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Why comply? Farmer motivations and barriers in cannabis agriculture

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ABSTRACT

Cannabis legalization is spreading rapidly. In California, as the plant transitions from an illegal drug to agricultural product, regulations have been implemented to manage its production and associated environmental impacts. Yet, at the early stages of this process, many of the state's cannabis farmers continue to operate illicitly. This study examines why some cannabis farmers are engaging in the state's licensing initiative while others are not. Through an anonymous survey of cannabis farmers in California, we analyzed socio-normative and cost-related factors influencing farmers' decisions to participate in legal markets, or not. Approximately one third of the 362 cannabis farmers who completed the survey reported that they had never applied for a license. These non-compliant farmers were likely to be smaller cultivators who grew cannabis as part of a diversified livelihood strategy. Farmers' non-compliance was primarily attributed to an inability to overcome barriers to participation. These included not only financial barriers but also administrative and psychological ones, all of which disproportionately affect farmers with fewer resources. Socio-normative factors, including pressure from neighbors and perspectives on the benefits of environmental regulations, were not found to motivate non-compliance. As a result, policy efforts to mitigate the administrative burdens of compliance, such as streamlining permitting processes, extending agricultural support services, and supporting farmer collectives, warrant further attention to enhance compliance, public safety, environmental outcomes, and rural development in cannabis cultivating communities. Reforms to promote compliance, particularly among smaller farmers, may prevent the kinds of industrial consolidation seen in agricultural and in other governmental efforts to regulate informal resource use and trade.

1. Introduction

In 2018, the State of California implemented regulations for recreational cannabis. Overnight, farmers were offered access to formal markets, contingent on their adherence to a suite of environmental practices and reporting requirements. To sell cannabis, outdoor farmers now had to declare water sources, avoid surface water diversion during dry periods, only use organic amendments, refrain from planting on slopes with high risk of erosion and downstream sedimentation, and test a percentage of all product for pesticides, mycotoxins, and heavy metals prior to sale (Bodwitch et al., 2019), among other requirements. Government officials developed this multi-agency regulatory initiative to, in part, address the effects of unpermitted cannabis cultivation in California's salmon-supporting forested watersheds (Butsic et al., 2018). These effects included dewatered streams (Dillis et al., 2019), habitat loss (Butsic and Brenner 2016), poisoned wildlife, and increased risk of eutrophication and resultant algal blooms, which can be toxic to fish and humans (Carah et al., 2015; Gabriel et al., 2018).

In restricting formal market access to only those producers who meet certain environmental standards, California's cannabis licensing initiative was novel in comparison to the regulation of many other agricultural crops. Governments in California and elsewhere have faced difficulties in monitoring farmers for environmental outcomes, due in part to the non-point source nature of farm pollution and diffuse farm

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locations (Ruhl, 2000; Holley et al., 2020). Environmental governing initiatives, especially those that increase production costs, have also been curtailed by politically powerful industry groups (Doremus and Tarlock, 2008; Ruhl, 2000). California's cannabis regulations, by contrast, introduced strong environmental protocols, at a time when data on the regulation's economic impacts were lacking, largely due to the quasi-legal or clandestine nature of many farmers' practices (Short-Giannotti et al., 2017). Additionally, a fledgling and politically marginalized cannabis industry generally supported environmental measures, partly out of a need to build alliances and establish legitimacy (Polson, 2019). Yet, the extent to which regulatory initiatives achieve policy goals depends on the participation and actions of citizens and firms (Parker and Neilsen, 2017), or in this case, farms. At the time of writing, far fewer farmers have applied for permits than anticipated and little is known about why they are, or are not, complying.

California's legalization initiative was implemented amidst an almost complete absence of information regarding cultivation practices and how the often-illicit trade shaped regional economies (Short--Giannotti et al., 2017). Cannabis' economic effect was likely significant, as farms were numerous throughout the region and the crop was lucrative - so lucrative some industry analysts, prior to legalization, argued the crop was the state's most valuable (Gettman, 2006). Large numbers of cannabis farms have been documented along the state's North Coast in particular (Butsic et al., 2018), located in hilly, forested landscapes to avoid detection (Corva, 2014). This region includes the tri-county "Emerald Triangle" (Humboldt, Mendocino, and Trinity), so termed for its history of cannabis cultivation (Meisel, 2017). In contrast to the majority of California's agricultural sector, major portions of these farms can be described as small-scale (Dillis et al. In press; Butsic et al., 2018).

The few existing studies of socio-economic dynamics in communities where cannabis was cultivated, prior to legalization in 2018, show that small-scale cannabis farms supported local economic activities (Polson, 2018; Budwig, 2011) amidst the globalization and then contraction of the region's extractive industries, especially forestry (Kelly and Formosa, 2020). Cannabis prohibition incentivized farmers to find inconspicuous outlets to launder profits, particularly through investments in local businesses and land markets. Cannabis farms were also sites of widespread employment, a phenomena partly explained by farmers' reliance on labor over fixed capital investments that can be seized by law enforcement (Polson, 2013).

Academic literature raises questions about the effects of formalization on rural communities. Despite claims to the contrary (de Soto, 2000), efforts to regulate small-scale producers' informal resource use and trade practices can fail to increase financial security for producers without other corrective or ameliorative measures (Siegel and Veiga 2009; Notess et al., 2020; Byemba, 2020). Studies on the formalization of small-scale farming, fishing, forestry, and mining economies have illustrated how policies can impose significant transformations in informal production practices, thus increasing costs and creating significant financial barriers to entry (Putzel et al., 2015; Krul and Ho, 2020; Kinyondo and Huggins, 2020). Formalization initiatives can also lead to exclusionary outcomes through policies that increase costs of participation (i.e. permitting fees) or create other barriers to entry for existing producers (e.g. through zoning regulations), privileging larger firms over smaller firms (Biber and Ruhl, 2014). Policies that exclude those who lack resources to comply can amplify existing racial, gender, and class-based inequalities, especially to the degree they restrict capital access (Bodwitch, 2017; Byemba, 2020).

Regulatory processes that disadvantage small farmers can hold profound implications for socio-economic dynamics and environmental governance in rural regions. For populations most vulnerable to the risks associated with climate change and other stressors, incomes from small farms can be an important part of diversified livelihood strategies shown to enhance resilience, or ability to weather shocks (Kumar et al., 2020). Regulatory initiatives that privilege larger farms can threaten employment in rural regions, given the likelihood increased farm size will correspond to increased mechanization (Ambros and Granvik, 2020). Costly initiatives can also lead to non-participation (Landry and Amara 1998; Pigford et al., 2018), and pose potential challenges to public safety (e.g. if illicit cannabis farmers violently defend property or crimes go unreported for fear of engagement with authorities). Farms and farming communities can play an important part in sustainable natural resource management, and changes to farming systems can enhance possibilities for community-engaged environmental governance (Luhrs, 2018). In rural regions of Northern California, environmental leaders and cannabis farmers have reported that pre-regulatory cannabis incomes enabled farmers to take measures to enhance environmental sustainability (Polson, 2019).

This paper seeks to understand what motivates cannabis farmers' compliance and non-compliance with California's licensing initiative. Our analysis draws on 362 cannabis farmers' responses to a 2019 survey that examined various factors influencing farmers' decision making. We identified factors for analysis from studies of farmer and firm motivations for compliance and the particular circumstances associated with formalizing an illicit commodity. To date, this study represents the largest survey of cannabis farmers in the United States. The survey's key finding is that cannabis farmers' decisions not to comply are primarily motivated by the financial and learning costs associated with transforming operations to meet regulatory requirements and navigate new bureaucratic systems. These costs disproportionately affect farms with fewer resources (monetary and otherwise). Farmers' responses challenge popular representations of unlicensed cannabis farmers as "outlaws," intrinsically opposed to regulation (Polson 2019). In discussing the implications of our results, we highlight steps governments can take to enhance compliance, outside of costly enforcement measures that will likely have declining efficacy with unregulated farmers.

2. Methods

2.1. Study context: cannabis legalization in California

California California's regulatory initiative was implemented with little knowledge of cannabis agriculture and its ramifications for farmers. This data paucity is causally related to the federal status of cannabis as a Schedule 1 controlled substance, a designation impeding government officials' and researchers' access to funding and farm sites (Short-Gianotti et al., 2017).[3] In California, the few industry analyses that examine both licensed and unlicensed farms, draw on Google Earth images of farm sites and are regionally specific (Butsic et al., 2018). Limited characterizations also come from law enforcement statistics (Polson, 2018), cultivation how-to guides (e.g. Rosenthal, 2010), and historical and journalistic accounts of cannabis production (e.g. Raphael, 1985; Brady, 2013). These accounts indicate that a large increase in pre-legalization cultivation occurred between 2012 and 2016 in watersheds along the state's North Coast (Butsic et al., 2018), attributed in part to rising social acceptance and the seeming inevitability of legalization (Polson, 2019), and reveal a geographic shift in post-legalization cultivation acreage to the Central Coast (Dillis et al., In Press).

The voter-approved Proposition 64 to legalize cannabis replaced a voter approved measure from 1996, which decriminalized cannabis cultivation for medical use markets with few guidelines on how cultivation might occur (Lee, 2012; Geluardi, 2010). Since 2018, regulations and licensing are overseen by the Bureau of Cannabis Control, and various state agencies are responsible for overseeing particular

[3] The federal status of cannabis as a Schedule 1 substance has also restricted farmers' access to federally funded services that other agricultural sectors receive to advance environmental compliance and production, including extension services, research support, crop insurance, and credit.

regulatory aspects. At the state level, agencies tasked with governing cannabis, at the time of this study, included (but were not limited to) the state Department of Fish and Wildlife, the state and regional Water Resources Control Boards, and the state Department of Food and Agriculture. Cultivation regulations go beyond what is required for other agricultural crops. For example, other crops generally do not require a state permit before cultivation (other than nurseries, where permitting is tied to a type of agricultural activity rather than a particular crop). Local control provisions have resulted in a checkerboard of regulatory requirements across jurisdictional hierarchies (Bodwitch et al., 2019; Polson and Petersen-Rockney, 2019). To acquire a state-level license, farmers must also receive requisite local permits, as determined by each county or municipality, which may entail zoning and planning permissions or restrictions, or environmental requirements that exceed state regulations. Additionally, federally-recognized tribes in California may regulate or ban cannabis on lands within their jurisdiction. State-level agencies may also implement bans in areas deemed significantly impacted by previous cannabis cultivation practices, such as areas close to fish-bearing streams. Cultivation remains prohibited on all federal lands and near most schools and playgrounds.

These requirements have placed new responsibilities on state and local agencies, as well as farmers seeking licensure, leading to delays and the granting of temporary and provisional licenses for farmers still working their way through the permitting process. The requirements on farmers who wish to participate in formal markets include, but are not limited to: state licensing, water rights permitting, discharge permitting, cultivation plans, property diagrams, waste management plans, and insurance for employees. Farmers may also be required to (re)locate their gardens a minimum distance from waterways and obtain clearance that their site is not home to endangered species or culturally significant tribal sites. Oftentimes, agencies require on-site inspections in ways rarely found in other sectors, making enforcement and rule stringency more common. Agencies have also increased mandates to monitor farmers, through on-farm cameras, employee screening, and "track-and-trace"[4] programs that monitor each plant from seed to transport off-farm. Additionally, all product must be tested by third party, licensed laboratories, which generally test for fewer potential pesticides and mycotoxins than other crops but at much lower thresholds, increasing the possibility of an end-of-season crop failure. Laws mandating that cannabis farmers update farm infrastructure and alter practices can increase costs significantly for farmers who previously supplied medical or illicit markets, and create potential barriers to legal market participation for many, but, significantly, not all farmers. While many of California's cannabis farmers have continued to operate outside of the state's regulatory framework, others have begun or completed the process for licensing their farms. To understand why some farmers have legalized their practices, while others have not, we examined the motivations behind farmer decision making.

2.2. Theoretical considerations

Studies of compliance indicate that individual and firm-level motivations are multiple (Ayres and Braithwaite, 1992; Gunningham et al., 2003; Holley et al., 2020), with factors motivating compliance generally categorized as calculated, social, or normative (Winter and May 2001). Calculated factors, also described as instrumental (Gunningham et al., 2005; Acheampong and Maryudi, 2020), or economic (Parker and Neilson, 2017; Holley et al., 2020), reflect the extent to which the potential costs of non-compliance override costs of compliance (Winter and May 2001). Costs of non-compliance are primarily associated with calculations related to the risk of detection (Winter and May 2001). Social motivations can reflect what others think of one's behavior, whether that manifests as stigmas or positive reinforcement. Social motivations may include the threat of informal sanctions from customers or purchasers further up supply chains, who only want to consume or sell products that meet environmental regulations (Gunningham et al., 2005). Relationships with neighbors can also influence compliance decisions, which for farmers, can include a reliance on neighbors for various forms of assistance throughout the year (Winter and May 2001). Normative motivations reflect a farmer or farm manager's personal ethics or politics, including their commitment to environmental practices (Gunningham et al., 2005). Studies identifying social and normative motivations for compliance help to explain why individuals and firms will comply with environmental regulations when the threat of enforcement is low, as is often the case in agricultural settings (Ruhl 2000; Holley et al., 2020), and why some even go "beyond compliance" (Porter and van der Linde, 1995; Vogel, 2005; Thornton et al., 2009). Socio-normative motivations may also incentivize non-compliance, if an individual chooses not to participate in a governing initiative because they view the regulatory initiative as ineffective or the regulatory body as illegitimate (Scott 1986; Boonstra et al., 2017; Acheampong and Maryudi, 2020; Oyanedel et al., 2020).

Calculated, social, and normative motivational factors can be interlinked, non-exclusive, and form the basis of either compliance or non-compliance (Winter and May 2001). Additionally, individual experiences with regulatory processes, including access to information, outreach, and enforcement, as well as firm characteristics, especially size, influence compliance motivations (Winter and May 2001; Thornton et al., 2009; Holley et al., 2020). The effect of social and normative motivational factors on compliance decisions is often stronger for larger firms, who are better able to finance changes to their operations necessary to meet regulatory requirements (Gunningham et al., 2005; Thornton et al., 2009). For individuals and firms that are financially constrained, costs override other motivations for compliance (Ajzen, 1991; Moore et al., 2018). Larger firms are also more likely to face public critiques due to higher visibility (Thornton et al., 2009).

In developing a survey of why cannabis farmers have complied, or not, with the government's legalization initiative, we explored relationships between farmers' compliance decisions and their calculated and socio-normative motivations, their experiences with the regulatory process, and various characteristics of their operations (Table 1). This approach aligns with "objectivist" traditions in compliance research, that seek to understand compliance behaviors through analyses of individual motivations, policy processes, and firm characteristics (Parker and Neilson, 2017; Holley et al., 2020). Following the overwhelming response from surveyed farmers that burdens, or costs, imposed by the regulatory system - rather than individual motivational and decision-making matters - are their primary barrier to compliance, we analyzed our results in terms of "administrative burdens" (Moynihan et al., 2014) imposed by regulatory participation.

The literature on administrative burdens (Moynihan et al., 2014) draws attention to several types of costs, or burdens, that can constrain citizens' participation in governing initiatives. These include compliance costs, learning costs, and psychological costs (Moynihan et al., 2014). Compliance costs include those required to obtain permits and fees and transform practices to meet regulatory requirements. Learning costs include the labor-time associated with learning new, changing, complex, or unfamiliar regulatory systems (Moynihan et al., 2014; Heinrich, 2016; Herd and Moynihan, 2018). Psychological costs include stress associated with participating in particular government initiatives (Moynihan et al., 2014). Analyses of psychological costs have primarily been applied to studies of why individuals refrain from participating in voluntary initiatives that are ostensibly designed to bring them benefit (i.e. welfare). Psychological costs have rarely been considered as barriers to compliance in studies of individual or firm level motivations for compliance.

In addition to findings that compliance and learning costs are significant burdens that impede regulatory participation, we suggest that

[4] Farmers' compliance with the "track and trace" program was not yet mandatory at the time of the study.

Table 1
Survey questions.

	Topics covered	Answer format	Analytical method
Application status	Did you apply for a permit, if so, what is the status?	Multiple choice	Descriptive statistics
Characteristics of farms/farmers	Location, production amount; percentage of income from cannabis; demographics (marital status, age, gender); environmental practices; local zoning.	Multiple choice	Descriptive statistics; t-tests
Motivations for compliance	*Calculated:* Costs, future market benefits; farm decision making; enforcement; fines. *Socio-normative:* Pressure from neighbors; perspectives on regulations.	Likert-scale ranking	Descriptive statistics; t-tests
Experiences with the regulatory process	Costs of coming into compliance and obtaining permits and fees; experiences with enforcement; access to information; experiences with outreach.	Likert-scale ranking; multiple choice	T-tests; descriptive statistics
Farmers' descriptions of the regulatory process	Factors that facilitated and posed barriers to compliance; any additional information farmers wished to describe about the characteristics of their farming operation, experiences with the licensing process, and how licensing might be improved.	Open Ended	Qualitative coding

psychological costs may also have significant effects on regulatory compliance, especially in contexts where individuals have limited experience engaging with government, as is the case in the formalization of previously illicit economies. For individuals working to gain government authorization of previously clandestine production practices, psychological costs might include historical trauma related to previous experiences with enforcement, such as raids (Corva, 2014), that increase stress associated with contemporary forms of engagement. Individuals choosing to legalize their operations may also experience stress associated with the knowledge that their interactions with government could endanger neighbors' non-compliant operations. We discuss potential psychological costs in analyzing of farmers' responses to our survey.

2.3. Survey design

Our survey examined compliance by asking farmers if they have applied for a cultivation permit, and if so, the status. In reporting data, we did not distinguish between farmers who had obtained state licenses successfully and those that were still working toward licensure. It is possible (and later confirmed in interviews) that some farmers who had not yet received licenses will drop out.

We examined farmers' motivations through a series of Likert-ranking questions that examined how particular social, normative, and calculated factors identified elsewhere as influencing motivation (Winter and May 2001), shaped their decision making. We also asked farmers about factors that might influence their motivations for compliance unique to the formalization of informal economies (Table 1). We asked a different set of questions regarding the factors motivating farmers who did and did not apply for permits, to identify factors "pushing" farmers into compliance and "pulling" them away. We analyzed farmers' accounts of their motivations for compliance using descriptive statistics.

We also asked farmers to describe how their experiences with regulatory processes influenced their compliance decisions. We asked about financial expenditures, estimates of enforcement risk, experiences with outreach, and access to information (Table 1). We additionally asked farmers to describe aspects of the legalization initiative that influenced participation in their own terms. We coded qualitative responses received from these open-ended survey questions inductively, and we used a grounded theory approach to organize codes into middle-level theoretical categories (Charmaz, 2014). Three different researchers reviewed the resulting codes to check for logical consistency. Finally, we asked about farm/farmer characteristics (Table 1). We report farm and farmer characteristics first, to provide context for subsequent responses.

For questions both sets of farmers responded to (applicants and non-applicants), we examined the hypothesis that applicants and non-applicants may have different motivations and experiences. We tested for this using a 2-sample *t*-test to compare means to quantitative and Likert-scale responses. We explore the implications of differences between applicants' and non-applicants' responses, or a lack thereof, in our discussion.

2.4. Survey dissemination

We obtained approval from the University of California, Berkeley's Institutional Review Board for research with human subjects, and we piloted the survey with farmers who had and had not applied for cultivation licenses. The survey was available online through the Qualtrics survey platform from May through August 2019 (Qualtrics 2019), accessible through a University of California Agriculture and Natural Resources website. Farmers could contact us for paper copies with pre-stamped envelopes if they preferred to take the survey off-line. We emailed the survey link to all those who had entered into the licensing process with state agencies, such that the survey was sent to over 6000 email addresses. We obtained these email addresses through a series of Public Records Act requests. Additionally, we distributed fliers advertising the survey and hard copies in community gathering locations and cannabis farm supply stores located along the state's North Coast, in regions containing large numbers of cultivators, as indicated by previous mapping and ethnographic data (Butsic et al., 2018; Polson, 2018). Hard copies were available at sites in Sonoma, Lake, Humboldt, Mendocino, Trinity, and Siskiyou Counties.

There are unique difficulties associated with determining and accessing the total number of cannabis farmers in California. In particular, federal prohibition has created disincentives for farmers to participate in research and thus reveal themselves. As a result, our survey results are non-probabilistic. We cannot make claims about the extent to which our sample is representative of the total population of cannabis farmers in California. Nonetheless, we believe we obtained a high degree of validity (data accuracy) and reliability (data consistency) by employing a purposive sampling technique (i.e. Palinkas et al., 2015), which targeted avenues most likely to reach large numbers of cannabis farmers.

3. Results

Overall, we received 362 complete survey responses. All but two responses were submitted online. Respondents reported on farms located in 42 counties. Humboldt, Mendocino, and Trinity counties comprised the most commonly reported zip codes, followed by Nevada County, another legacy cultivation center in the Sierra Nevada Mountains (Fig. 1). In total, over 700 respondents started the survey, although a large number (>300) stopped the survey before completion. In reporting results, we include all responses received for each question.

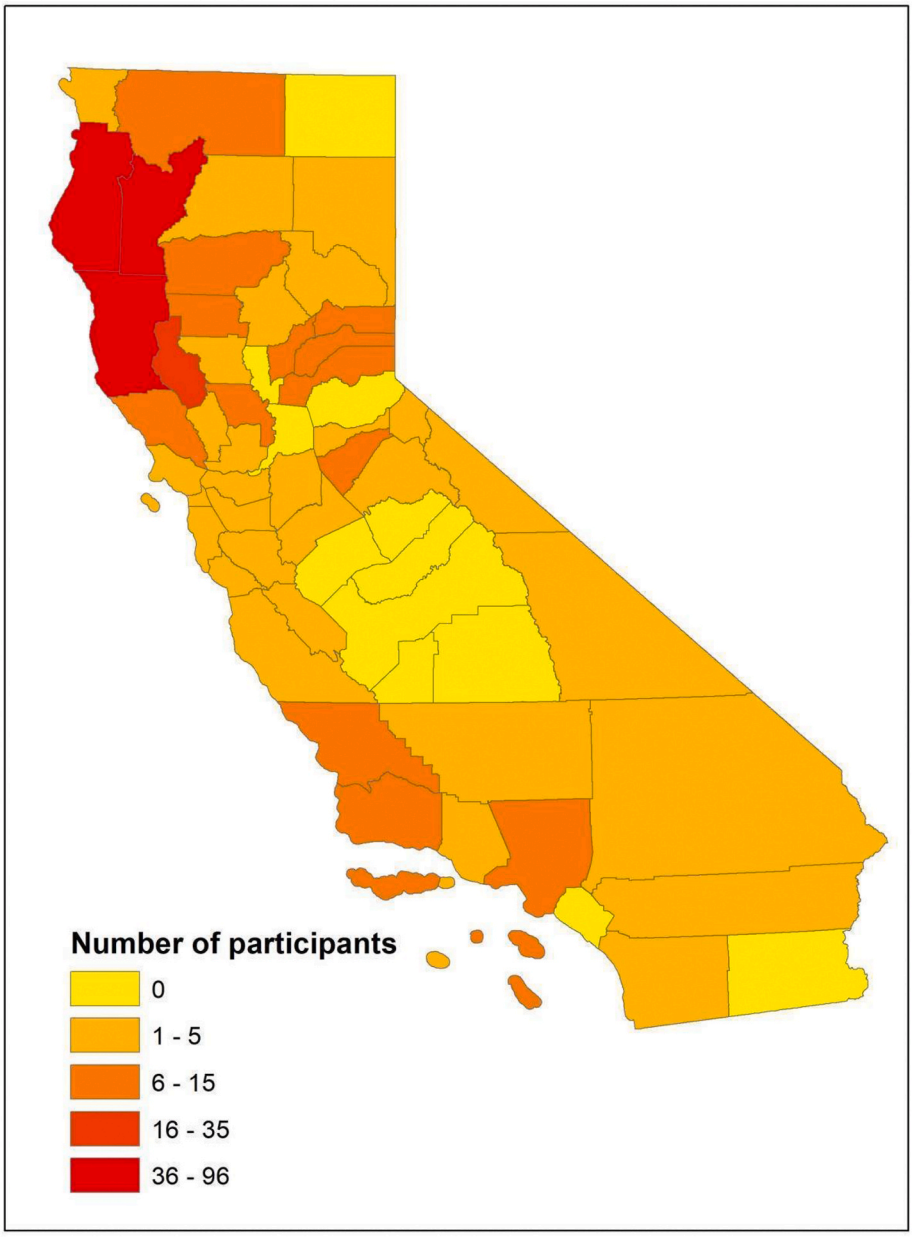

Fig. 1. Number of survey respondents per county.

3.1. Characteristics of farmers

Within our sample, thirty-five percent of respondents had not applied for permits, thirty-three percent of respondents had permits approved and twenty-eight percent were pending approval (n = 362). Non-applicants were more likely than applicants (pending or approved) to report a smaller farm size, as determined by production amount (Table 2). A majority of those that did not apply described their farms as a form of supplemental income (Table 3). Non-applicants reported having less educational attainment. Marital status and gender were similar for applicants and non applicants (Table 4) as was ethnicity (seventy-nine percent of total respondents were white).[5]

Non-applicants and applicants reported engaging similar production practices. On average, both non-applicants and applicants reported using common environmental stewardship practices over at least fifty percent of the time (Table 5). T-tests showed no statistically significant differences between non-applicants and applicants in their use of organic amendments (Applicants (A) M = 0.939, SD = 0.171; Non-applicants (NA) M = 0.946, SD = 0.174; p = 0.72), biodynamic practices (A: M = 0.736, SD = 0.021; NA: M = 0.756, SD = 0.038; p = 0.672), composting (A: M = 0.868, SD = 0.285; NA: M = 0.834, SD = 0.312; p = 0.32), efficient climate control (A: M = 0.58, SD = 0.439; NA: M = 0.486, SD = 0.459; p = 0.102) and strategies to minimize fuel consumption (A: M = 0.821, SD = 0.277; NA: M = 0.825, SD = 0.277; p = 0.840). T-tests revealed that applicants were statistically more likely to report engaging in the use of energy efficient lighting systems (A:M = 0.730, SD = 0.404; NA: M = 0.571, SD = 0.457; p = 0.003), water conservation (A: M = 0.771, SD = 0.35; NA: M = 0.668, SD = 0.405; p = 0.023), organic pest remediation practices (A: M = 0.964, SD = 0.120; NA: M = 0.897, SD = 0.245; p = 0.004) and reduce-reuse-recycle initiatives (A: M = 0.849, SD = 0.281; NA: M = 0.741, SD = 0.374; p = 0.004) than non-applicant farmers (Table 5). Additionally, most farmers

[5] By comparison, statewide, 63% of non-cannabis farmers are white and 91% are male (USDA 2017).

Table 2
Production.

	0 pounds	0-25 pounds	25-100 pounds	101-250 pounds	251-1000 pounds	1001-2500 pounds	Over 2500 pounds	n
Pounds produced indoors								
Not Applied	53.96%	23.02%	11.51%	5.76%	5.04%	0.72%	0.00%	139
Applied	90.65%	7.91%	10.79%	7.91%	9.35%	4.32%	0.72%	183
Total	62.42%	13.35%	9.63%	5.90%	6.21%	2.17%	0.31%	322
Pounds produced outdoors								
Not Applied	15.87%	26.44%	25.00%	13.94%	12.50%	3.37%	2.88%	208
Applied	15.31%	2.93%	21.17%	28.34%	22.15%	5.86%	4.23%	307
Total	15.53%	12.43%	22.72%	22.52%	18.25%	4.85%	3.69%	515

Table 3
Income from cannabis.

Income received from cannabis					
	0%–20%	21%–50%	51%–80%	81–100%	Total
Not Applied	44.74%	28.95%	7.89%	18.42%	77
Applied	25.61%	12.98%	24.56%	36.84%	285
Total	29.64%	16.34%	21.05%	32.96%	362

reported that their cultivation site was located more than 150 ft from the nearest waterway (Table 6). A majority of non-applicants reported they were located on properties not zoned for cultivation (Table 7).

3.2. Motivations for compliance and non-compliance

A majority of all farmers agreed (Likert-scale ranking 4–5) that their compliance decisions were primarily shaped by whether they believed they could make a living on the regulated market (numeric results available in Table 8). Within the group of those who did not apply for permits, farmers were most likely to report costs to be a significant or primary factor motivating their decision not to apply for permits. Non-applicant farmers were also likely to report that county incentives were too weak to motivate compliance. A majority of non-applicants were motivated to remain illicit by a belief that: their cultivation practices are better for the environment than that regulated by government; that their family or workers are more secure financially by staying unregulated; the unregulated market offers more economic opportunities; being unlicensed improved their ability to make decisions about their farm; and compliance would adversely limit or affect other realms of life. The risk of arrest or property seizure was not a significant factor for non-applicants in their decisions to not comply. Few non-compliant farmers felt community pressure to remain unlicensed.

Within the group of those who applied for permits, many farmers reported that the idea that licenses will hold future economic value was a significant or primary factor motivating their decision to comply. A majority of applicants were also motivated by a fear of arrests and the idea that compliance offers more security for family and workers. Less than a majority of applicants reported that their compliance decisions were motivated by the idea that: licensing has a positive effect on the environment; licensure improves the ability to make farm-related decisions; the fines for being non-compliant are too high; or there are more economic opportunities in the regulated market. Consistent with non-applicants' responses, few applicants were motivated by county incentives; felt that the costs were reasonable; or felt community pressure to become licensed (Table 8).

3.3. Farmers' experiences with the regulatory process

Farmers who applied for a license spent more money to come into compliance than on permits and fees (Figs. 2 and 3). Compliance costs included expenses incurred updating roads, culverts, and buildings to adhere to state and local standards.

Two-thirds of all respondents reported that a lack of clear, accurate information on regulations had hindered their ability to comply (Table 9). Applicants most consistently rated government websites as

Table 4
Demographics.

Education							
	Some school	High school	Some college	Bachelor	Masters	n	
Not Applied	1.25%	11.25%	53.75%	28.75%	5.00%	80	
Applied	1.37%	9.25%	33.56%	41.44%	14.38%	292	
Total	5	36	141	144	46	372	
Marital status							
	Single	Married	n				
Not Applied	64%	36%	80				
Applied	67%	33%	291				
Total	245	126	371				
Gender							
	Female	Male	Non-binary	n			
Not Applied	31%	68%	1%	80			
Applied	35%	63%	2%	291			
Total	127	238	6	371			
Age							
	Under 30	30–39	40–49	50–59	60–70	Over 70	n
Not Applied	0.2%	2.1%	4.2%	3.1%	4.7%	1.2%	424
Applied	2.8%	20.2%	24.7%	12.1%	13.8%	2.8%	356
Total	11	81	106	56	69	15	780

Table 5
Cultivation techniques.

	0	25%	50%	75%	100%	n
Percent of time using organic techniques						
Not Applied	3.09%	1.03%	1.03%	6.19%	88.66%	97
Applied	1.89%	2.52%	3.46%	9.12%	83.02%	318
Total	2.17%	2.17%	2.89%	8.43%	84.34%	415
t-test	Mean difference = 0.01		p-value = 0.68		t-stat = 0.40	
Percent of time using biodynamic techniques						
Not Applied	12.22%	5.56%	13.33%	16.67%	52.22%	90
Applied	15.36%	6.86%	10.78%	15.03%	51.96%	306
Total	14.65%	6.57%	11.36%	15.40%	52.02%	396
t-test	Mean difference = 0.02		p-value = 0.67		t-stat = 0.42	
Percent of time using compost						
Not Applied	9.47%	1.05%	7.37%	12.63%	69.47%	95
Applied	7.35%	3.19%	6.71%	7.99%	74.76%	313
Total	7.84%	2.70%	6.86%	9.07%	73.53%	408
t-test	Mean difference = −0.03		p-value = 0.32		t-stat = −0.97	
Percent of time using closed loop techniques						
Not Applied	26.74%	5.81%	20.93%	11.63%	34.88%	86
Applied	21.33%	10.33%	15.33%	17.33%	35.67%	300
Total	22.54%	9.33%	16.58%	16.06%	35.49%	386
t-test	Mean difference = −0.05		p-value = 0.20		t-stat = −1.07	
Percent of time using efficient lighting systems						
Not Applied	33.72%	4.65%	8.14%	9.30%	44.19%	86
Applied	20.34%	5.42%	5.08%	10.51%	58.64%	295
Total	23.36%	5.25%	5.77%	10.24%	55.38%	381
t-test	Mean difference = –0.15		p-value = 0.01		t-stat = -2.89	
Percent of time using climate control that minimizes energy use						
Not Applied	38.82%	9.41%	9.41%	8.24%	34.12%	85
Applied	30.77%	6.99%	11.19%	10.14%	40.91%	286
Total	32.61%	7.55%	10.78%	9.70%	39.35%	371
t-test	Mean difference = −0.8		p-value = 0.14		t-stat = −1.47	
Percent of time using water conservation techniques						
Not Applied	5.26%	0.00%	3.16%	13.68%	77.89%	92
Applied	0.63%	0.63%	1.57%	8.49%	88.68%	313
Total	1.69%	0.48%	1.94%	9.69%	86.20%	405
t-test	Mean difference = −0.10		p-value = 0.02		t-stat = -2.25	
Percent of time using organic pest control						
Not Applied	5.26%	0.00%	3.16%	13.68%	77.89%	95
Applied	0.63%	0.63%	1.57%	8.49%	88.68%	318
Total	1.69%	0.48%	1.94%	9.69%	86.20%	413
t-test	Mean difference = −0.67		p-value = 0.01		t-stat = −3.64	
Percent of time reducing-reusing-recycling						
Not Applied	16.30%	2.17%	9.78%	15.22%	56.52%	92
Applied	6.67%	4.13%	8.89%	13.33%	66.98%	315
Total	8.85%	3.69%	9.09%	13.76%	64.62%	407
t-test	Mean difference = −0.10		p-value = 0.01		t-stat = −2.87	
Percent of time minimizing fossil fuels						
Not Applied	8.42%	4.21%	11.58%	17.89%	57.89%	95
Applied	8.68%	4.15%	13.74%	17.57%	58.79%	313
Total	6.63%	4.17%	13.24%	17.65%	58.58%	408
t-test	Mean difference = −0.01		p-value = 0.60		t-stat = −0.04	
Percent of time using no till techniques						
Not Applied	8.60%	1.08%	4.30%	17.20%	68.82%	93
Applied	8.68%	1.61%	6.75%	13.18%	69.77%	311
Total	2.17%	2.17%	2.89%	8.43%	84.34%	404
t-test	Mean difference = 0.01		p-value = 0.91		t-stat = 0.10	

Table 6
Cultivation site.

Distance from nearest stream					
	<50 ft	51–100 ft	101–150 ft	151 ft or more	n
Not Applied	7.93%	7.32%	12.20%	72.56%	164
Applied	3.23%	14.96%	10.85%	70.97%	341
Total	4.75%	12.48%	11.29%	71.49%	505

Table 7
Local zoning.

Is your property zoned for cannabis?			
	No	Yes	n
Not Applied	51.85%	48.15%	135
Applied	4.40%	95.60%	341
Total	17.86%	82.14%	476

important, while non-applicants most consistently rated neighbors as important, compared to other information sources.

We asked about outreach from six groups: the state forestry and fire response agency (CalFire), state and regional water quality control boards, farmer associations, county sheriffs, county agricultural commissioners and consultants. T-test results show that for five of the six groups, those who applied had received significantly more outreach than those that did not apply. Statistical differences existed for Cal Fire (A: M = 0.1235 SD = 0.329; NA: M = 0.046, SD = 0.21; p = 0.020), the state water board (A: M = 0.461 SD = 0.499; NA: M = 0.137, SD = 0.34; p = 0.020), farmer associations (A: M = 0.365 SD = 0.482; NA: M = 0.147, SD = 0.355; p = 0.000), county agricultural commissioners (A: M = 0.474 SD = 0.500; NA: M = 0.073, SD = 0.023; p = 0.000), and consultants (A: M = 0.368 SD = 0.483; NA: M = 0.110, SD = 0.314; p = 0.000). The one exception to this was the sheriff's department, where there was no significant difference (A: M = 0.084 SD = 0.278; NA: M = 0.064, SD = 0.24; p = 0.46) (Table 10).

Of all respondents, ninety-one percent (n = 390) did not experience any formal enforcement. T-test show that non-applicants were more likely than applicants to report enforcement from the Water Board (A: M = 0.053 SD = 0.225; NA: M = 0.109, SD = 0.314; p = 0.057) and the California Department of Fish and Wildlife (A: M = 0.50 SD = 0.219; NA: M = 0.097, SD = 0.298; p = 0.093) (Table 10). Significant differences were not found for the other agencies: county planning departments (A: M = 0.133 SD = 0.34; NA: M = 0.149, SD = 0.351; p = 0.80); county agricultural commissioners (A: M = 0.060 SD = 0.238; NA: M = 0.033, SD = 0.181; p = 0.332); the Bureau of Cannabis Control (A: M = 0.039 SD = 0.194; NA: M = 0.045, SD = 0.208; p = 0.810); and the California Department of Food and Agriculture (A: M = 0.034 SD = 0.183; NA: M = 0.033, SD = 0.181; p = 0.963) (Table 10).

When interacting with government regulators, nearly three-quarters of all respondents indicated that they always or often fear cascading, impossible, or expensive requirements and T-test revealed that applicants (M = 2.997, SD = 1.473) and non-applicants (M = 3.112, SD = 1.706; p = 0.546) shared these fears. Farmers who applied (M = 2.970, SD = 1.39) welcomed government actions more than those who did not (M = 1.987, SD = 1.29, p = 0.00) (Table 11).

T-tests showed non-applicants (M = 3.80, SD = 1.32) were more likely than applicants (M = 3.039, SD = 1.300, p = 0.000) to view regulatory requirements and inspections as a violation of their privacy or autonomy. Additionally, non-applicants (M = 2.807, SD = 1.74) were more likely than applicants (M = 1.54, SD = 1.081, p = 0.00) to fear the detection of unregulated cultivation when interacting with regulators, although less than a majority felt this way (Table 11).

T-tests indicated non-applicants (M = 3.412, SD = 1.375) responded similarly to applicants (M = 3.58, SD = 1.250, p = 0.24) that environmental regulations improve the environment. Slightly fewer (43% of

Table 8
Motivations for compliance.

For all farmers: My decisions about compliance are primarily shaped by whether I believe I can make a living in the regulated market. (1 = completely disagree, 5 = agree)

	1	2	3	4	5	n
Not Applied	22.50%	3.75%	11.25%	15.00%	47.50%	80
Applied	19.06%	10.37%	22.41%	15.38%	32.78%	299
Total	19.79%	8.97%	20.05%	15.30%	35.88%	379
t-test	Diff = 0.28		p-value = 0.13		t = 1.502	

For non-applicants: The costs to get a license/come into compliance are too high. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Not Applied	12.5%	1.25%	0.00%	6.25%	80.00%	80

For non-applicants: County incentives to enter regulation (grandfather clauses, remediation-relocation program, etc.) are too weak. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Not Applied	18.42%	2.63%	9.21%	13.16%	56.58%	76

For non-applicants: My cultivation practices are better for the environment than those mandated by government. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Not Applied	12.82%	10.26%	10.26%	17.94%	48.71%	78

For non-applicants: My family and/or workers are more secure financially by staying unregulated. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Not applied	12.99%	16.88%	5.19%	28.57%	28.57%	77

For non-applicants: There are better economic opportunities in the unregulated market. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Not Applied	17.94%	7.69%	20.5%	19.23%	34.61%	78

For non-applicants: Being unlicensed improves my ability to make decisions about my farm(s) (i.e. plant number, input sourcing). (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	Total
Not Applied	27.63%	6.58%	13.16%	18.42%	34.21%	76

For non-applicants: Compliance might adversely limit or affect other realms of my life (e.g. gun ownership, child custody, other drug commerce). (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	Total
Not Applied	31.58%	5.26%	13.16%	6.58%	43.42%	76

For non-applicants: The possibility of being arrested or having property seized is low. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	*n*
Not Applied	32.91%	11.39%	21.52%	10.13%	24.05%	79

For non-applicants: Financial penalties for being non-compliant are negligible or unlikely. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	*n*
Not Applied	38.96%	12.99%	20.78%	10.39%	16.88%	77

For non-applicants: Community/neighbor pressure to remain unlicensed. (1 = not at all factor in the decision NOT to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Not Applied	66.25%	10%	7.5%	5%	11.25%	80

For applicants: Licenses may hold economic value in the future. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

Table 8 (*continued*)

	1	2	3	4	5	n
Applied	8.53%	6.83%	17.06%	23.55%	44.03%	293

For applicants: I am/was worried about arrest, property seizure, and/or other consequences. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	16.33%	8.00%	15.33%	15.33%	45.00%	300

For applicants: Compliance offers more security for my family and workers. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	17.73%	9.03%	13.71%	19.06%	40.47%	299

For applicants: I believe that licensing has a positive environmental effect. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	21.84%	11.60%	22.53%	18.09%	25.94%	293

For applicants: Licensure/compliance improves my ability to make decisions about my farm(s) (i.e. plant number, input sourcing). (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	Total
Applied	30.77%	10.37%	19.06%	15.38%	24.41%	299

For applicants, fines for being non-compliant were too high. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	33.56%	12.75%	17.45%	11.74%	24.50%	298

For applicants: There were more economic opportunities in the regulated market. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	39.52%	15.12%	19.59%	15.12%	10.65%	291

For applicants: County incentives to become licensed (grandfather clauses, remediation-relocation programs, etc.). (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	44.00%	12.33%	16.33%	15.33%	12.00%	300

For applicants: The costs to get a license/come into compliance were reasonable. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	68.00%	16.00%	8.33%	3.67%	4.00%	300

For applicants: I felt community/neighbor pressure to become licensed. (1 = not at all factor in the decision to pursue a cultivation license; 5 = primary factor)

	1	2	3	4	5	n
Applied	69.39%	12.24%	10.54%	2.72%	5.10%	294

non-applicants; 41% of applicants) in both groups agreed that environmental regulations improve the performance of cannabis farmers. Non-applicants were as likely as applicants to feel this way. T-tests also indicated that non-applicants (M = 2.437, SD = 1.59) and applicants (M = 2.18, SD = 2.03, p = 0.157) fear disapproval from neighbors when interacting with government regulators (Table 11).

3.4. Farmers' descriptions of the regulatory process

For applicants and non-applicants who offered reflections in the form of open ended responses on regulation and legalization generally (n = 231), the two single most frequent observations were that "costs are too high"[6] (n = 103; 45%) and "policies are biased against small, legacy, and

[6] Text in parentheses refers to the qualitative codes we assigned.

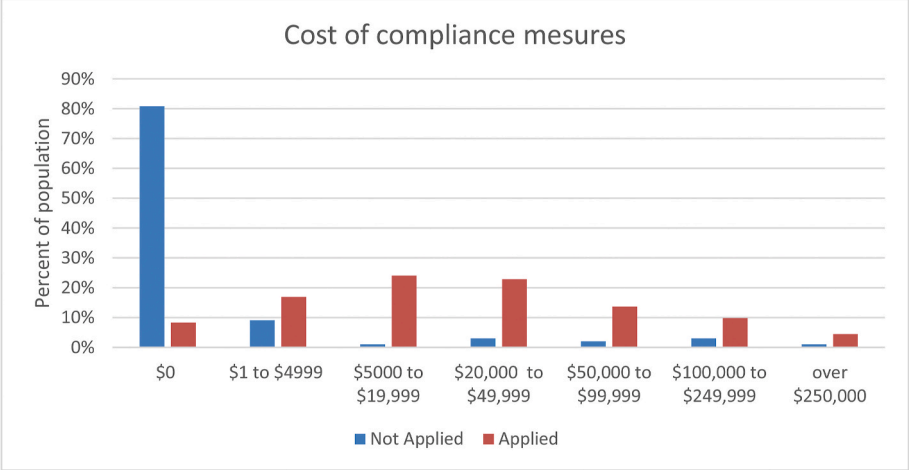

Fig. 2. Costs of compliance.

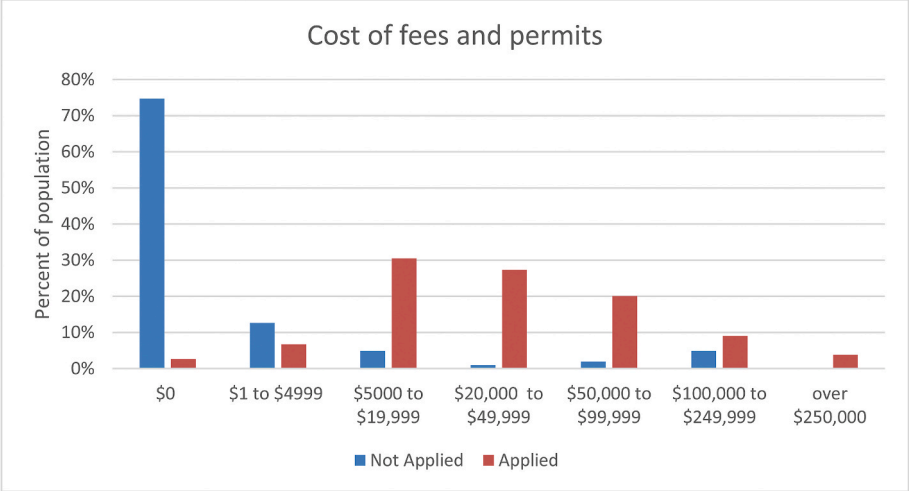

Fig. 3. Costs related to permits and fees.

medical growers" (n = 92; 40%). The next tier of responses (18%–13% in descending order) included observations that "participation in legal markets limits economic opportunities," "cannabis has inequitable regulations compared to other sectors," there is an "overly complex permitting process," and respondents have had "difficulty meeting regulatory requirements."

When these individual factors are thematically clustered into middle-level theoretical concepts, the overwhelming response is that "barriers to compliance are too high" (mentioned 364 times[7]). This is followed by the perception that "policies are unfair" (e.g. cultivation is "over regulated" and treated with "punitive attitude and actions"; policy making and execution has been riddled with "graft" and "deception; " there is too much "revenue seeking by government"; mentioned 247 times) and that "policies are ineffective" in design, execution, and achieving aims (e.g. overly complex, slow, ineffective, redundant policies enforced by fragmented agencies with little knowledge of cannabis; mentioned 240 times).

3.4.1. *Non-applicants*

A majority (59%, n = 56) of those who did not apply for permits indicated that they were deterred from doing so due to the "cost of compliance". One third expressed that the regulatory initiative "favors larger, well-resourced operations" (31%).

Non-applicants also explained that "participation in legal markets limits economic opportunities" (18%). Some felt a "distrust of government" (15%) and that they experienced "difficulty meeting regulatory requirements" (15%). Some also indicated that regulations were "ineffective" (13%) and that "regulations are inequitable compared to other sectors" (such as grapes, tomatoes, etc.) (11%).

When clustered thematically, the main factor deterring compliance for non-applicants was "regulatory problems" (e.g. bans on cultivation, zoning barriers and unclear information about how to comply; mentioned 59 times). This was followed by doubts about "economic viability" of regulation (e.g. cost; mentioned 46 times), concerns that "regulations are biased or discriminatory" toward cannabis farmers generally and small farmers particularly (mentioned 35 times), an "inability to qualify" for compliant status (mentioned 20 times), and "uncertainty about future if compliant" (mentioned 17 times). Only a few expressed no need or desire to comply (mentioned 9 times).

3.4.2. *Applicants*

In response to an open-ended question regarding barriers to compliance among applicants (n = 212), the number one response (again) was "cost of compliance" (92 of 212; 43% of respondents). The

[7] An individual response may mention more than one of the factors incorporated into the theme.

Table 9
Experiences with the regulatory process: information.

A lack of clear, accurate information on regulations has hindered my ability to comply (1 = completely disagree, 5 = agree)						
	1	2	3	4	5	N
Not Applied	19.75%	2.47%	12.35%	9.88%	55.56%	81
Applied	5.33%	7.00%	19.67%	17.33%	50.67%	300
Total	8.40%	6.04%	18.11%	15.75%	51.71%	381
t-test	Mean difference = −0.21		p-value = 0.18		t-stat = -1.34	

How important are the following sources for getting information on regulations?						
	Not important	Somewhat Important	Neutral	Somewhat Important	Very Important	N
Neighbors						
Not Applied	23.40%	9.57%	20.21%	13.83%	32.98%	94
Applied	18.73%	20.63%	17.78%	19.68%	23.17%	315
Total	19.80%	18.09%	18.34%	18.34%	25.43%	409
t-test	Mean difference = 0.13		p-value = 0.43		t-stat = 0.7349	
Government Website						
Not Applied	35.16%	14.29%	20.88%	12.09%	17.58%	91
Applied	7.57%	12.93%	23.34%	22.40%	33.75%	317
Total	13.73%	13.24%	22.79%	20.10%	30.15%	408
t-test	Mean difference = −1.01		p-value = 0.01		t-stat = −6.3467	
Consultants						
Not Applied	54.44%	16.67%	13.33%	5.56%	10.00%	90
Applied	21.27%	16.83%	20.63%	15.24%	26.03%	315
Total	28.64%	16.79%	19.01%	13.09%	22.47%	405
t-test	Mean difference = −1.07		p-value = 0.01		t-stat = −6.2062	
Government Workshops						
Not Applied	55.56%	11.11%	16.67%	5.56%	11.11%	90
Applied	25.00%	23.40%	24.68%	16.03%	10.90%	312
Total	31.84%	20.65%	22.89%	13.68%	10.95%	402
t-test	Mean difference = -0.61		p-value = 0.01		t-stat = −3.8419	
NGO + Trade Organizations						
Not Applied	50.00%	5.68%	14.77%	12.50%	17.05%	88
Applied	30.03%	18.85%	21.41%	17.57%	12.14%	313
Total	34.41%	15.96%	19.95%	16.46%	13.22%	401
t-test	Mean difference = −0.23		p-value = 0.18		t-stat = −1.33	
Business Partners						
Not Applied	47.19%	10.11%	20.22%	12.36%	10.11%	89
Applied	17.95%	16.67%	25.32%	25.64%	14.42%	312
Total	24.44%	15.21%	24.19%	22.69%	13.47%	401
t-test	Mean difference = −0.74		p-value = 0.01		t-stat = −4.57	

next most frequent single factors (between 21 and 15%) were, in descending order, "slow regulatory process," "agency incompetence," "changing regulations" and "unclear information," all of which indicate aspects of the regulatory process that preclude compliance.

When thematically clustered, the predominant theme from the qualitative responses from applicants was that the largest barrier to compliance is "problems with the design and execution of the regulatory system" (mentioned 228 times). This category included factors ranging from regulators' "lack of knowledge of cannabis and farmers" to "negative or troublesome interactions with regulators" to "conflicts between governmental jurisdictions." The next most important thematic cluster of barriers to compliance was "cost" (mentioned 94 times) and "sense of bias/distrust" (mentioned 87 times) against cannabis or cannabis producers. Finally, "difficulty meeting regulations" (mentioned 57 times) and "bad information/services" from various governmental and non-governmental sources (mentioned 55 times) were referenced as significant.

In response to questions regarding factors that facilitated compliance for applicants (n = 192), the single most frequent factor was "persistence" (n = 54; 28%). The next most frequent responses, in descending order were "consultants" (17%), "community" (14%), "assistance from regulators" (14%), and "financial resources (12%). When clustered, the predominant theme in factors facilitating compliance were "personal attributes" (mentioned 97 times), including a "desire to be legal," "flexibility," "fear of legal consequences," and "persistence." Other significant thematic clusters of facilitating factors were: "social support" (i.e. community members, organizations, advocacy groups and actions; mentioned 50 times), "third party assistance" (i.e. consultants, lawyers; mentioned 44 times), "resources" (i.e. financial, administrative, recourse to illegal market; mentioned 33 times), and "educational background" (mentioned 32 times).

4. Discussion

What motivates cannabis farmers' decision making? Why do some pursue compliance and others do not? This study suggests that decisions are not driven by social or normative factors. Farmers did not feel strong social pressure to comply, or not comply, and they did not report significant levels of opposition to regulation in general. To the contrary, both applicants and non-applicants saw a general utility in regulation for environmental protection. The majority of applicants, as well as non-applicants, were skeptical regarding the extent to which the cannabis farm licensing regulations improve the environmental performance of cannabis farmers. It was not the case that applicants evidence different, more virtuous environmental values than non-applicants, as is often purported in public discourse (Polson 2019). Both groups reported high

Table 10
Outreach and enforcement by regulatory agencies.

	No Outreach	Outreach	Total
Department of Fish and Wildlife			
Not Applied	91.74%	8.26%	89
Applied	73.03%	26.97%	317
Total	77.42%	22.58%	406
t-stat	Mean difference = −0.18	p-value = 0.01	t-stat = −4.15
State or Regional Water Quality Control Board			
	No Outreach	Outreach	Total
Not Applied	86.24%	13.76%	92
Applied	53.93%	46.07%	317
Total	61.51%	38.49%	409
t-stat	Mean difference = −.21	p-value = 0.01	t-stat = −3.37
Sheriff			
	No Outreach	Outreach	Total
Not Applied	93.58%	6.42%	92
Applied	91.57%	8.43%	317
Total	92.04%	7.96%	409
t-stat	Mean difference = −.02	p-value = 0.50	t-stat = −0.657
County Agriculture Departments			
	No Outreach	Outreach	Total
Not Applied	92.66%	7.34%	92
Applied	52.53%	47.47%	317
Total	61.94%	38.06%	409
t-stat	Mean difference = −0.41	p-value = 0.01	t-stat = −8.04
Consultant			
	No Outreach	Outreach	Total
Not Applied	88.99%	11.01%	89
Applied	63.20%	36.80%	317
Total	69.25%	30.75%	406
t-stat	Mean difference = −.025	p-value = 0.01	t-stat = −5.24
Cal Fire			
	No Outreach	Outreach	Total
Not Applied	95.41%	4.59%	92
Applied	87.64%	12.36%	317
Total	89.46%	10.54%	409
t-stat	Mean difference = −0.07	p-value = 0.02	t-stat = −2.32
Enforcement			
California Department of Food and Agriculture			
	No Enforcement	Enforcement	Total
Not Applied	96.63%	3.37%	89
Applied	96.53%	3.47%	317
Total	96.55%	3.45%	406
t-stat	Mean difference = −.0009	p-value = 0.96	t-stat = −0.04
State or Regional Water Quality Control Board			
	No Enforcement	Enforcement	Total
Not Applied	88.04%	11.96%	92
Applied	94.64%	5.36%	317
Total	93.15%	6.85%	409
t-stat	Mean difference = −.056	p-value = 0.03	t-stat = 1.91
Department of Fish and Wildlife			
	No Enforcement	Enforcement	Total
Not Applied	89.25%	10.75%	93
Applied	94.97%	5.03%	318
Total	93.67%	6.33%	411
t-stat	Mean difference = −.005	p-value = 0.05	t-stat = 1.68
County Planning Departments			
	No Enforcement	Enforcement	Total
Not Applied	84.78%	15.22%	92
Applied	86.71%	13.29%	316
Total	86.27%	13.73%	408
t-stat	Mean difference = 0.009	p-value = 0.63	t-stat = 0.24
County Agricultural Department			
	No Enforcement	Enforcement	Total
Not Applied	95.56%	4.44%	90
Applied	93.99%	6.01%	316
Total	94.33%	5.67%	406
t-stat	Mean difference = −.026	p-value = 0.57	t-stat = −0.97
Bureau of Cannabis Control			
	No Enforcement	Enforcement	Total
Not Applied	95.51%	4.49%	89
Applied	96.08%	3.92%	306
Total	95.95%	4.05%	395
t-stat	Mean difference = 0.005	p-value = 0.80	t-stat = 0.24

levels of environmental practices, and where the two groups diverged, non-applicants still reported at least 50% engagement.

Farmers' decisions *did* appear to be driven by concerns about costs, financial and otherwise, that they would assume through regulatory participation. The vast majority of those surveyed reported high financial costs as a significant barrier to successful compliance. All farmers were concerned with maintaining their livelihoods, even if they differed on whether being unregulated or regulated would offer this economic security. The decision to comply was motivated by perceptions of the benefits of regulatory participation and, crucially, one's ability to meet the required costs. It should be no surprise, then, that compliance status was positively associated with farm size. The smaller the farm, the less likely one was to have applied for a license. As smaller farms are more likely have fewer resources, this finding reinforces the conclusion drawn from previous studies that financial costs are a significant factor in small firms' compliance decisions (Thornton et al., 2009). Indeed, smaller farms were more likely to rely on cannabis as one among several livelihood strategies, suggesting that high compliance costs adversely affect these farmers and the community resilience commonly associated with livelihood diversification (Kumar et al., 2020). Additionally, the farmers who were motivated by risk of fines and arrests have generally entered the regulatory system, while those who reported not fearing such consequences remained unregulated, suggesting that for government, enacting more severe forms of enforcement or penalties may have declining returns. Some level of continued enforcement is likely important to motivate continued compliance, in part by maintaining perceptions of the inevitability of enforcement (Thornton et al., 2009), but will need to be accompanied by systematic changes to ensure the participation of farmers who remain illicit.

Efforts to decrease the administrative burdens farmers assume to participate in the legal system will likely have a more direct effect on rates of compliance. Survey data suggests a link between financial costs and learning costs. Those with less resources, or with multiple jobs, will find it difficult to dedicate large amounts of time to navigating mercurial regulations. Further, for those who have less prospects of large earnings (e.g., because they have small farms), there is less motivation for navigating new regulatory systems, so long as a livelihood is possible in the unregulated market. For applicants, compliance is rendered a matter of personal endurance, which should be read not as simply a matter of character difference but as a capacity to endure that is ensured by resources, time, educational status, and expectation of benefit.

This said, learning costs – or the costs of navigating complex regulatory systems – were a significant barrier across the board. All farmers reported challenges in learning about the regulatory system, due to unclear information. This burden fell heaviest on people with less formal education, as they were more likely to be a non-applicant. Further, those with less access to, or outreach from, assistive agencies were less likely to apply. The finding that non-applicants were more likely to get information from neighbors than other sources suggests a certain lack of engagement with – possibly a greater fear or suspicion of – government agencies by those who have yet to enter formal markets. Attitudes

Table 11
Experiences with and perspectives on regulatory processes.

For all farmers: In interacting with regulators, I fear cascading, impossible, or expensive requirements. (1 = never the case; 5 = always the case)						
	1	2	3	4	5	*n*
Not Applied	6.02%	1.20%	4.82%	16.87%	71.08%	83
Applied	3.97%	5.96%	16.56%	24.83%	48.68%	302
Total	4.42%	4.94%	14.03%	23.12%	53.51%	385
t-stat	Mean difference = 0.37		p = 0.01		*t*-test = 2.69	
For all farmers: I welcome interactions with government regulators. (1 = completely disagree, 5 = agree)						
	1	2	3	4	5	*n*
Not Applied	55.00%	10.00%	21.25%	7.50%	6.25%	80
Applied	18.60%	22.26%	22.92%	15.95%	20.27%	301
Total	26.25%	19.69%	22.57%	14.17%	17.32%	381
t-stat	Mean difference = 0 .11		p = 0.64		*t*-test = 0.59	
For all farmers: I consider most regulatory requirements and inspections to be a violation of my privacy and/or autonomy. (1 = completely disagree, 5 = agree)						
	1	2	3	4	5	n
Not Applied	9.64%	6.02%	20.48%	20.48%	43.37%	83
Applied	15.95%	16.61%	32.89%	16.61%	17.94%	301
Total	14.58%	14.32%	30.21%	17.45%	23.44%	384
t-test	Mean difference = 0.77941		p-value = 0.01		t-stat = 4.8202	
For all farmers: My interactions with government officials influence my decision to comply (or not). (1 = completely disagree, 5 = agree)						
	1	2	3	4	5	n
Not Applied	31.71%	4.88%	19.51%	8.54%	35.37%	82
Applied	23.33%	15.00%	23.67%	14.67%	23.33%	300
Total	25.13%	12.83%	22.77%	13.35%	25.92%	382
t-test	Mean difference = −0.97		p-value = 0.01		t-stat = -5.62	
For all farmers: In interacting with government regulators, I fear discovery of unregulated cultivation. (1 = never the case; 5 = always the case)						
	1	2	3	4	5	n
Not Applied	31.71%	4.88%	19.51%	8.54%	35.37%	82
Applied	23.33%	15.00%	23.67%	14.67%	23.33%	300
Total	25.13%	12.83%	22.77%	13.35%	25.92%	382
t-test	Mean difference = −0.97		p-value = 0.01		*t*-stat = -5.62	
For all farmers: Environmental regulations improve the environment. (1 = completely disagree, 5 = agree)						
	1	2	3	4	5	n
Not Applied	15.85%	6.10%	28.05%	23.17%	26.83%	82
Applied	7.97%	10.96%	26.91%	23.26%	30.90%	301
Total	9.66%	9.92%	27.15%	23.24%	30.03%	383
t-test	Mean difference = −0.19		p-value = 0.23		*t*-stat = −1.20	
For all farmers: Environmental regulations increase the environmental performance of cannabis farmers. (1 = completely disagree, 5 = agree)						
	1	2	3	4	5	n
Not Applied	21.25%	3.75%	32.50%	25.00%	17.50%	80
Applied	9.93%	17.88%	31.13%	19.54%	21.52%	302
Total	12.30%	14.92%	31.41%	20.68%	20.68%	382
t-test	Difference = −.11		p-value = 0.49		*t*-stat = −0.69	
For all farmers: I fear the disapproval of neighbors if I interact with government officials. (1 = never the case; 5 = always the case)						
	1	2	3	4	5	n
Not Applied	43.90%	13.41%	15.85%	4.88%	21.95%	82
Applied	44.70%	21.19%	16.23%	6.62%	11.26%	302
Total	44.53%	19.53%	16.15%	6.25%	13.54%	384
t-test	Mean difference = 0 .29		p-value = 0.10		*t*-stat = 1.64	

toward government are less a normative stance against government as they are a determination that the government does not treat farmers fairly, as shown in farmers' responses to open-ended questions. These findings, again, reinforce the idea that costs and a correlated perception of benefit, rather than social and normative factors, are paramount in motivating farmer decisions. Failure to alleviate these costs will hold implications for rural development in historic cannabis growing communities, especially if smaller farms, that serve to support non-cannabis earnings, are excluded from legal markets. In what follows, we draw on farmers' responses to describe the compliance, learning, and psychological costs associated with legal market participation and discuss strategies to reduce them.

4.1. Compliance costs

Compliance costs are numerous and wide-ranging, but they can intensively affect farmers who have to remediate legacy land use issues (e.g. from timber), by upgrading buildings to meet disability access standards, constructing culverts for access roadways, and addressing previous environmental impacts. As a result, legacy farmers can encounter significant compliance costs as compared to those able to locate their farms on more arid and flat landscapes with access to municipal water, and where zoning laws are amenable to cannabis farming. Additionally, for a majority of non-compliant farmers in our sample, compliance costs would have included the need to relocate their farm to a location that allowed zoning. Cannabis regulations appear to

favor people who can access capital to purchase land and individuals who are able to move easily (e.g. less attached to community and place; have no caretaking responsibilities). Compliance costs can be further compounded by long permit approval processes that preclude farmers' abilities to obtain revenue from cultivation, thus favoring, again, those with more resources. Regulations with high costs and capital requirements likely disproportionately and adversely impact legacy farmers who lack formal financial histories, with potentially severe impacts on regional economies previously supported by cash exchanges. Pre-legalization farmers operated in a cash economy, which imposed barriers to savings and limited access to credit. As mentioned in the previous section, these costs also adversely affect smaller farms, which often have less administrative and financial resources and rely on multiple livelihood strategies.

High compliance costs associated with transforming landscapes (e.g. upgrading culverts) to meet regulatory requirements may be offset by providing additional funding through agricultural support services. In other agricultural sectors, mechanisms to enhance farmers' environmental outcomes have included: tax incentives for ecosystem services; financial assistance with public-good resources; crop insurance programs; and credit extension and small business development grants to farmers. Cannabis farmers are currently ineligible for many of these services under state and federal law. Importantly, such legal changes would need to be done in ways that make services available, but do not trigger exemptions from environmental regulations that apply to other forms of agriculture. Regulators might also consider a scaled approach to regulating cannabis farmers that alleviates costs for smaller farms. Currently (2021), licensing fees are lowered based on size of operation, but costs associated with transforming operations to come into compliance are not. One option might be to subsidize smaller farmers' efforts to cover costs associated with bringing land up to code with environmental standards, such as that related to the implementation of culverts near waterways.

Generally, to the degree any of these initiatives lower compliance costs (whether by targeted assistance in achieving or maintaining compliance or navigating regulatory frameworks; i.e. Carter et al., 2018), the more likely participation will become. Elsewhere, regulatory initiatives that moderate costs have been shown to achieve broader participation than those that do not (Croisier, 1998; Ruiter, 2005; Jobin, 2008; Pigford et al., 2018). When the perceived monetary and non-monetary costs of participation in formal arrangements are relatively high, actors have tended to seek alternatives (Landry and Amara 1998; Pigford et al., 2018), such as unregulated market persistence. Increased enforcement on its own, while a motivating factor for some (especially those who have already applied), will be unlikely to halt non-compliance.

It should be noted that many counties and municipalities prohibit cultivation. Efforts to increase jurisdictions that permit cultivation are likely to positively impact on compliance rates, as many farmers cannot take on the costs associated with relocating. Public-facing communication initiatives that emphasize the environmental and economic benefits of regulated cannabis may help alleviate pressures that local elected officials face from some residents to disallow cultivation. In contexts where local bans advance collective goals (e.g. environmental outcomes, public safety, cultural revitalization), public funds for farmers to relocate their farms elsewhere might be considered. An interesting example of this is Humboldt County's Retirement, Remediation and Relocation program, where legacy farmers are provided permits if they move to sites that are better suited for agriculture. Alternatively, reducing the discretion that local governments have to restrict cannabis cultivation or creating disincentives to implementing bans at the county level may be worth further consideration in pursuit of the public interest.

Costs associated with obtaining a cultivation license, as well as farmers' reluctance to apply due to their uncertainty surrounding market futures, suggest that collective processing and marketing initiatives may be fruitful. In other contexts, farmer cooperatives have been identified as a mechanism to increase small-scale farmers' abilities to access markets and insurance, as well as information and technology, to promote regional development (Fischer and Qaim, 2012; Reed and Hickey, 2016; Wossen et al., 2017; Scaramuzzi et al., 2020). Processes that can support cannabis farmers' capacities to organize and develop collective marketing strategies could have a major impact if new markets and forms of competition are opened up as federal legalization unfolds, or international treaties banning trade are lifted.

4.2. Learning costs

Learning costs are costs associated with accessing information about, and required by, regulatory initiatives. Limited access to information and lack of prior engagement with formal agencies, for non-applicants especially, suggest that learning costs were especially burdensome. In cannabis agriculture, learning costs are intensified by the numerous agencies an individual must engage with to obtain permits. In the absence of agricultural extension services or collective support groups for cannabis, learning costs fall on individual farmers. With regulations frequently changing and little infrastructure to communicate those changes, learning costs are a constant pressure, evidenced by the two-thirds of all farmers impeded by unclear information. In rural regions, poor internet connectivity and long distances between county offices and farm sites exacerbates these costs. For those with other jobs, without family or business partners to rely on for administrative or farm duties, or without funds to hire consultants, the time required to navigate regulations is a highly significant barrier to licensure.

Strategies to reduce the learning costs that farmers assume when navigating unclear and inconsistent regulatory landscapes will likely enhance farmers' abilities to participate in legal markets. Coordination between state agencies and local government authorities could be strengthened to enhance communication among government actors and increase their ability to implement regulations consistently. Government efforts to streamline licensing processes could, for example, serve to advance compliance for low-income and disadvantaged farmers. The use of permitting programs that reduce the information that farmers need to provide up front could be helpful (Biber and Ruhl, 2014). Peer-to-peer learning as well as monitoring programs and outreach from non-state entities (e.g. Resource Conservation Districts) may serve to remove entry barriers for farmers distrustful or nervous about government engagement (e.g. because of threat of detection of illicit grows or cascading regulatory requirements).

The costs associated with navigating a changing regulatory landscape and the uncertainty farmers expressed regarding the environmental benefits of the cannabis licensing initiative may be further mitigated by improving the participation of small-scale, legacy, and unregulated farmers in the development of regulatory programs. Elsewhere, development organizations have advocated for industry participation as a mechanism to advance compliance with environmental initiatives (World Bank, 2017). The equitable inclusion of a diverse range of industry representatives (not simply the largest or most powerful stakeholders) has been identified as a way to reduce the likelihood of regulatory capture (Malesky and Taussig, 2019). The relative lack of data regarding cannabis production practices in different landscapes means that farmers will be an important source of information when developing strategies to enhance compliance and ensure the environmental goals of the regulatory initiative are achieved. All of these measures would be enhanced by innovative methods to consult and incorporate unregulated farmers.

4.3. Psychological costs

Psychological costs of compliance include the burdens one assumes by entering conditions of market insecurity, regulatory flux, and the persistence of federal prohibition. Applicants and non-applicants both attest to psychological costs: there is universal fear that regulatory

interactions will produce cascading regulatory requirements. Likely because of this distrust of officials, non-applicants consistently viewed neighbors as valuable sources of information, suggesting that increasing compliance may depend upon building trust and on local communicative pathways. As such, strategies that worked to facilitate participation initially (e.g. government outreach) may need to be further developed to influence remaining unregulated farmers. To access those farmers with a distrust of government, neighbor to neighbor information exchanges may be particularly impactful. In rural regions elsewhere, neighbor to neighbor "experience exchange" efforts have played an important role in farmers' decisions to adopt new environmental practices (Hansen et al., 2020), and may facilitate cannabis farmers' access to information about and support for compliance.

Compliance appears to alleviate psychological costs associated with engaging in illicit activities.[8] Farmers who applied for permits were motivated to do so to mitigate threat of enforcement, provide security for their family and workers, and to benefit from the future value licenses may hold, suggesting a greater sense of safety, security, and future. Non-applicants, however, do not perceive that participation will give them these benefits. To the contrary, they have identified non-compliance as the least taxing, psychologically speaking. To bring this population into compliance requires not only more effective communication systems but actual evidence that small, legacy, diversified, and poorer farmers can succeed in the regulated market. That is, the system must not only appear equitable but be equitable. In doing so, we frame non-compliance as a result of systemic problems, rather than one of individual motivations.

4.4. Limitations

Inherent biases associated with this study include how farmers may be disincentivized to report illicit practices or other socially stigmatized behaviors, even on an anonymous survey. As a result, the rate of non-compliance reported in our analysis (approximately one third of respondents), is likely lower than what would be observed in the field. Additionally, because farmers generally, and unregulated farmers in particular, have been stigmatized, respondents may exhibit social desirability biases in responses, such as when they report high rates of environmentally-sound agricultural practices.

4.5. Future research

To better understand the stakes associated with the continuation of a regulatory initiative that fails to reduce farmers' administrative burdens, research on the economic contributions illicit farms make to rural communities, including the diversified livelihoods that many of these farms appear to support, is needed. Additionally, models based on current trends in farm attrition, geography, and size are needed to predict the implications of current regulatory directions. Further, in-depth research into the changing matrix of decision-making for unregulated farmers, especially as the legal industry rapidly transforms the regulatory landscape, can help farmers overcome new barriers to compliance. Research is also needed on ways to decrease financial costs while maintaining environmental outcomes. Finally, a better understanding of the ways regulations are enacted, modified, and suspended (via bans) at the local level will help identify specific sites where the administration of California's legalization initiative may be altered to enhance compliance.

[8] Existing accounts of administrative burdens have largely regarded "psychological costs" as relating to stigmas associated with participation in government programs (i.e. welfare, food stamps) (Carter et al., 2018; Herd et al., 2013), our data, however, suggest that there is little stigma placed on cannabis farmers who enter regulation.

5. Conclusion

This study analyzes the largest survey of cannabis farmers in California to date, and the largest systematic account of unregulated cannabis farmers in the United States, a group who face disincentives to report their practices publicly. Outside the United States, large surveys of cannabis farmers have explored production methods and rationales (Decorte et al., 2012; Barrett et al., 2012), but not compliance motivations and barriers. Our analysis of farmers' decision making offers new insights for cannabis legalization and related environmental protection efforts in California and elsewhere. Non-compliance appears motivated by an inability to overcome the financial, learning, and psychological costs associated with participation. At present, significant administrative burdens reflect, among other things, inconsistencies and antagonistic cross-purposes among federal, state, and local cannabis policies. They are aggravated by the denial of basic supportive programs for farmers (e.g. extension support, small farmer programs) and the lack of support for cooperatives and other programs to alleviate competitive pressures, compliance costs, and learning costs. The current regulatory landscape incentivizes farmers to locate farms in certain areas and makes it difficult to cultivate in others, including many communities that historically harbored and have come to depend upon cannabis cultivation. In places with few other opportunities for employment, California's cannabis licensing initiative creates a mechanism through which state officials might work to sustain long-term rural development. Substantive support for small farmers, however, is needed to ensure cannabis maintains its unique status as (and reflects initial legislative directives to keep it as) an agricultural industry comprised primarily of small-scale farms (Dillis et al., In Press).

By addressing compliance motivations and barriers, this study shows how cannabis legalization might increase compliance, create more equitable and inclusive participation, and, in so doing, enhance desired outcomes for communities and the environment. In cannabis agriculture, the costs of complying with environmental regulations are being pushed onto the cannabis farmer, without the mediating support from government, research, or nongovernmental organizations present in other agricultural and industrial sectors. A formalization initiative that makes legal markets too costly to access leaves poorly-resourced farmers with few options – engage illicit cultivation practices, assume precarious amounts of debt (if credit is available) or abandon livelihoods all together. Reducing barriers to legal market entry may produce many positive effects. It may advance public safety, since those in illegal markets cannot appeal to public agencies to resolve conflict, protect property, or address violence. Reducing barriers to entry can also enhance the environmental efficacy of the state's legalization initiative. Such attempts may be considered as an alternative to an enforcement-first approach, which may entail significant costs, demonstrate declining returns, and subject cultivators to irreparable harms that exacerbate stratification and negatively impact community development. By reducing barriers to compliance, the economic stability of cultivators and their communities can be enhanced.

Credit author statement

Hekia Bodwitch: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Michael Polson: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Supervision; Writing - review & editing. Eric Biber: Conceptualization; Funding acquisition; Supervision; Writing - review & editing. Gordon Hickey: Funding acquisition; Methodology; Resources; Supervision; Writing - review & editing. Van Butsic: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization;

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Declaration of competing interest

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