN	ELECTORAL VOTES
Wyoming	249,061	124,531	3
Vermont	299,290	149,646	3
South Dakota	363,815	181,908	3
North Dakota	322,627	161,314	3
Montana	484,484	242,243	3
District of Columbia	293,764	146,883	3
Delaware	413,921	206,961	3
Alaska	300,495	150,248	3
Rhode Island	446,049	223,025	4
New Hampshire	710,972	355,487	4
Maine	724,623	362,313	4
Idaho	656,742	328,372	4
Hawaii	434,697	217,349	4
West Virginia	672,119	336,060	5
New Mexico	783,757	391,879	5
Nebraska	772,515	386,259	5
Utah	1,020,861	510,431	6
Nevada	1,014,918	507,460	6
Mississippi	1,285,584	642,793	6
Kansas	1,157,532	578,767	6
Iowa	1,582,180	791,091	6
Arkansas	1,069,468	534,735	6
Oregon	1,789,270	894,636	7
Oklahoma	1,334,872	667,437	7
Connecticut	1,558,993	779,497	7
Louisiana	1,994,065	997,033	8
Kentucky	1,798,048	899,025	8
South Carolina	1,964,118	982,060	9
Colorado	2,571,846	1,285,924	9
Alabama	2,074,338	1,037,170	9
Wisconsin	3,068,434	1,534,218	10
Missouri	2,763,689	1,381,845	10
Minnesota	2,936,561	1,468,281	10
Maryland	2,707,327	1,353,664	10
Tennessee	2,460,904	1,230,453	11
Massachusetts	3,167,767	1,583,884	11
Indiana	2,633,143	1,316,572	11
Arizona	2,306,559	1,153,280	11
Virginia	3,854,489	1,927,245	13
New Jersey	3,651,140	1,825,571	14
TOTAL		**29,847,550**	**270**
TOTAL U.S. VOTES	**129,227,22**		**538**
SHARE OF TOTAL		**23.1%**	**50.2%**

College has reared its ugly head before in American history. In 1860, Lincoln won the election with just 39.8 percent of the national popular vote, and in 1824 John Quincy Adams prevailed with only 30.8 percent.[11] In 1992 Bill Clinton secured the Office with just 43 percent of the popular vote.[12] Were a candidate to pursue a carefully crafted campaign exploiting weaknesses of the Electoral College, one could manipulate America's election system to their advantage.

Arguments Against the National Popular Vote

Calls for complete abolishment of the Electoral College have arisen from state chambers and politicians across the nation. Regrettably, many of these arousals lack staying power and tend to track the presidential media cycles. Evidence of this may be found in the sharp increase of Google searches for "Electoral College" and "popular vote" during election years. The most prominent alternative election system remains the complete abolishment of the present system in favor of the NPV. While this method of determining the highest office in America does alleviate many of the criticisms outlined above, it fails to address several key nuances of the Electoral College and introduces a number of problems of its own.

Most obviously, the NPV method would minimize the voice of less populous states. While the popular vote argument calling for equal and equitable voting certainly remains valid, even desired, it ignores the importance of regional preferences. As our nation has developed and constructed its identity, state boundaries have given rise to localized needs. Contained within state borders lie unique cultural identities, economies, and communities that depend on each other for growth.

The Electoral College does not count a Montanan's vote differently than a New Yorker's vote, or a West Virginian's differently than a Floridian's, but rather ensures a count of all states' votes. Under the present structure, every state, regardless of cultural or economic needs, maintains representation. We may realize this concretely by considering the structure of the Senate. Regardless of population, all states enjoy equal footing, ensuring no state or state-level need goes wholly without ear. When a region's voice is disregarded, the nation's democracy dims. The District of Columbia famously taunts "No Taxation without Representation" on every license plate because residents do not enjoy congressional representation. State-level voices matter. To silence these voices in our nation's electoral process would be a scourge on democracy.

In this dilemma, proponents of the NPV ought to feel a sense of distress over the Electoral College's ability to truly give equal weight. A common defense of the NPV generally follows that because it forces more distributed vote earning, it may lead to candidates focusing on the needs of small states even more than they presently do, citing the fact that America's 50 largest cities account for only 15.1 percent of the total population.[13] However, Figure 1 shows how a candidate in a popular vote election could easily target a few counties in order to reach more than 50 percent of the population.[14] By focusing on the most populous areas, presidential candidates could ignore enormous swaths of rural and suburban voters and avoid giving attention to some states entirely, yet still claim the presidency.[15] If adopted, the increasing number of people migrating to urban centers would exacerbate this flaw of the NPV until only the largest population centers decided the presidency.

A Call for Compromise

Most Americans over the past 60 years have supported an abolishment of the Electoral College in favor of a NPV system.[16] Large fluctuations fall in tandem with election cycles, but the majority opinion persists.[17] The Electoral College lags behind our pro-

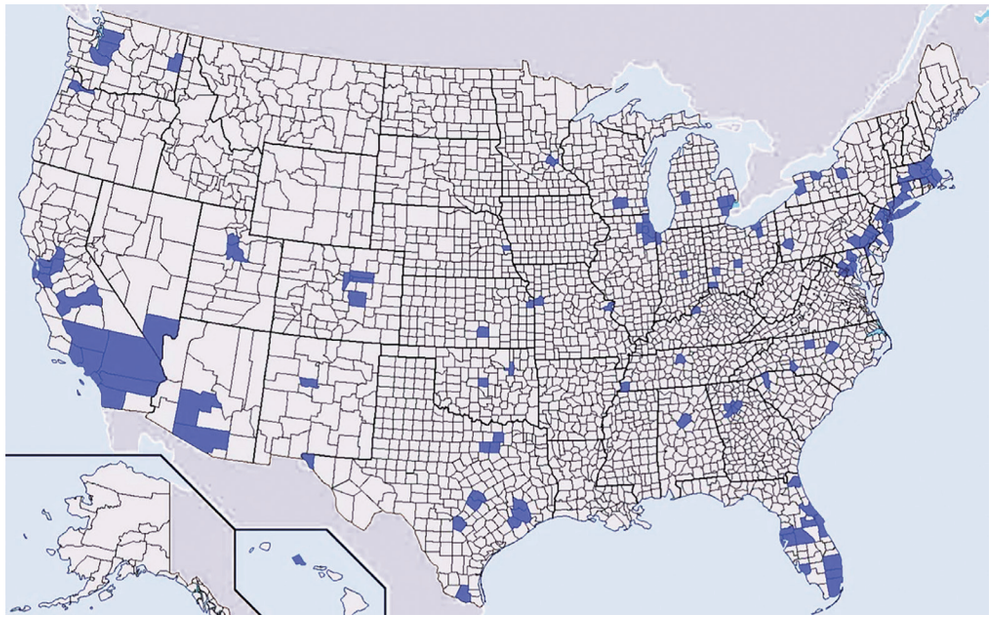


FIGURE 1. SEQ FIGURE ARABIC 1 COUNTIES COMPROMISING >50% OF THE US POPULATION

gressing culture, concentrates messaging to a few battleground states, suppresses voter participation, and bears the ugly scar of racist beginnings. Electoral systems should first and foremost capture the opinion of the people. Not a few people, not a select group of people, but the people. By this metric, both the Electoral College and the NPV fall short.

Due to the politicization of the electoral process, agreeable means of reform are exceedingly difficult to find. When pundits or politicians speak for or against our election process, the motives tend to lie in self-interest. Sadly, these motives also tease out the voices that benefit a particular party, pushing partisanship onto an issue that all should be invested in. Despite striving for a democracy, reality does not meet desire. Neither the Electoral College nor the NPV reflect the voice of the People. Given that the principles of democracy depend upon the integrity of the electoral process, our present dilemma demands a solution.

A Proposal

The ultimate downfall of both electoral systems lies in their vulnerability to manipulation. The politician's manipulation exists due to the desire, ability, and efficacy exploiting a flawed system. A solution must then revoke the possibility of exploitation. To this end, a more balanced system must meet several criteria in order to be a feasible solution. The system must require that candidates win more votes overall. The system must be sensible and avoid monumental change. Lastly, the system must be non-partisan and draw support from advocates across the political spectrum. The proposal presented here attempts to address these multiple requirements through one pivotal change: the allocation of 51 electoral votes to the plurality winner of the popular vote.

To address the need to require more votes in order to secure a victory, let us again turn to the data presented in Table 1. Under the proposed system, a candidate must win 295 votes in order to obtain a majority. Below, in Table 2, the data continues in order of increasing state population until surpassing the 295 threshold.

TABLE 2: ELECTORAL VOTES NEEDED TO WIN UNDER A MIXED SYSTEM[18]

STATE	VOTES CAST (2012)	VOTES NEEDED TO WIN	ELECTORAL VOTES
Washington	3,125,516	1,562,759	12
Virginia	3,854,489	1,927,245	13
New Jersey	3,651,140	1,825,571	14
North Carolina	4,505,372	2,252,687	15
TOTAL		**33,662,996**	**297**
TOTAL U.S. VOTES	**129,227,221**		**589**
SHARE OF TOTAL		**26.0%**	**50.4%**

For a candidate to cross the new 295 electoral vote threshold, one would need to win in Washington state and North Carolina. Doing so gives the candidate a slight majority of 297 electoral votes and an improved minimum vote percentage of 26 percent. Using 2012 data, this amounts to an increase of 7,630,888 votes.

Regarding a sensible system, consider again that only four elections have been won by the popular vote loser. Under the proposed system, forty-two election outcomes would remain unaltered. Of the four elections where such a change might have mattered, two would have been shifted under the proposed compromise. In the remaining two elections, the results would be unchanged, provided candidates did not cater to a broader base of voters given the new popular vote weight.

The system achieves non-partisanship by combining the brighter points of the Electoral College and the NPV method. Given that the Electoral College structure persists under the proposal, all states, in particular less populous states, maintain their voices and importance in federal elections. However, the added weight given to the popular vote bolsters the importance of all voters, without bias, and regardless of the resident state.

Readers may be wondering why the proposal calls for specifically 51 Electoral College votes. The new electoral value must be as unbiased as possible. However, some degree of subjectivity will persist in any basis, and thus a more symbolic method arose. In an effort to provide a real-world basis for the figure while remaining practical, 51 became the recommended number for the following reasons:

1. Fifty-one represents each of the electoral vote-holding entities that exist today; that is, the 50 states and the District of Columbia. By choosing 51, there exists a means for the allocation of electoral votes to the popular vote to expand with the nation. Should Puerto Rico, Guam, or any other territory be incorporated into the United States, the number will increase by precisely the number of entities that join. Imperatively, 51 does not mean an allocation of one electoral vote per state (and D.C.) It is simply a representation of the number of existing voting districts in America at any given time, thus also changing in accordance with the nation.

2. The change this figure presents maintains feasibility where a more substantial change may not. Intuitively, one may see how allocating a number far too large (for example, 500 Electoral College votes) would not assist the goal of amending our flawed but functional system, but rather would obliterate it.

3. Fifty-one does not introduce political bias – any political party could stand to benefit from such a change if different campaign tactics were implemented prudently. Deeper than parties and political ideals, this compromise broadens democracy and strengthens the voice of Americans. Every

single American vote stands to increase in strength through the proposal.

Aside from the numerical value itself, the proposed mixed-method approach provides a number of benefits without introducing chaos or difficulty. By largely preserving the Electoral College process as it stands, no adjustments or alterations need to be made to any existing legislation that dictates state electoral processes. States maintain complete control over the selection of their electoral allocation method. Maine and Nebraska may continue to implement congressional representation, and any others are free to join them. Furthermore, no new electors need to be established since the electoral votes under the mixed-method compromise are not state-allocated. Here, the electoral votes are not represented by any tangible body of people but are themselves a representation of a statistic. "Faithless" electors are an impossibility.

Notably, the mixed-method proposal has many implications for improved campaign practices and voter representation. In order to safely win an election, no political party could afford to ignore either aspect of the system – the existing Electoral College or the NPV. Given the viability of targeting the popular vote as a successful strategy, candidates would need to adopt elements of both systems into their campaigns or risk defeat. Through a need to address both elements of the system, shortcomings of each pure method fade while the benefits of each elevate.

For example, since receiving a portion of any state's votes bolsters the odds of winning the 51 national electoral votes, the proposal has the ability to strip away battleground states' ultra-competitive edge. As a result, candidates would no longer need to spend a disproportionate amount of time or resources attempting to narrowly break a state's popular vote cusp. Balanced messaging and broad support would become viable strategies and result in political platforms that better reflect the needs of the national body.

Above all else, the proposal grants every American a stronger vote. No matter the district or county or state, every vote cast would have added value. Voters in dense, populous states would no longer be underrepresented as individuals, while those living in smaller states would still be able to project their voice to the national level. Under both scenarios the proposal incentivizes states to produce the highest possible turnout in order to contribute the greatest possible weight to the 51 national electoral votes. Voter suppression would inevitably persist, but deeper scrutiny of state turnout would likely increase, bringing greater awareness to disparaged communities and reducing ostracism. The mixed-method system emboldens the American voter without compromising state-level needs.

The proposal grants every American a stronger vote. No matter the district or county or state, every vote cast would have added value.

Of the hurdles the Founding Fathers sought to overcome with the Electoral College, none are lost in the proposed compromise. Elections continue to be protected from foreign influence and dogmatic party leadership, both through transitory assemblies of electors and an incorruptible statistic of 51. Congressional influence does not dictate the American leader, and thus no president becomes beholden to Capitol Hill. The raised threshold of victory necessitates a broader sampling of the American population but does not do so at the expense of small states or fewer urban voters.

The proposal finds its strength by balancing state and federal values. Championing a solitary solution that neglects the needs of many Americans will never prevail; only with a carefully crafted compromise can we remedy our failing system. With the simple addition of 51 electoral college votes to account for the national popular vote, the mixed-method proposal accomplishes exactly that. It mitigates the shortcomings of the individual methods while maintaining and improving upon their benefits. Presidential candidates would face a need to reach voters from all walks of American life, promoting a political era of reformed campaign strategy and a dampening of hyper-partisanship.

For the first time in nearly 60 years, our electoral body would increase by Constitutional provision. As more voices are heard in presidential campaigns, our leaders would begin to better represent the People. The proposed compromise, shaped for the people, forces the needle of our republic to redirect towards democracy. In reading this article, continue the discourse; through discussion and compromise we will achieve the best possible outcome for each other. Only together may we work towards a more perfect Union.

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Access to Contraception and Reproductive Rights in the Philippines

— Aparna Nellore

Edited by:
Jaemie Anne Abad
Georgia Gillan
Amrutha Ramaswamy

Abstract

The Philippines faces a problem of inadequate contraceptive usage, which leads to unintended pregnancies, risky medical procedures and lack of women's control over fertility decisions. High birth rates are correlated with poverty, which impacts women and vulnerable populations most heavily. This article considers three alternatives: distributing contraceptives for free to low-income women and families through a home-delivery service; updating laws on contraception and abortion; and strengthening family planning campaigns. When combined, these policies would improve health outcomes for women and empower them to plan and space their fertility decisions.

Introduction

The Philippines is one of the 179 countries that agreed on a call for all people to have access to comprehensive reproductive health care as part of the International Conference on Population and Development in Cairo in 1994.[1] Despite recognizing that reproductive autonomy and safety is critical to expanding women's opportunities, the promise remains unrealized. The lack of access to modern contraceptives in the Philippines leads to unintended pregnancies and unsafe abortions that have adverse health impacts for women, contributes to inequitable social and economic outcomes, and violates women's rights.

The Philippines has one of the highest birth rates in Southeast Asia.[2] Many of these births are among women who did not want to get pregnant but had no means to prevent it. Over 30 percent of pregnancies are unintended.[3] Many other women resort to unsafe abortions and other risky procedures, making the tally of maternal deaths around 1,000 per year.[4] Many women have more children than they would prefer to have, demonstrating a lack of control over family size and autonomy over their fertility decisions. This is a violation of women's reproductive rights and freedoms.

Two-thirds of Filipina women are not using any form of contraception, including 49 percent of unmarried, sexually active women who do not want to get pregnant.[5,6] For many Filipina women, there is a disparity between her fertility preferences and what she does to prevent pregnancy. This is sometimes called her "unmet need." Among married women, 30.4 percent have unmet need.[7]

An estimated six million women have an unmet need in the Philippines, including two million poor women.[8] The Philippines' poverty rate is 16.7 percent, one of the highest in Southeast Asia.[9] At a macro level, high birth rates are positively correlated with poverty levels in developing countries.[10] The pressure of supporting a family that is larger than desired is greater on households with limited resources. Poverty impacts women to a greater degree than men and, when combined with higher healthcare costs for women, makes them more vulnerable to adverse health outcomes.[11]

> *For many Filipina women, there is a disparity between her fertility preferences and what she does to prevent pregnancy.*

In the majority-Catholic Philippines, where about three-quarters of the population consider religion to be "very important," the Catholic Church has a large influence over public policy decisions and leads the charge in opposing abortions and modern forms of contraception.[12,13] The Church and its associated allies have filed successful lawsuits that rendered the morning-after pill and family planning for minors without parental consent illegal. The choice of contraceptives offered in the market is limited due to Church-supported bans.

A lack of knowledge about family planning and sex education contribute to inadequate use of contraception. Anecdotes from social networks play a large role in informing people's perceptions of the health risks of contraception. This can lead to misconceptions about the efficacy of contraceptives and concerns related to IUDs, in particular.[14] The stigmatization of sex and social norms around gender roles, decision-making authority of men, and family size are factors in denying women access to contraception.[15] Other barriers include behavioral issues such as underestimation of the risk of becoming pregnant, the effort and dollar cost of purchasing contraceptives, the embarrassment of asking for it in a store, among other barriers to access.[16]

The COVID-19 pandemic has exacerbated poor reproductive health conditions in the Philippines.[17] It is estimated that there were

214,000 additional unplanned births in 2021. One major reason for the baby boom was the difficulty in accessing contraceptives during lockdowns or due to COVID-19-induced shortages.[18] Additionally, due to the increased pressure on health systems caused by the pandemic, attention to women's health may have been diverted. Service disruption, among other reasons, contributed to a 26 percent increase in maternal mortality relative to 2019.[19]

> *The stigmatization of sex and social norms around gender roles, decision-making authority of men, and family size are factors in denying women access to contraception.*

Improved Access to Contraception Comes with Societal Benefits

The lack of access to contraceptives has consequences that extend beyond individual women and households into the domains of public health, social and economic inequity, and women's reproductive rights. Modern contraceptives have positive externalities. They not only help women and families control fertility decisions, but also produce better outcomes for society in terms of fewer and safer births, reduced child and maternal mortality, opportunities for women to generate income, and more.[20] It is in the interest of the Philippines government to minimize the negative health outcomes relating to unintended or unsafe pregnancies and to prevent intergenerational poverty.

Women have a right to safe and high quality reproductive services and family planning, a right that is disproportionately denied to low-income women. Many women resort to expensive and risky procedures, a burden that falls more on the poor and most vulnerable. Reproductive health and family planning can generate better economic outcomes by allowing women to "postpone childbearing and to take up career options that were previously precluded."[21,22]

Current Provisions for Reproductive Health are Lacking

The Responsible Parenthood and Reproductive Health Act of 2012 (known as the RH Law) guarantees free, universal access to nearly all modern contraceptives at government health centers.[23] A number of provisions in the original bill were struck down, diluting the effectiveness of the law. Abortion is still illegal under this law, and women who undergo abortion for any reason may be punished by imprisonment for up to six years.[24] However, the RH Law recognizes women's needs for post-abortion care. The implementation of the RH law is siloed to individual agencies and programs and focuses heavily on family planning at the expense of other aspects of reproductive health.[25]

> *Women who undergo abortion for any reason may be punished by imprisonment for up to six years*

In 2017, President Rodrigo Duterte issued an executive order that granted free access to contraceptives for six million women who could not obtain them.[26] The global initiative FamilyPlanning2020 (FP2020) believes that the Philippines is on track to further strengthen access to modern contraceptive methods.[27] However, the Philippines is also one of the few countries with increasing rates of HIV infection and teenage pregnancy., Under the status quo, some women's health metrics may continue to see improvement,

but are more likely to taper off.[28,29] There is evidence from similar developing countries, like Pakistan, that contraceptive use slows down and plateaus.[30] Under the status quo, contraceptive use rate does not seem likely to rise, as barriers to contraceptive access or use remain unaddressed.

Policy Alternatives

1. Free Government Provision of Modern Contraceptives to All Filipino Women

The current distribution of contraceptives is inequitable, which is compounded by difficulties in accessing them due to COVID-19 lockdowns, social norms, and lack of knowledge.[31] Various behavioral and social issues present barriers to contraceptive use. The time and effort required to procure contraceptives may discourage many women from doing so. A study from Matlab, Bangladesh found that sending a female health worker to the homes of married women to offer free contraceptives and other health services led to a decline in fertility and maternal mortality rates. Moreover, social norms may make contraception a taboo topic around the house.[32] Women are more likely to take up family planning and contraceptive supplies in the absence of their husbands.[33]

The proposed alternative is a free, monthly home delivery service for low-income Filipino women, containing their chosen method of modern contraception. For families that can afford supplies, private markets should be stimulated to provide a subscription-type delivery box, as is available in the United States.[34]

Distribution of contraceptives through home delivery systems would address the problem of lack of access and potentially low usage. It would eliminate barriers such as embarrassment of asking for contraception, discomfort of discussing it at home, and the cost and effort taken to procure contraceptives. Removing out-of-pocket costs may reduce income-related disparities, promote more consistent contraceptive use and decrease birth rates.[35]

The societal cost savings from reducing unintended pregnancies would also lighten the burden on public health systems.[36] There is little chance of political pushback for this alternative, as it is just a more effective distribution method for contraceptives that are already earmarked for Filipino women. Additionally, private firms would be willing to enter the market provided there is a business case.

2. Amending Laws to Preserve Choice in Contraceptive Methods

United Nations human rights experts have called on states to revoke laws that deny access to safe abortion, which instrumentalize women's bodies and violate women's human rights.[37] Ireland, also a majority-Catholic country, repealed an amendment of the Constitution banning abortion in almost all circumstances in 2018.[38] After the repeal of the anti-abortion amendment in Ireland, there was a huge rise in the number of legal abortions in-country and fewer women traveling across borders to get the procedure.[39]

While former President Duterte demonstrated support for preserving women's reproductive rights, the country has not gone far enough to address the ban on abortions. Reconsidering regulations that currently outlaw abortions would expand women's reproductive rights by allowing choice and autonomy over their fertility and contraception decisions. There is currently little data on how many unsafe abortions and maternal deaths would be prevented by implementing this policy change. The legalization of abortion will only result in a positive impact if healthcare providers ensure easy access.[40]

Despite the Church's strong influence on policy, there are several enabling factors that may support regulatory change:

PUBLIC SUPPORT

Filipinos seem to be less conservative than the laws that govern them.[41] There is still demand for abortion and artificial contraception despite the Catholic Church's opposition. About 600,000 women still get abortions yearly,[42] and 70 percent of Filipinos expressed support for the 2012 RH Law when polled.[43]

POLITICAL LEADERSHIP

Former President Duterte expressed support for women's health and reproductive rights and has been publicly at odds with the Church. Despite severe criticism for his violent 'war on drugs' in the Philippines, he was applauded for his 2017 executive order to provide modern contraceptives.[44]

ISSUE FRAMING

Framing the topic of contraceptives as a women's rights issue may not be sufficient to overcome the Church's opposition. Instead, evidence-based arguments in national interest may be more powerful. Policymakers could frame increasing access to contraception as a means to prevent intergenerational poverty and negative health outcomes for the entire population, as well as granting women additional economic opportunities.

Policymakers could frame increasing access to contraception as a means to prevent intergenerational poverty and negative health outcomes for the entire population.

3. Information Campaigns on Family Planning

United Nations human rights experts have
Family planning programs typically consist of educational, social, and medical services aimed at assisting individuals or families to make informed decisions about the number of children to have and spacing between children. Evidence shows that when family planning programs are in place, in the long-term, women have between five and 35 percent fewer children and space their pregnancies further apart.[45] Family planning programs are also associated with higher incomes and lower poverty.[46]

Improving family planning programs in the Philippines would address the problem of low contraceptive usage by tackling existing constraints, such as lack of knowledge, overestimation of risks of contraceptives, underestimation of likelihood of becoming pregnant or contracting STDs.[47]

TWO AVENUES TO RAMP UP FAMILY PLANNING ARE:

a. Door-to-door campaigns carried out by well-trained health workers targeting women and their partners. Involving men in family planning discussions dispels misconceptions around contraception and fosters open discussion within the family.[48]

b. Using mass media (especially radio, television and newspapers) to effectively disseminate information regarding women's health and encourage them to seek health services. A study from Myanmar and the Philippines established a connection between exposure to media and likelihood of women using contraception.[49] The media message would be framed as improving overall healthcare, rather than focusing on contraception, in order to avoid the stigma around sex and birth control.

Information campaigns can shape decision-making by expanding knowledge of and dispelling misconceptions about contraception. A study in Burkina Faso found that a mass media campaign promoting family planning and modern contraception led to a six percentage point increase in use of modern contraceptives, which translated into a ten percent reduction in births and an increase in women's self-assessed health and well-being.[50]

Door-to-door campaigns and the use of mass media would require government resources and manpower on a large scale. The Burki-

na Faso study concluded that mass media campaigns are highly cost-effective. An estimated 37,000 additional women took up modern contraception as a result of the campaign at an annual cost of US$42.50 per additional woman. A nationwide scale-up of the program is estimated to drop the cost by six times.[51]

Recommendation: A Package of Policies

The first proposed policy alternative, free government provision of contraceptives, directly addresses the problem of inadequate supply. The second alternative, revoking the law banning abortions, tackles the broader issue of women's reproductive rights. The last alternative emphasizes public education and awareness about family planning and contraception. As each policy alternative targets different dimensions of the identified problem, they would be most effective if implemented together.

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The Promise, Challenges, and Solutions for Managed Aquifer Recharge in California

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Abstract

Managed Aquifer Recharge (MAR) is a potential solution to California's water supply challenges. MAR, which is the intentional storage of water underground for use at a future time, has a number of potential benefits given California's challenging natural hydrology and the effects of climate change. This article identifies some of the key technical, financial, and legal difficulties of implementing MAR and discusses potential solutions in each of these areas.

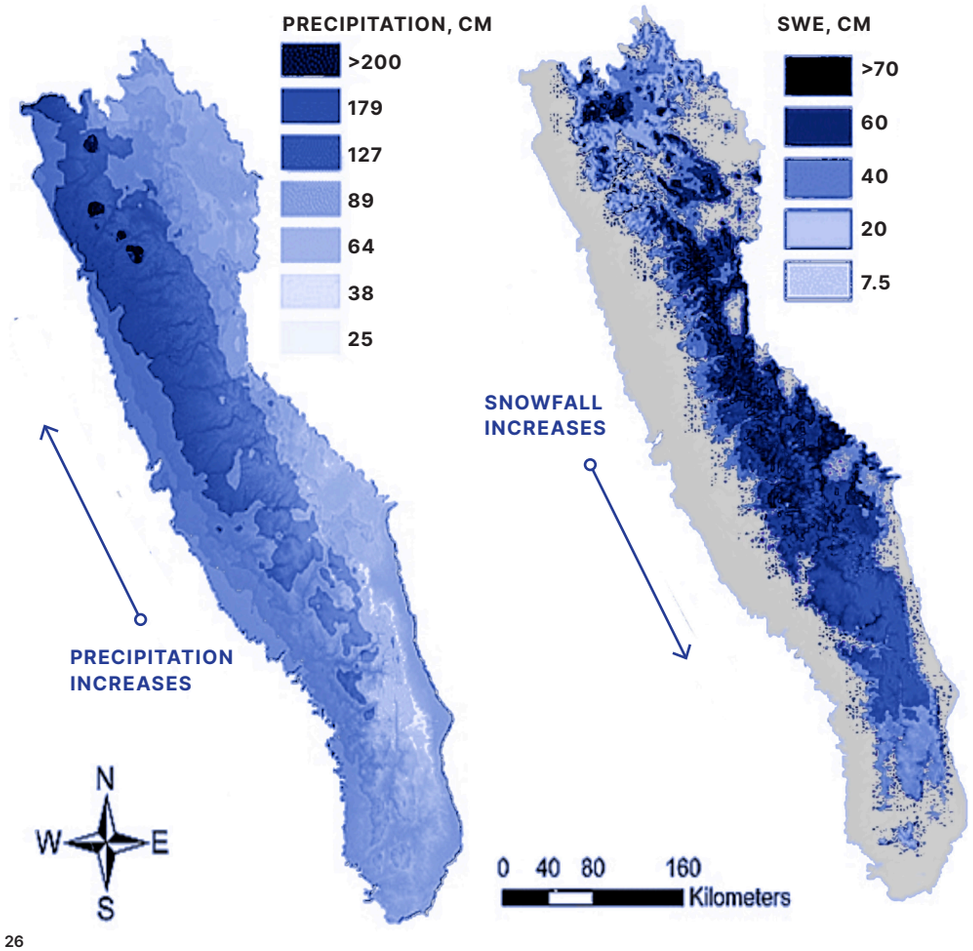
Introduction

California faces many unique challenges related to its water security and will face more in a climate-changed future. The state typically experiences wet winters followed by dry summers, meaning that winter precipitation must be stored for use in the summer.[1] In addition, California receives much of its precipitation in the northern part of the state (see Figure 1), while much of its population lives in the southern part of the state.

To address the spatial mismatch in precipitation and needs, California manages a variety of aqueduct systems to transport water from north to south (see Figure 2) via the Federal Water Project and State Water Project.[2]

In addition, California has a large agricultural sector, which provides a third of the nation's vegetables and two-thirds of its fruits and nuts.[3] This sector is politically powerful and relies heavily on groundwater pumping for crop irrigation. Farmers are pumping groundwater (bringing underground water to the surface) so rapidly that many parts of California, and especially the Central Valley, are experiencing land subsidence, declining groundwater levels, and likely permanent loss of water storage potential.[4] Researchers estimate that California farmers will need to temporarily stop using 500,000 to 1,000,000 acres of land to achieve groundwater sustainability.[5]

Figure 1: Precipitation and snowfall in California's Sierra Mountains. From Bales, et al. 2006.



Climate change is exacerbating many of the challenges listed above. First, snowpack plays a critical role in storing winter precipitation for later use in the summer as the snowpack melts. As the climate warms, snowmelt will both occur and peak earlier in the year.[6] As snowmelt begins to occur during wet winter months, the resulting water flows will further jeopardize the stability of surface water storage in California. New storage will likely be needed to capture those earlier flows.

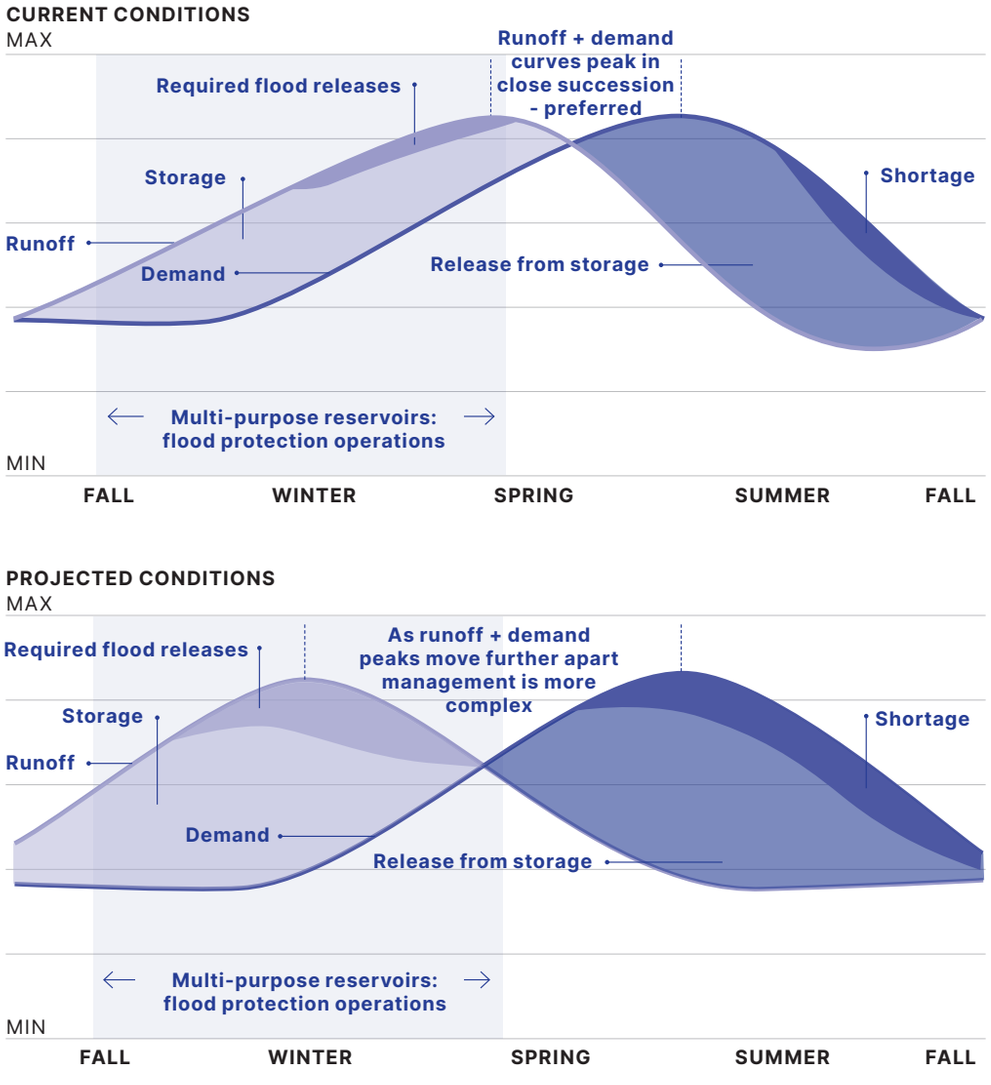
Otherwise, dams may need to release water to prevent flooding during large storms (see Figure 3).

Second, climate modeling suggests that both droughts and floods will become more extreme in the future.[7] California already tends to experience wet and dry years, and climate change will only lead to more prolonged droughts punctuated by excessive precipitation.

Figure 2: California's surface water conveyance system. From California Department of Water Resources, 2015

To address these challenges, California passed the Sustainable Groundwater Management Act (SGMA) in 2014.[8] SGMA requires groundwater basins to achieve sustainable levels by 2040. Local Groundwater Sustainability Agencies (GSAs) had to submit plans by January 2020 to the California Department of Water Resources describing how they would reach this goal. According to Aaron Fukuda, general manager of an irrigation district in the Central Valley, accomplishing this objective will mean taking advantage of what will likely be only three or four wet years between 2022 and 2040.[9]

Figure 3: Under current conditions in California (top graphic), reservoirs store most winter precipitation and provide water resources when there is higher demand in the spring and summer. However, under future conditions in which snow melts earlier (bottom graphic), reservoirs will need to release more water (Required flood releases) before high demand periods for water. These earlier releases will create larger water shortages (Shortage) during those high demand times. From California Department of Water Resources, 2015.



In this context, managed aquifer recharge (MAR) is a technology and practice that holds significant promise for managing water resources. It allows for the capture and underground storage of flows in wet seasons to be accessed during dry periods. MAR can be done in multiple ways and with many different sources of water. For instance, water can come from capturing stormwater, or potential flood-water flows, and recharging it into the ground. Water for MAR can also come from wastewater treatment facilities, which is already done in many parts of California. For example, the Kern Water Bank uses 70 recharge ponds that have capacity to recharge half a million acre-feet of water per year.[10] Meanwhile, a MAR project in the Los Angeles Basin provides a buffer against seawater intrusion into local groundwater sources.

Another potential source is flows from diversions of surface water. MAR can move this water underground for storage in multiple ways. For instance, water in spreading basins can seep slowly into the ground and injection wells can pump water below the surface. These are only a few of many approaches to MAR.

MAR has many benefits. By increasing groundwater levels, MAR can play a significant role in helping water agencies meet SGMA goals. Furthermore, MAR presents a "supply-side" water solution (increasing water available to use) rather than a "demand-side" solution (reducing water use). Supply-side approaches are typically more popular and politically palatable than policies that require using less water (especially in agriculture, where conservation often entails fallowing land or growing lower-priced crops). Finally, MAR is often cheaper than other water sources, such as desalination or importing water from distant sources. This article explores the technical, financial, and legal challenges of MAR, and some potential solutions.

Challenges for MAR in California

MAR faces many technical, financial, and legal challenges. Technical challenges include identifying suitable soil types, minimizing potential water pollution risks, and improving forecasts that inform dam operations. Financial challenges include high upfront costs of procuring land, project development timelines, and a lack of available funding. Finally, California's complex water rights system poses a further challenge to MAR. The sections below discuss these different types of challenges and potential solutions.

Technical challenges

Finding the most suitable locations for MAR that minimize unintended consequences while meeting societal challenges can be difficult. This is because MAR requires water to quickly percolate and flow into underground reservoirs. In addition, because groundwater levels affect adjacent surface water, MAR can also create unintended consequences that could alter surface water availability and allocations for surface water users. Therefore, project planners must determine the suitability of subsurface soil types for these flows prior to project development and MAR benefits from technologies that can determine an area's subsurface geology quickly and cheaply.[11] These technologies can help planners understand flow rates and implications for interconnected groundwater and surface water systems.

In addition, many MAR projects need accurate precipitation and streamflow forecasts to maximize their use because they are downstream from dams. Operators must trust these forecasts to release and recharge water at optimal times to balance needs for flood prevention, water storage, and possibly hydropower generation.[12] Lastly, MAR project sites also face significant pollution challenges—especially in agricultural areas—from salts, fertilizers, and pesticides.[13]

Potential solutions to technical challenges

To improve project siting approaches, the federal government, universities, and private philanthropy should fund basic research in soil geology, the impact of MAR on pollution, and weather forecasting. For example, a 2019 study showed that a towed time-domain electromagnetic method, a geophysical method for creating 3-dimensional images of the soil subsurface, can efficiently acquire subsurface data at a resolution and scale needed to determine the site suitability for MAR.14 Another study quantified the risk of nitrate and salt leaching below the surface to contaminate at-risk aquifers.15

Funding this type of basic research at federal and state levels can provide the technical details needed to do MAR efficiently and effectively while minimizing unintended consequences like pollution. Specifically, funding can help with research to determine how land or well types impact recharge rates and water quality. Research and modeling can also determine how integrating MAR and weather forecasts into dam operations could help or harm flood protection systems, ecosystems, and hydropower. Lastly, funding research to simply improve weather forecast skill at smaller spatial units or for greater lengths of time (e.g., five days vs. three days) can play a significant role in improving dam operation decisions to balance many needs, including flood prevention, hydropower, and MAR.16

Establishing partnerships between universities, landowners, farmers, and water authorities can make this research actionable. For example, the Re-Inventing the Nation's Urban Water Infrastructure (ReNUWIt) Engineering Research Center worked with water utilities to evaluate cutting-edge technologies in demonstration projects.17 Similar efforts geared toward MAR can implement and improve technical solutions, communicate results to others, and create the partnerships needed for larger-scale implementation. In addition, governments may also need to provide subsidies or other support to ensure these technologies are affordable. Support for technological developments can enable all stakeholders to quickly understand soil types, underground flows, and pollution levels to implement MAR more effectively.

Financial challenges

Financial challenges also create difficulties for scaling MAR. Developing a MAR project can be expensive—land purchases, feasibility studies, and infrastructure to develop a site all add to project costs. A study of proposed California MAR projects found that the median project would cost $2.2 million.[18] These costs pose a challenge for local entities that typically must fund MAR projects with limited state support—even those in urban areas with more customers. In general, the United States does not invest enough to meet water infrastructure needs, which makes obtaining financial resources challenging. The American Society of Civil Engineers projects that the U.S. water sector will underspend on water-related infrastructure needs by $2.2 trillion from 2019 to 2039.[19] This $2.2 trillion projected shortfall does not "reflect financial impacts from climate change," indicating that the true investment deficit is likely higher.

The American Society of Civil Engineers projects that the U.S. water sector will underspend on water-related infrastructure needs by $2.2 trillion from 2019 to 2039.

Potential solutions to financial challenges

Given the lack of capital investments in water, securing financial resources will play a key role in enabling MAR to scale up and better support sustainable water resources management in California.

Tiered or budget-based water rates for agricultural users can help meet these financing needs. Many urban water systems in California have adopted tiered or budget-based water rates for single-family residences. In a tiered rate structure, each household pays increasing costs per unit of water once water use exceeds certain thresholds.[20] A budget-based water rate is similar, but the threshold at which water costs increase vary from household to household depending on the number of people who live in the home, the adjoining land, and other factors. In these rate systems, water costs are lowest for necessary indoor use, slightly higher for efficient outdoor use, and highest for inefficient outdoor use.

One can imagine developing a similar pricing structure in agriculture based on field acreage and crop-water needs. To maximize efficient use, water would cost less per unit for the small amounts needed to grow lower-priced staples like vegetables and cost more per unit for larger amounts needed to grow high-price crops like citrus and nuts. These rates could increase irrigation district revenue from growers of high-price crops while incentivizing users to conserve water.

Of course, such a proposal would face scrutiny and contestation in the political domain. As the Introduction mentions, California's agriculture sector is politically powerful. However, as water becomes scarcer and more unreliable, well-designed rate structures that drive prices higher for those farming higher-priced crops can more equitably shift cost burdens, raise revenue for needed MAR projects, and encourage conservation. These shifts would increase the reliability of the water supply for all users in the long term.

In addition to receiving increased user revenue from more efficient water rate structures, MAR projects will need funding from other sources. While state budgets, progressive water rates, and philanthropy can help meet investment needs, closing the $2.2 trillion investment gap in water infrastructure will also require the support of the federal government. The federal government has made some progress, investing $55 billion in water infrastructure through the Infrastructure Investment and Jobs Act of 2021.[21]

Water rights challenges

The complex surface water and groundwater rights systems in California is a significant barrier to MAR, as well as to the broader goal of water and groundwater sustainability.

CALIFORNIA'S SURFACE WATER RIGHTS SYSTEM

California has four different types of surface water rights: Pueblo, Reserved, Riparian, and Appropriative.

Pueblo rights come from the laws of Mexico or Spain. They provide pueblos, or cities, the right to yield all streams, rivers, and groundwater within a city's jurisdiction.[22]

Reserved rights refer to water set aside by the federal government in conjunction with land set aside for the public. This allows for reserved or tribal lands to use sufficient water to fulfill the "primary" purpose of the reserved land.[23]

Riparian rights attach only to parcels of land adjoining a stream. These rights apply only to water available under natural conditions, and must be used on property that adjoins the stream. Riparian rights holders share these rights. In other words, all owners of these rights share shortages.[24]

Appropriative rights are unconnected to land ownership and require demonstrated use of water over time for the owner to retain them. These appropriative rights are prioritized based on the doctrine of "first in time, first in right," meaning they are held by those who began using the water first.[25]

Water rights take priority in the following order: pueblo, reserved, riparian, and appropriative.[26] While markets can help provide flexibility to meet the needs of more people, they privilege those with more wealth, access to markets, and existing water rights.[27]

One issue with this surface water rights system is its sheer complexity. It combines elements of Mexican common law with both riparian and appropriative rights. In contrast, most of the Eastern United States only uses riparian rights and most of the Western United States only uses appropriative rights.[28] California also has a separate system of groundwater rights, even though surface water and groundwater are inherently connected.[29] Combining all of these water rights systems in California requires significant state monitoring and leads to many lawsuits over water allocations when the state tries to implement changes or curtailments.[30] Overall, the complex system gives priority to senior water rights holders and those with the financial means to access the legal system.

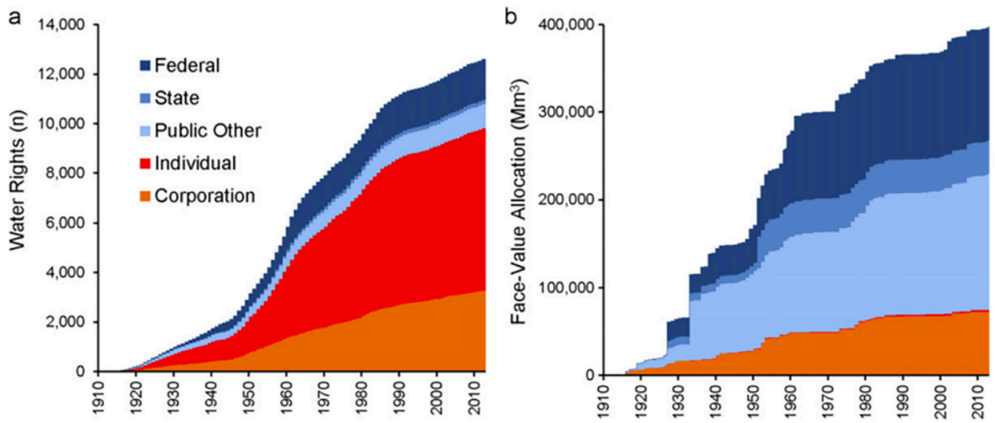
As MAR becomes more prevalent in California, it's unclear how the legal system will handle the conversion of surface water to groundwater that MAR requires. Currently, surface water stored underground is governed by the surface water rights system as long as the water will eventually be put toward a "beneficial use."[31] Legislation to recognize surface water recharge as a beneficial use has been controversial due to concerns that it could allow senior water rights holders to hoard water.[32] It is not hard to see a scenario in which surface water and groundwater rights holders engage in legal and political battles to control increasingly scarce and unreliable water sources in California rather than taking steps to maximize water storage capacity and capability.

When the government holds water rights, agencies can drive decisions and coordinate at the state and local levels to pursue the public interest for long-term water sustainability and equity.

Given the water challenges California faces, the state's complex water rights system will advantage those with access to financial, knowledge, and legal resources. These disparities will create distortions in water allocation mechanisms. Fortunately, public agencies own over 80 percent of California's surface water rights (see Figure 4), allowing them to serve the public interest in their distribution of water.[33]

When the government holds water rights, agencies can drive decisions and coordinate at the state and local levels to pursue the public interest for long-term water sustainability and equity. However, some basins have lower percentages of their water rights held by public agencies. For example, the public holds zero percent of water rights in the Kings River basin.[34]

Figure 4: Water rights allocations by number (left) and volume (right), Grantham and Viers, 2014



Potential solutions to water rights challenges

Increasing the share of water held by the public can reduce contention over converting surface water to groundwater, especially if that groundwater also remains publicly available. The state can bring more water into the public domain through a federally-backed and financed program that allows California to administer and run a voluntary water rights buyback program. Similarly, California could phase out—or time limit—water rights over a multi-year period as opposed to letting them last in perpetuity. If people know they will not be a senior rights holder forever, they will have more incentive to support initiatives that provide broader public access to water in their basin.

Alternatively, the state could also require that some percentage of private water rights be put toward public benefit each year. This approach would limit impacts on senior water rights holders and therefore be more politically palatable but would still ensure that some water is being distributed based on equity and public-benefit criteria in all basins, including those with no public water. Many river basins have 90 percent or more public ownership of water rights, so this program could be targeted to the few basins with more private ownership.[35] Finally, the public trust doctrine, which holds that state courts and agencies must protect public interests in waterways, can also ensure public ownership and public-interest decisions in water use.[36]

As mentioned earlier, the complexity of the water rights system has the potential to heighten legal disputes and tensions. However, these could be partially alleviated by the increase of peak stream flows due to climate change. For example, at a recent MAR conference, the California Department of Water Resources indicated that they are planning for scenarios in which the

Merced watershed reaches six times its current hundred-year peak flow in the future.[37] Another conference presenter simulated and began planning for a threefold increase in peak flows by 2070 in the San Joaquin valley. If peak flows do reach new maximums in this range, MAR can play a big role in not only capturing that water, but in helping to prevent flooding. Given that climate change will also make droughts more severe in California, there may even be a greater need to capture flows from precipitation events.[38] While these flows represent an opportunity, capturing them is a high-stakes challenge because they will occur infrequently.

Recharge Net Metering Case Study

The Pajaro Valley runs a "Recharge Net Metering" program to better manage its groundwater.[39] This program brings together many of the suggestions listed above. Farmers and landowners must pay for groundwater they pump in the Pajaro Valley; each well is metered to measure withdrawals.[40] As farmers and/or landowners recharge groundwater, they receive payment for that recharge at half of the rate it costs them to pump water from the basin. They do not retain the right to pump the water they recharged at a later time. Instead, that water becomes equally available to everyone in the basin. Third-party certifiers identify project sites and verify that the recharge is occurring. These certifiers sometimes also develop plans and raise funds to build recharge projects.[41]

The program works well because of its sound economics and incentive structure. For the Pajaro Valley water authority, paying landowners half of their selling price for water is significantly cheaper than the cost of their next most viable water sources, importing

water or building a wastewater recycling plant. Because the water authority pays for recharge at half the rate they sell water to users, the authority also makes a profit.[42] Those who recharge groundwater benefit by receiving credits on their water bill, and the entire basin benefits from higher groundwater levels and greater basin-wide sustainability.[43] Finally, recharge net metering provides an incentive for anyone paying for water in the Pajaro Valley to recharge groundwater as well.

This Pajaro Valley overcomes technical and financial barriers to developing MAR projects through its third-party certifiers. They help identify suitable locations for MAR and help raise funds for recharge projects.[44] Because recharged water remains equally available to everyone, the water rights remain in public hands. There is some risk that recharge net metering will benefit wealthier landowners and farmers who can afford the upfront costs of setting up and verifying their recharge projects. Oftentimes, water agencies contact landowners about preparing their properties for recharge and cover those costs. By prioritizing lower-income and high-potential sites for such grants and technical assistance, water agencies can ensure equitable access to recharge projects to mitigate some distributional impacts of recharge net metering.

Recharge net metering in the Pajaro Valley shows how individuals, the public, and a water authority can come together to develop recharge projects with benefits that accrue to both individuals and the broader community.

Recharge net metering in the Pajaro Valley shows how individuals, the public, and a water authority can come together to develop recharge projects with benefits that accrue to both individuals and the broader community. This example also shows how funding and partnership between governments and water utilities can lead to development of MAR sites. This approach can provide a framework for basins throughout California to scale MAR.

Conclusion

California faces many water resources management challenges. Precipitation falls primarily in the north and in the winter, but water is needed most in the summer and further south. Climate change exacerbates these challenges by reducing snowpack storage and causing more extreme droughts and storms. MAR can address these challenges by storing water underground when it is plentiful and pumping it during dry periods. However, MAR faces technical, financial, and legal challenges in implementation. Solutions include more support for research that can help projects understand and overcome technical barriers, federal funding for MAR projects, and making more water available for public-benefit uses through phase-outs or buybacks of water rights. Overall, MAR is well-suited to mitigate California's increasingly variable annual precipitation and enable the state to achieve sustainable groundwater levels. Continuing to address these challenges will be critical as MAR plays an increasingly significant role in making California more resilient to climate change.

MAR is well-suited to mitigate California's increasingly variable annual precipitation and enable the state to achieve sustainable groundwater levels.

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Low-Hanging Fruit: Advances in Sustainable Pesticide Applicators are Ripe for the Picking

— Ellen Kamps

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Abstract

Large-scale farmers in California rely on pesticides to protect crops that are worth $100 billion in revenue annually. However, the airblast sprayer technology used to apply these pesticides is decades old, resulting in pesticide drift, soil and water contamination, human health risks, and environmental hazards. What can California agencies do to minimize the economic, health, and environmental risks arising from airblast technology use on farms?

Introduction: A Contaminating Culprit

California's Ventura County is a veritable cornucopia. More than 70 percent of homes are within three miles of a farm that produces specialty crops such as strawberries, lemons, raspberries, and blueberries. But this $2 billion industry can make a noxious neighbor. In Ventura County alone, over five million pounds of pesticides are sprayed on these specialty crops every year, exposing tens of thousands of farmworkers and neighboring communities to harmful chemicals.[1]

Within Ventura's $2 billion agriculture industry, pesticide and herbicide drift is a growing problem. According to the Environmental Working Group, one fifth of the pesticides used on specialty crops in Ventura are linked to cancer, and according to the National Library of Medicine, the occupational hazards from exposure to pesticides are also linked to immune system disorders, reproductive issues, developmental disorders, and neurological diseases.[2]

According to the U.S. Geological Survey, pesticide contamination is widespread throughout the United States, posing several public health and safety risks. Pesticides were found in all samples from major rivers throughout the country, and the levels commonly exceeded the guidelines for the protection of aquatic life.[3] In 2012, the California Pesticide Illness Surveillance Program documented 237 cases of illness related to agricultural pesticide use, and in 2013, California's San Joaquin Valley's groundwater tested positive for high levels of common grape and citrus herbicides that threaten the ecosystem and human health.[4]

Airblast Sprayers: A Blast of Bad News

Pesticide contamination and exposure are largely caused by drift and runoff that are inherent to the technology used to apply pesticides: airblast sprayers. These sprayers use a fan and large amounts of chemicals and water to saturate specialty crops with pesticides. While the pesticide spray hits its target — the crops — the intensive water usage and wind can lead to harmful runoff and drift.

The problem is clear: pesticide drift and runoff, exacerbated by airblast sprayers, cause unacceptable soil, water, and air contamination.

Since the 1950s, airblast technology has been largely unmodified and is still the primary method of pesticide applications in California. Fundamental to their design, airblast sprayers require large amounts of water, chemicals, and labor, but they have remained popular due to their ease of use, and effectiveness in eliminating insects and diseases.

However, the wide-reaching negative repercussions of this technology are crystalizing as studies show that the health and wellness of farmers, California residents, and the environment are at risk. The problem is clear: pesticide drift and runoff, exacerbated by airblast sprayers, cause unacceptable soil, water, and air contamination.

A Case for State Intervention: Making Hay While The Sun Shines

California is in a unique position to challenge the agriculture industry's reliance on airblast spray technology. The state produces 90 percent of specialty crops grown in the United States for domestic consumption and international export.[5] The state cannot afford to miss the opportunity to address the threat that airblast sprayers present to California's natural resources, agriculture sector, and human health.

The Costs of Inaction

If present trends continue and airblast technology remains unchecked, it could impact the livelihoods of farmers and residents who live in agricultural communities, decrease the resilience of American farms, and degrade the natural environment.

Despite growing risks, regulatory bodies have not stepped in to discourage the use of airblast sprayers. The United States Department of Agriculture (USDA), Environmental Protection Agency (EPA), California Department of Pesticide Regulation (CDPR), and California Department of Food and Agriculture (CDFA) do not offer stringent requirements on sustainable spray technology for California farmers. Although federal and state agencies work together to regulate the chemical composition of pesticides, the onus remains on farmers to seek out technology that will serve their communities' well-being, the agriculture sector, and the environment.

Without intervention, farmers are likely to continue spraying pesticides using airblast sprayers. They will continue paying for excess materials, experience harmful exposure to pesticides, and pollute the environment and their communities.

Without intervention, farmers are likely to continue spraying pesticides using airblast sprayers. They will continue paying for excess materials, experience harmful exposure to pesticides, and pollute the environment and their communities.

Alternative Solutions: Nipping the Problem in the Bud with New Technology

As a result of advances in precision spray technologies, market-ready alternatives to airblast sprayers are available. These new technologies offer significantly reduced environmental and health impacts, while continuing to deliver important protection and nutrients to specialty crops.

Electrostatic spray technology allows farmers to reduce chemical exposure by minimizing drift, eliminating runoff, and saving time spent on applications in the field. Further, using less water and chemicals provides an opportunity for farmers to decrease their expenses. Switching to electrostatic sprayers could save farmers 2.8 million gallons of water per year on a 1,000-acre citrus orchard. On that same orchard, they would save $108,200 on labor and $71,526 on diesel per season using new technology.[6] Raising farmer income has many potential positive impacts: farming would be seen as a more viable occupation, incentivizing smaller, family-owned farms.

Criteria for Evaluation: An Effective, Equitable, and Feasible Yield

The state of California has various options to incentivize the transition away from airblast sprayers. When considering alternatives, it is important to evaluate them based on principles of efficacy, equity, and the feasibility of adoption.

An effective alternative helps farmers reduce their input costs: water and diesel usage, and the liability associated with exposure to pesticides. From an equitable lens, alternatives should allow all farmers to access new technology regardless of language or financial barriers.[7] Finally, feasibility adoption criteria will ensure that farmers, as agricultural experts, direct how new technology is adopted and implementation occurs, thus encouraging strong support that reimagines sustainable pesticide applicators.

A Trade-In Program Could Free Farmers from Reliance on Airblast Sprayers

A trade-in program could entice farmers to adopt new technology at a fraction of the cost. By offering growers of all financial means an equal opportunity to access this technology's benefits, this program could help free farmers from their economic reliance on airblast sprayers.

Inspired by the Car Allowance Rebate System of 2009, a trade-in program could encourage farmers to trade their airblast sprayer in exchange for a credit towards the purchase of a new electrostatic sprayer, coupled with a low-interest loan over multiple seasons.

If this program were instituted by the state, it could offer an opportunity to trade in dated airblast sprayers. This state-led buy-back program could be led by the California Department of Pesticide Regulation, in concert with the California Department of Food and Agriculture, with opportunities for farmers to be involved with the rollout.

However, trade-in programs tend to be expensive. Using the Car Allowance Rebate System in 2009 as a case study for viability, some economists reported that the costs of the program outweighed all benefits by $1.4 billion.[8] Furthermore, some consumers were left with last-minute disqualified vehicles, preventing them from participating. If a trade-in program were to be adopted for airblast sprayers, it would need support with a strong cost-benefit analysis and adequate funding.

Update Educational Requirements for Pest Control Advisors

Another recommendation involves updating technical training to educate key stakeholders about alternative sprayer technologies. Pest Control Advisors (PCAs) are licensed individuals who offer recommendations on the agricultural use of pest control products and techniques to farmers.[9] This alternative proposes that the California Department of Pesticide Regulation offers continuing education classes to inform PCAs on the effectiveness of precision, electrostatic sprayers. At the time of this article, the continuing education classes available are limited to airblast and backpack sprayers.

Strengthening a lasting transition to sustainable agriculture practices requires assessing and accommodating a diversity of lived experiences. Studies indicate that pockets of immigrant farmers in the U.S., who climb the agricultural ladder from laborer to farm owner, are choosing agrarian methodologies that involve low-spray and integrative pest management.[10] Yet, non white immigrants still face obstacles based on class and ethnic status, in addition to linguistic, literacy, and educational limitations. In an effort to promote equity within this recommendation, and to build a more unified network of sustainable advocates, PCA classes should be offered in languages beyond English and Spanish, such as indigenous languages from Mexico, (Amuzgo, Chatino, Mazateco, Mixteco, Nahuatl, Triqui, and Zapoteco), as well as Hmong, Tagalog, and Punjabi.

This alternative would require an investment of time and procedural examination, and risks pushback from airblast manufacturers and pesticide companies. To alleviate the challenges involved with restructuring state licensing curriculum and promoting language access, it would be wise to coalesce environmentalists, farmers, and agricultural communities to raise awareness of market-ready sustainable pest control technology.

The initiatives proposed above could support and strengthen the position of farmers as the backbone of America while addressing human health, agricultural, and environmental hazards.

Ripe for the Picking: Conclusion and Next Steps

California government agencies should consider multiple ways to transition farmers who run on small margins to adopt cleaner technology. The California Department of Pesticide should encourage the adoption of new pesticide spray technology through a trade-in program. It should also provide crucial system support and education through an updated PCA training curriculum. While these policy changes would realistically take several years, farmers and their neighbors could reap the benefits within the first season. This multi-stakeholder approach considers key tradeoffs and potential benefits for farmers, farmworkers, agricultural communities, and the environment.

The initiatives proposed above could support and strengthen the position of farmers as the backbone of America while addressing human health, agricultural, and environmental hazards.

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An Interview with Michelle Reddy, PhD

Program Director of the Master of Development Practice and Professor of Practice at GSPP

Interview by:
Alex Reep
Isabela Scarabelot
Karen Toro

Michelle Reddy is an Assistant Adjunct Professor and Program Director for the Master of Development Practice (MDP) at the University of California, Berkeley. She has also been a lecturer at Stanford University and Sciences Po, and from 2019-2022 she was a postdoctoral fellow in Comparative Politics and International Relations at Sciences Po. She received her PhD in 2019 from Stanford University in International Comparative Education. Prior to Stanford, from 2010-2014, Michelle was Assistant Dean at the Paris School of International Affairs, which she helped launch in 2010. She draws on political science and organizational sociology to investigate the role of non-state actors, such as NGOs, CSOs, parents' organizations, teachers' unions, in development, democratization, and crises. Michelle is passionate about novel approaches to research design, including making RCTs more participatory. Originally from Brooklyn, New York, Michelle has worked in the US, France, Senegal, Guinea, and Sierra Leone.

MICHELLE REDDY, PHD

Karen Toro (BPPJ): First, could you introduce yourself in your own words?

Michelle Reddy (MR): I'm Michelle Reddy. I'm the Program Director of the Master of Development Practice (MDP) at UC Berkeley, which is now part of the Goldman School of Public Policy. I'm also a professor of practice at the Goldman School, meaning I teach the MDP seminar. I'm originally from Brooklyn, New York and have lived in a variety of places — mostly France and West Africa. Now, I've lived in California for a total of seven years, because I received my PhD and a master's degree from Stanford. My background is in international development, focused mostly on education, civil society, and political science. A lot of my research focuses on domestic organizations working on education and health in developing countries, as well as crises. I've worked on three crises: Ebola, migration, and COVID-19.

KT (BPPJ): How do your personal experiences as a first-generation college student, a first-generation American from Brooklyn, and a woman inform your work?

MR: One, I grew up in a place where my neighbors were from all over the world. Many were immigrants, including my parents, and I grew up hearing a lot of different languages. Oftentimes, when I go to West Africa, I'm asked, "Why would you leave the United States to come to West Africa, and what makes you interested in coming here?" Going to a country that was very poor and has experienced famine, poverty, ethnic conflict, and that also was colonized made me interested in development challenges. My dad also was a Vietnam veteran, so I grew up hearing a lot of stories like, "We had this foreign intervention where the military told us people wanted us there. But you have to have the will of the people, and we learned that we did not have the support of the people in Vietnam" I think that really sparked my interest in civil society and empowering domestic actors as well. Also, I studied French in school and, in studying politics, I became interested in places that had significant political and economic challenges. So those two things brought me to French-speaking West Africa, to Senegal, and Guinea, and eventually Sierra Leone, and Ghana.

AR (BPPJ): What are you particularly passionate about within the sustainable development and public policy space?

MR: I'm really passionate about finding ways to empower local civil society and developing the capacity of organizations within developing countries to deliver services and to catalyze democracy. I think international aid has a lot of shortcomings. We tend to focus on the political economy, on institutions, and on institution-building, but institutions take a really long time to build, especially in places that are post-conflict or very poor. I'm really passionate about looking at local organizations as the building blocks of larger institutions. Unfortunately, it's oftentimes very challenging for these organizations to find funding.

I'm really passionate about finding ways to empower local civil society and developing the capacity of organizations within developing countries

AR (BPPJ): You've done a lot of work analyzing the efficacy of nonprofits in developing countries, no?

MR: Following the expansion of international NGOs, one of my teachers at Columbia asked us, "Shouldn't the purpose of an NGO be to do itself out of business?" It's true, if you're looking at international NGOs, but that's not what's happening. These organizations get larger and larger over time, and the same thing is happening with foundations or any kind of development aid organization. It's a big question we have to ask ourselves in terms of sustainability, and if the sector is really going to encourage development, I think we also need to encourage the capacity of local institutions themselves.

AR (BPPJ): Which individuals (thinkers, practitioners) have significantly impacted your perspective or career in this field?

MR: There are a few. One I speak really, really highly of is my former faculty chair at Sciences Po who was on the commission to establish the MDP. Her name is Laurence Tubiana. She was the French ambassador for climate change – very accomplished in the field of sustainable development. What I admire most are the people who are still humble and kind within their career. She's a really humble person, who you can easily talk with. That's something that motivates me.

AR (BPPJ): How do your cross-cultural experiences inform your current work as the new MDP visionary at Berkeley? What are considerations others should have in mind as they're working cross-culturally?

MR: One thing that I always take with me is that in Senegal, in the office, people go around and say "hi" to each other first thing in the morning. To a very busy American, it seems like, "Why would you do that? You need to start working right away." But [greeting everyone] is actually very efficient. Rather than being on email all of the time, you check in with everyone and gain a quick perspective on things.

There are things we can learn from professional practice in other contexts that are really useful and help us rethink how we do things. Oftentimes, the perspective is that the Western way of doing things is the way we should do things, and then sometimes you're in a context where you stop and realize, "There are different ways of doing this. I can actually change what I do." There isn't any one template because there are just so many different work environments. For instance, a lot of people feel Europeans work less than Americans, but, actually, they're very efficient with their time. How you organize your time is a big thing. It's not necessarily the number of hours you spend working, but efficiency is really important.

The generosity of people - with their time and welcoming me as a foreigner - has really has inspired me.

During my PhD fieldwork, I interviewed over 100 organizations. A lot of people in the U.S. were really surprised at how I was able to go through it so fast. For instance, the first time I did fieldwork, I interviewed 80 organizations in eight weeks across four field settings. But the reason why I was able to do it wasn't because I was really driven, though I was. It was because people were really willing to talk to me, especially in rural regions, outside of the capitals. People said "No one ever comes up here and talks to us or asks us questions." People are really eager to be heard, (which

made them eager) to spend their time with me. I really received this gift of time.

I remember helping some colleagues with a survey research on food insecurity and Ebola outcomes in a village in Sierra Leone, and people came up to me and gave me food. It put me in a strange situation because I didn't want to take food but I also had to take it for cultural reasons. The generosity of people - with their time and welcoming me as a foreigner - has really has inspired me.

AR (BPPJ): How did you reckon with your own positionality as a well-educated, white woman when you were doing this field research?

MR: That's something you always need to think about. Coming in, as a Westerner and as a white woman, and people are giving me the gift of their time. You need to constantly interrogate yourself and any assumptions and biases you may have - as well as that might exist within your training. I also have deep friendships from my work with people from the communities I have been to and this enables me to challenge my own perspectives and interrogate my own world view. An important thing that I practice is always trying to share or to give something back. For instance, I always try to pass on scholarship and funding opportunities [to interviewees or affiliated] organizations. After each interview, I usually would share a compiled list. I view sharing knowledge and opportunities as a way to counterbalance the privilege that coming from the West brings. Sharing opportunities is extremely important and I also try to connect people and help build networks. Positionality and reflection are constant, ongoing work.

Isabela Scarabelot (BPPJ): You managed the launch of the MDP at Sciences Po in Paris, and now you are the director of the same program here at UC Berkeley. What do you think is unique about the MDP? How do you feel it has evolved over the last few years?

MR: When I saw the job posting, I was super excited (and knew I had to) apply, because I love the MDP. I started with the MDP at Sciences Po, and we welcomed our first cohort in August 2011, so I've been with the MDP a long time. I first heard about the MDP when I was a Master's student at Columbia when their MDP program was launched in 2008. We were one year too late and were really disappointed because it was such a great program and we wished we had been able to do it.

The philosophy of the MDP is something that really excites me, because you have this interdisciplinary program, drawing on natural sciences, health sciences, business, social sciences, project management, and so on with the goal of training practitioners who can speak across a variety of sectors. That was something that was viewed as very lacking. A lot of the greatest minds in international development came together for the 2008 Commission on Sustainable Development to think about this program, [including] some of the people I really respect. They made it an incredible program, in terms of its philosophy.

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IS (BPPJ): What do you think we should know about the power of this MDP network?

MR: The MDP network is expanding globally. There are 36 universities globally, in addition to affiliate universities. I think it's really powerful that there is a global network of MDPs throughout the world.

IS (BPPJ): How can we - through this MDP network - work to decolonize knowledge through research partnerships, institutional partnerships, and between the MDP programs?

MR: There is a lot we need to change in the field of development. The way I think about this is informed by my training as a researcher, and there are a lot of problems with how academia is structured, in the rewards and incentives of research, that we need to change in order to decolonize knowledge. For instance, it's really important to co-author with scholars from the Global South. Citing authors from the Global South - and female authors - is key. In academia, oftentimes, there is pressure to just cite the leading figures, who are not representative of the global population. Fortunately, there has been some shifting. For instance, Oxford University Press developed guidelines for authors, asking submissions to include authors who are not necessarily the leading figures in the field in order to diversify who they cite and their authorship. Who we are reading and who we are citing is really important.

I can give an example of how decolonizing knowledge works. I've heard that there were arguably better COVID-19 outcomes in Rwanda. They have a good school of public health and Paul Farmer and Partners in Health were there, so there was a significant investment in research capacity. This is an important call for those of us in elite universities to really develop the research and technical capacity of the Global South in terms of disseminating knowledge and training people locally. It's really, really key that we do this. I hope that this is a shared vision within the MDP network. The MDP network convenes once a year and brings different faculty and program directors together, and some of these relationships form inevitably over time.

IS (BPPJ): That is great to hear. Coming from Brazil and having done a lot of research there, I know how hard it is to get our work out on an international scale.

This is an important call for those of us in elite universities to really develop the research and technical capacity of the Global South in terms of disseminating knowledge and training people locally.

MR: It is really hard. When I've done fieldwork, I have local research assistants who I work with and train as well. But getting their research out is a real challenge because a lot of the work is from the Global North. Something I wanted to do with the MDP seminar class, which is focused on international development policies and institutions, is to have students bring in readings on development from where they are from. I think those voices are really important when we are studying development.

IS (BPPJ): The MDP recently joined the Goldman School. What do you think this means for both the program and the school, in terms of new opportunities?

MR: It has been described by both the Goldman School and the MDP as a "win-win." We, as the MDP, will benefit from economies of scale at the Goldman School where there is a larger administration, a development office, and experiences like the DC trip. Similarly, for the Goldman School, they were very interested in having international students and an international program be part of Goldman because there is growing international interest. Also, a lot of the problems that California is facing are global problems, namely climate change and the impacts of climate change on migration, transportation, and urban policy.

IS (BPPJ): You have an incredible academic journey and vast experience in education. How do you see graduate school impacting the next career steps for GSPP students? What should these students consider as they

aim to make the most of their experience here at Goldman?

MR: It depends on what you want to do. What is great about the MDP and being in Goldman is you can take classes from across campus – it's really a unique gift. Having worked at a university outside of the United States and having many colleagues that were trained outside of the United States, something that a lot of people appreciate about the American higher education system is having a university with different departments and schools. I feel this is a really great learning laboratory. The MDP takes that one step further because it encourages you to take classes across campus. One thing also that's really unique about the MDP and Goldman is, despite the rigorous academic course load, students are very socially implicated as well.

KT (BPPJ): Do you have any advice for policy students on how to deal with adversity in the current job space, especially with the current macroeconomic climate?

MR: It's tricky. I think people feel they have only two years to figure out everything in their life. Students feel like they are under an enormous amount of pressure and that if they don't take this one class, they won't make it professionally or they won't get to where they want. It's important to know you don't have to figure it all out within two years. Take time to enjoy the environment you're in and to interact with your classmates. Networking and spending time among your cohort is really important. For instance, I got my first job after my master's degree through a friend who happened to hear of a job I was a good fit for. Focusing only on the academic part makes it easy to feel stressed out. It's important to remember you have these people from internships and classes who you can also learn from and who are part of your professional network. Take some time to meet this group of people from all over the world and to learn from them.

AR (BPPJ): What is your radical vision for how you would like to see GSPP and other ivory tower academic institutions advance justice, while we have all these resources and connections?

MR: What I'm seeing from students is that there's a need for less technocratic approaches to their training, a need to discuss these issues of justice more in the classroom. I think, as an institution, UC Berkeley, and other higher education institutions, can work more on training faculty and instructors to better handle questions of equity and justice in the classroom and create space for students to discuss these issues. Part of it is also our pedagogical approaches. Facilitating student inquiry is key, and being able to respond to questions that students are grappling with. Instilling a culture of inclusion and belonging is key. This requires self-reflection, as well as training on how to mediate and how to include different voices. I think institutions of higher learning can do a better job in terms of facilitating conversations - and sometimes uncomfortable conversations - about race, wealth, and privilege within the classroom. You are a different generation, and knowing student expectations, beliefs, and values is really important. For faculty, engaging with and harnessing that energy is key.

KT (BPPJ): That's such a good point. For our program, we did a training over the summer that all the students attended. I remember thinking it would be amazing if faculty also did this diversity, equity and inclusion training just to learn how to have those conversations, how to facilitate them, and how to be more inclusive. Thanks for sharing so much with us!

MR: My pleasure, thank you!

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