Weed's for Smokin,' Water's for Fightin' Over*: An examination of the water demands of marijuana and impacts of federal legalization

***Apologies to Mark Twain**

By

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Legalization of marijuana is an ongoing conversation at all levels of government as states continue to legalize medical and recreational marijuana and the federal government has begun approach reform, however there is little research of data concerning the needs of marijuana as a commercial crop, particularly the water demand. This project conducted an analysis of existing data on the water needs of marijuana and applied it to a hypothetical market in the state of Idaho, developed by comparing the markets of other western states that have long allowed for both medical and recreational marijuana. The hypothetical market was divided by counties based upon agricultural output and further analysis of water use focuses on two counties in the southeastern portion of the state in order to compare marijuana's water to existing diversions from the Snake River, which operates under the prior appropriation water doctrine. While marijuana has a high water demand, this hypothetical market requires relatively little in comparison to what is being cultivated now, however, the Snake River is overallocated and continuing current patterns could result in severe ecosystem damage, especially as it pertains to the salmon that have historically spawned in the Snake River. Legalization of marijuana provides an opportunity to reshape water policy to create systems that better support both agriculture and wildlife.

Introduction

In October 2022, President Biden announced a pardon for all American citizens who were then being held on federal charges of marijuana possession, as well as a move to reschedule marijuana (The White House, 2022) (*Presidential Proclamation on Marijuana Possession*, 2022). With this announcement, the potential federal legalization of marijuana retuned to the national conversion, if it ever left.

Federal legalization of marijuana has been on the minds of the people for over twenty years, since California became the first state to legalize medical marijuana in the 1990s. Since California's pioneering decision, forty states have followed suit, legalizing medical marijuana, along with the District of Colombia, Puerto Rico, Guam and the US Virgin Islands. In 2012, the states of Colorado and Washington became the first to legalize recreational marijuana, and many states followed, making recreational marijuana use legal in twenty-three states and the District of Columbia ("Where Marijuana Is Legal in the United States," 2023).

In addition, loopholes under the Farm Bill that allow for the production of hemp also allow for a particular strain of THC, the active compound in marijuana, Delta-8 to be technically legal, though many worry about the lack of regulation in this industry (Zhang, n.d.) (Mentzer, 2022). In the seventeen states that allow for medical marijuana but not recreational marijuana, many people exploit the systems in place, fraudulently obtaining medical marijuana cards. Furthermore, for much of the time that a legal market has existed, federal guidelines have prevented marijuana related businesses from accessing conventional banking, which means that the industry has delt primarily in cash, though recent congressional action has been aimed at changing this (*SAFER Banking Act*, n.d.). Furthermore, in 2021 a bill was introduced to the United States Congress to decriminalize marijuana (Rep. Nadler, 2022). While this did not pass, it is a reminder that certain legislators are in favor of changing the way marijuana is treated on the federal stage.

With President Biden's recent pardon, the move to reschedule marijuana, ongoing legislation at the state level, and a recent movement toward allowing marijuana related businesses access to conventional banking, it is likely that federal legalization is coming in the not-too-distant future. Under current guidelines, marijuana is a Schedule I substance in company with substances that include heroin and ecstasy, and therefore, according to the US Drug Enforcement Agency, DEA, it has no accepted medical use and a high potential for abuse (*Drug*

Scheduling, n.d.). This is generally regarded as being untrue by many medical professionals and, states where it is legal, marijuana can be used to treat epilepsy, chronic pain, and complications resulting from HIV/AIDS, among others (*What You Can Expect from Medical Marijuana*, n.d.). In light of this, President Biden's administration hopes to recategorize marijuana as a Schedule III substance, placing it alongside ketamine and testosterone. The FDA regards Schedule III substances as having low to moderate potential for abuse (*Drug Scheduling*, n.d.).

While there are some who do not think that federal legalization is soon to come, (Dunaevsky, 2022), Biden's pardon and call for rescheduling certainly raises the question. Legalization is a good direction in which to move as states continue to pass bills for legalization and an overwhelming majority of Americans support legalization (Green, 2022). Still, despite public support, there is an overarching issue with legalizing marijuana at a federal level: namely the implications of marijuana a crop in the current agricultural system.

Growing marijuana requires the significant amounts of water, which has the potential to become a massive problem. In and of itself, this is not what many would understand as a major issue—the US produces many crops that require significant water input—but given that much of the American West is facing a significant water crisis and many staple food crops rely heavily on irrigation water, this has the potential to make marijuana legalization difficult and potentially disastrous.

While data is limited and varied, and marijuana's status as a Schedule I substance has limited the amount of research that has been completed, it is generally estimated that marijuana cultivation requires somewhere around six gallons of water per day per plant during the growing season (Drotleff, 2021), which has the potential to be as long as six months. Other data suggests that it takes approximately two gallons of water to produce one eighth of an ounce of sellable product ("How Much Water Does It Take to Grow Cannabis?," 2020), and other reports suggest that a marijuana plant needs one third of an inch of water per day (*Water Demands for Cannabis | Jain Irrigation USA*, 2021). This means that, should marijuana be federally legalized, more and more people will begin to cultivate a highly profitable crop (*How Profitable Are Dispensaries | Learn About Dispensary Startup Costs & Is a Dispensary Profitable - Projection Hub*, n.d.) in a time of unprecedented water shortages (*American West Faces Water and Power Shortages Due to Climate Crisis*, 2022). Comparatively, the average household uses approximately three hundred gallons of water per day (US EPA, 2017). Wheat, which is grown throughout the

American West, both under irrigation and as a dryland crop, uses, on average, eighteen to twenty-one inches of water per growing season (*Wheat Irrigation - MSU Extension Water Quality | Montana State University*, n.d.), but certain varieties can provide substantial yields with less water. Potatoes, which are also grown in the Northwest, use approximately eighteen inches of water during the growing season (*Potatoes: An Alternative to Consider - MSU Extension Water Quality | Montana State University*, n.d.).

Another complicating factor is that while states have legalized marijuana, they have largely done so without also implementing clear growing guidelines, which leaves related water policy in a grey area, given the similarly grey legality of the crop. This can result in poor resource management and cause environmental degradation, and, perhaps more importantly, threaten water supplies (Stoa, 2016). The legal market does have the potential to slow or end illegal growing operations, which can wreak havoc on the environment (Bauer, et al., 2015), but that does not mean that legal growing operations have all the regulation and oversight that might be necessary to protect waterways and water resources.

Very little research on cultivating marijuana exists, especially as it relates to water, and that which does exist tends to focus on the impacts of illegal cultivation, rather than licensed operations. While this has its merit, and illegal cultivation is certainly an environmental issue, this makes it highly difficult to fully analyze the potential policy changes and understand how to best protect resources and food systems, which rely on the same irrigation water that marijuana grows will be vying for under legalization.

Slightly more research exists on hemp, though that, too, is fairly limited in its scope and focuses primarily on hemp as a food or fiber crop (*Global Hemp Innovation Center*, 2019). Some work is also being done on hemp as a cover crop for dryland wheat farmers, though that is, of course founded on systems with no irrigation. The existing research suggests that cultivating marijuana requires enough water that diverting it from streams or rivers can cause serious damage to aquatic ecosystems if done illegally or under poor regulations. Research also suggests that illegal cultivation can lead to the deposit of petroleum-based products and pesticides in waterways as a byproduct of preparing and managing the land, as well as managing the crop. In addition, illegal growers may divert surface water, which can lead to seriously depleted steam flows. (Bauer, et al., 2015). Illegal cultivation can also contribute to build of pesticides in ecosystems as growers work to protect crops from animals in the area (Burns-Edel, 2016), and

illegal crops are often destroyed though the application of herbicides, which have incredibly negative impacts of the environment as well (Rosa Del Olmo, 1998). As illegal cultivation often takes the form of 'trespass grows,' growing marijuana outdoors on isolated portions of public or private lands, the management of the crop requires grower to get to and from their crop regularly and there is no documentation of the agrichemicals that are applied to the crop, some of which inevitably end up as runoff in waterways. Furthermore, given that these grow sites are located on isolated sites, growers are beholden to precipitation or what they can divert from waterways in the area.

Just as there is little research on cultivating marijuana, there is little existing research on demand or use patterns across the population. This lack of research makes it highly difficult to assume the rate of growth required to sustain the market, as well as the land and water requirements of that growth. Some states impose limits on how many plants an individual can grow, but this is generally aimed toward private citizens producing their own supply, rather than commercial entities. Existing research also fails to analyze the differences in cultivation methods, which include traditional outdoor cultivation, greenhouse cultivation, and hydroponic cultivation, among others, all of which will have different water requirements for maintaining a healthy and productive operation. The final issue posed is the fact that there is still a significant illicit marijuana market that dominates the overall market, especially in places where marijuana is not legal (Wartenberg et al. 2021), which makes it highly difficult to adequately assess the true impacts that cultivation can have on the environment. That being said, there are still pathways for assessing this.

Location

This work if focused on two counties, Bingham and Power, in Idaho's Snake River Valley. Like the rest of the American West, this region operates on prior appropriation water doctrine, which assumes that water is most valuable when it comes out of a waterway and is put to beneficial use, generally agricultural use, and those who did so first have priority rights to the water (*Prior Appropriation Doctrine*, n.d.). In theory, tribes have the oldest water rights, often called grandfather water rights, to ensure that treaties entitling them to continue traditional activities are upheld, however application of this is not always done well. This water rights system, combined with climate change, has led to reduced flows in Western rivers and worry among agriculturists over their ability to have a successful harvest should there be a drought or

other abnormal circumstances. The Colorado River, for instance, which often pointed to as an example of this crisis, is massively over appropriated and climate factors have led to restrictions on growers in Central Arizona ("Colorado River Shortage," n.d.). Similarly, over reliance on irrigation water and a mentality that assumes water will be readily available forever had contributed to the serious depletion of the Ogallala Aquifer (Little, 2009), which sits under the Great Plains. This means that these growers are beginning to be forced to look elsewhere for water to continue agricultural activities. Just as agriculturists on the Great Plains and in Central Arizona rely on aquifers and rivers for irrigation water, those of Southern Idaho rely on the Snake River. This reliance on diverting water, prior appropriation, and climate change has already created a precarious situation for the American West, the global economy, and food systems. Adding a crop with the water demand of marijuana could spell disaster for these systems and the ecosystems they are situated in.

*Figure 1- Map of Idaho counties and rivers, (*Map of Idaho Lakes, Streams and Rivers*, n.d.)*

Prior appropriation remains a contentious topic in the American West. The system ignores indigenous tribes claims in to water (Sommer, 2023) and cities like Los Angeles have grandfather rights large amounts of Colorado River water over the vast majority of the watershed, despite the idea that those who used the water first have the oldest right to the water. The Navajo Nation, for instance, continues to argue with states like California over rights to the Colorado River (Sullivan, 2023), and throughout the West complicated systems of rights continue to breed resentment and upset between people when usage is curtailed.

Along with operating on prior appropriation water doctrine, Bingham and Power Counties have several other advantages for this work. The first is that there is no legal marijuana market in the state of Idaho. Idaho is one of the more conservative states, as can be seen from active bills in the state (*FastDemocracy - Be Informed. Be Effective. Be Social.*, n.d.), and therefore falls behind many other Western states in legalizing marijuana. This means that while there very well may be an illegal market, it is likely a very well-kept secret and small and therefore likely has a minimal environmental impact.

The third advantage provided by this location is the Snake River, originates in the Northern Rocky Mountains and flows through Southern Idaho before emptying into the Columbia River in Washington, and offers an excellent indicator species in salmon. Prior to being dammed the Snake River was host to some of the greatest salmon runs on earth and while that has been impacted some by the dams that have been put in place along the Columbia and Snake Rivers (*In the Columbia–Snake River Basin, Salmon Are Losing Their Way*, 2018), the salmon runs do still happen and work is being done to support the populations and ensure that the fish have access to spawning grounds. More importantly, though, salmon are temperature sensitive fish with a preference for big, cold rivers, like the Snake, particularly for spawning (Crozier et al., 2020). Increased reliance on the Snake River for irrigation has the potential to shrink and warm the river, making it less hospitable to salmon populations. This provides a metric by which to measure environmental impact and a baseline point for determining the health of the river.

The goals of this project are two-fold. First, I aim to understand the water needs of marijuana and the current status of the Snake River as it relates to the allocation of irrigation water. Secondly, I aim to find the potential environmental impact of marijuana cultivation in the Snake River Valley and provide suggestions for mitigating that impact.

Assumptions

Given the nature of the data and the research, I made several assumptions in analyzing the data. The first is that I assumed approximately half of the necessary water would come from existing water rights as existing agriculturists converted land and changed their operations to grow marijuana. This is because it is a profitable crop and I have also assumed that family farms will be handed off to younger generations, and as that happens, these new farmers will be more

willing to expand their operations to capitalize on a new opportunity, or that deals will be made between people who are looking to open a dispensary to secure a supply. While supply and demand are difficult to fully forecast, current legislation requires dictates that marijuana cannot be sold or transported across state lines (Aronczyk, 2023). While this is, in part, due to the fact that it is not federally legal, it means that all the available data pertaining to legal growing operations sell only within their state, and existing market data uses only what is grown in a particular state. While this would likely not continue to be the case under federal legalization and it is likely that a particular state or region would end up producing the majority of the marijuana sold in the country, it makes sense to found an analysis of water demand in a particular state given that the market and ecosystem effects can be better analyzed. In addition, should state legalization come before federal legalization, it is likely that will come with a ban on sale and transportation across state lines.

I also assume that production will not exceed demand and that there will be no illegal market outside the legal market. In other western states, production has, at times, exceeded demand, and should that happen in the state of Idaho, water demand would rise beyond my predictions. Similarly, I assume that marijuana cultivation would follow the same patterns that the existing agricultural industry does within the state and that marijuana grown in a given county would be a percentage of the total market equivalent to the percentage of total agricultural in that county. This is because all of Idaho's counties are agriculturally productive, and this provides a firm basis for making projections about water use.

Methods

In order to find a value for the total average water usage of commercial marijuana plants, I combined data from a handful of sources. The data came primarily from greenhouse operations, meaning that the final numbers may not be entirely applicable other growing practices, but will still provide some context for further understanding. I also reviewed and gathered data from existing literature, which included reviewing websites, cultivation guides, and personal communication. Sources ranged from one to thirteen gallons per plant per day and averaged to 6.7 gallons of water per plant per day of the growing season, with variations in actual use depending on the growth stage of the plant.

I then reviewed marijuana market sizes, consumption data, and population data from four other western states that have legalized marijuana, California, Colorado, Oregon, and

Washington, in order to understand the existing markets in similar states (*High Quality Cannabis Prices by U.S. State 2022*, 2022) (*Marijuana Use by State U.S. 2021*, 2023). This yielded an average percentage of the population purchasing and consuming marijuana or marijuana products of 25.98 percent, which I then applied to the state of Idaho to find a number of people in the state who would be purchasing marijuana or marijuana products. Using the same data and sale volume data from the state of Oregon (*2023 Recreational Marijuana Supply and Demand Legislative Report*, 2023)—the data was not available from other states—I found consumption per person, which I then applied to the number of people purchasing marijuana and marijuana products. This yielded the potential size of Idaho's marijuana market in pounds: 118,532 pounds per year.

With the potential size of the market established, I then used agricultural economics data from the University of Idaho (*Https://Www.Uidaho.Edu/-/Media/UIdaho-Responsive/Files/Cals/College/About/Idaho-Ag-Map-2019.Pdf*, n.d.) to project potential production in individual counties. To do this, I used the average price per ounce of $236.16 of the aforementioned four western states (*High Quality Cannabis Prices by U.S. State 2022*, 2022) to find the total market size in dollars. I then combined the value of the agricultural industry in Power and Bingham counties compared to the entire state to find the percentage of the economy, nine percent, which I then applied to my pounds per year estimate to determine how much marijuana would be grown in the two counties.

With that projection, I estimated a range for the industry's water requirements. I assumed that approximately half of the necessary water would come from rerouting existing water rights as farmers move already productive and irrigated land into marijuana cultivation in order to capitalize on a highly profitable market and will therefore have no further impact on overall water resources. I therefore also assumed that the other half of the necessary water would come from new water rights, as the growers would be new to the agricultural sector and need to secure water rights or dig new wells, for which a license from the Idaho Department of Water is required (Idaho, n.d.), both of which have their own sets of complications and considerations. This analysis is focused on the potential of securing new water rights that divert water from the Snake River.

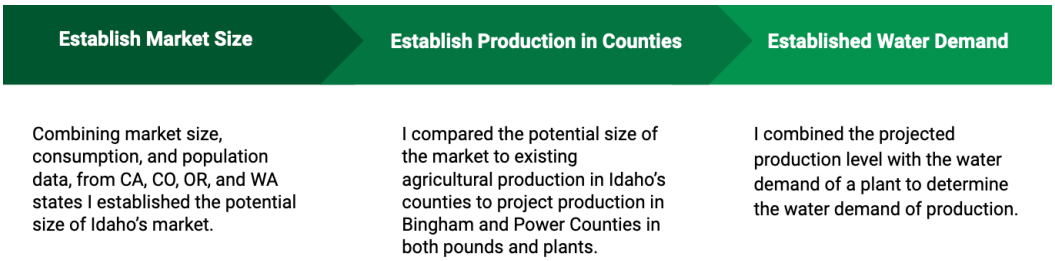

Figure 2: Chart outlining methods.

To analyze the current state of the Snake River and the potential impact of further diverting water, I reviewed existing water rights that divert water from the Snake River in Bingham and Power Counties. Water rights summaries from the Idaho Department of Water Resources (*Water Right Report*, n.d.) (*Water Right Report*, n.d.) (*Water Right Report*, n.d.) (*Water Right Report*, n.d.) were reviewed to find the total number of acre-feet currently diverted from the Snake River for irrigation in Power and Bingham Counties. I also gathered annual stream flow data from directly below American Falls Dam provided by the United States Geological Survey, USGS, averaged it to find the average flow over the course of a year in order to find a baseline stream flow after existing water rights in Bingham and Power counties are fulfilled as those rights divert water above the dam.

Results

The admittedly limited available data suggests that marijuana cultivation uses anywhere from one to thirteen gallons of water per day, with an average of 6.7 gallons per day per plant and an average growing season of 150 days (Bauer, et al., 2015). Each plant yields one third of a pound of dried product (T. Irvine, personal communication, September 25, 2023). Using consumption statistics from Oregon, Washington, California, and Colorado (*Marijuana Use by State U.S. 2021*, n.d.) and purchase data from 2021 (Oregon Liquor and Cannabis Commission, 2023) reveals a demand for in the state of Idaho of approximately 119 thousand pounds of usable marijuana.

Assuming that there is one third of a pound of sellable product per plant, this demand reveals a need for approximately 361,000 plants to be propagated per year and would therefore necessitate 362.41 million gallons of water per year. There are 325,851 gallons of water in one acre-foot, therefore this new market would demand 1112.20 acre-feet of water in the state. Factoring in agricultural economics data (*Https://Www.Uidaho.Edu/-/Media/UIdaho-Responsive/Files/Cals/College/About/Idaho-Ag-Map-2019.Pdf*, n.d.) in order to project the

percentage of the total demand that would be produced in a given county, the projected demand for marijuana production in Bingham and Power counties is an additional 100 acre-feet per year. Returning to the assumption that approximately half of this demand will be filled by existing water rights, this production would require an additional 50 acre-feet of water to be diverted per year.

Existing water rights in Bingham and Power Counties divert 297,184.25 acre-feet per year (*Water Right Report*, n.d.) (*Water Right Report*, n.d.) (*Water Right Report*, n.d.) (*Water Right Report*, n.d.), assuming that all water rights are fulfilled. This water is diverted from American Falls Reservoir. The USGS monitoring station at Needly, Idaho, directly below American Falls Dam, measures an annual average streamflow of 9,352.06 acre-feet per day, given existing water rights (*Data - Idaho Power WebPortal*, n.d). Given that the Snake River is, like all Western rivers, over allocated, and that there are a significant number of downstream water rights, diverting additional water and reducing this average streamflow could have serious negative impacts for not only the Snake River, but the Columbia River, and their ecosystems and could also cause economic damage that ripples throughout the American Northwest.

This is again, because of the damage that could be done to fish populations. The annual salmon runs are highly important to these rivers and this region. Salmon die after spawning and the carcasses provide highly important nutrients for the ecosystem and as salmon runs continue to decline, there are fewer and fewer nutrients being bought back to a given ecosystem, therefore making it that much harder for other species to survive (Cederholm et al., 1999). Furthermore, salmon fisheries on the coast of the Pacific Northwest are highly reliant on salmon spawning in the Snake and Columbia Rivers and further degradation of this habitat could damage those fisheries. The Snake River is also a popular sport fishery and therefore provides economic activity as people travel to the river to fish, buy equipment, and otherwise participate in the economy as they move from place to place.

Projected Market Size (pounds)	119,000
Projected Market Size (plants)	361,000
Water Demand (acre-feet) (state)	1112.2
Water Demand (acre-feet) (Bingham, Power Counties)	100
Current Water Rights (Bingham, Power Counties from American Falls Reservoir) (acre-feet)	291,184.25

Annual Stream Flow Neely, ID (acre-feet/day)	9,352.06

Figure 3: Chart summarizing results.

Discussion

The state of Idaho irrigates over three million acres of agricultural land (Idaho, n.d.) and diverts around seventeen million acre-feet of water per year for irrigation purposes (*Idaho Ranks No. 2 in Total Irrigation Withdrawals*, 2021). Much of this water is drawn from the Snake River, which flows through some of the most agriculturally profitable counties in the state. These figures make the 1112 acre-feet that the projected marijuana industry would need seem irrelevant overall. Certainly, the additional fifty acre-feet of water per year needed to irrigate marijuana in Bingham and Power counties is nothing compared to what is already diverted. Even if growers in the two counties satisfied the water needs with entirely new water rights, those would only call for approximately one hundred acre-feet per year.

These numbers are small, and they pale in comparison to everything that is diverted, but those numbers are not the only thing at play. The fact of the matter is that the Snake River, like the vast majority of rivers in the American West, is overallocated, and the American West continues to suffer from drought conditions, water shortages, and heatwaves, all of which increase water demand and create varying levels of upset. Water shortages and drought can also contribute to crop failures and have major economic impacts. The Snake River is incredibly important in its own right as an important water source, ecosystem, and recreational space, but it also contributes approximately thirty-six million acre-feet every year to the Columbia River (*Snake River*, n.d.) upon which many more people rely for irrigation water, but also serves as a shipping passage and as an important salmon habitat and is of cultural significance to Native Peoples of the Pacific Northwest.

Fifty acre-feet in two counties, or a total of 556.1 acre-feet in the state per year in diversions added to seventeen million acre-feet of diversions hardly warrants attention in reality. Even if all the water for the new marijuana market came from new diversions, it still only comes out to be 1112.2 acre-feet in the state. Not diverting this amount of water over the course of the growing season does not solve overallocation issues, nor would it have a particularly notable impact on the ecosystem, especially if diverted slowly over the course of the growing season. What then matters more is that it is more water being diverted from an already stressed and damaged system. By issuing more water rights or diverting more water, the state of Idaho would essentially discount any efforts to preserve and protect natural resources and return to the faulty

ideas that were at the forefront of water development in the American West that suggested that would always be water for agricultural use. This does, however, present an opportunity to re-shape how water is allocated and used throughout the American West. Given that this work assumes federal legalization of marijuana is what will allow for the development of a marijuana market in the state of Idaho, there is an opportunity for this legislation to shift how water use is addressed and how water is allocated.

What also compounds this issue is the changes in precipitation every year which leads to peak flows earlier in the year and very low flows in the late summer. As climate change continues to impact winter temperatures, places like Idaho that historically have gotten significant snowfall, which then accumulated at high elevations and melted slowly to feed rivers, are seeing less and less snowfall. Instead, these places are getting significant amounts of rain in the winter months, which can cause severe flooding, an issue in its own right, but rain also doesn't feed rivers in July, August, and September, when water is in the highest demand (Crozier, 2014) (Shea, 2024).

While there are, of course, systems that in theory protect rivers when flows are lower to prevent serious harm to ecosystems, they are not perfect, and waterways throughout the American West are already suffering. Even if junior water rights, which are given the lowest priority and the first to be cut off if there isn't enough water, as new rights issued would be, are suspended in times of drought or low stream flows, that doesn't mean that no one will divert water, nor does it mean that diverting water before and after drought conditions or low stream flows won't have negative impacts. Salmon, for instance, prefer cold water to spawn. Climate change, however, means that rivers are, on average, warmer than they were historically and less water in the river means that the river will warm faster, and this is compounded by the huge number of dams on the Snake River, which slows the flow and allows the water to warm. Prior to being dammed, the Snake River was a notable salmon hatchery, and there are ongoing efforts to restore passage for salmon from the Pacific Ocean to the Snake River for spawning, and salmon also spawn throughout the Columbia River and its tributaries. As water continues to be diverted from the Snake, the Columbia, and other tributaries, conditions only become worse for spawning salmon, thus damaging commercial fisheries, sport fisheries, and an important element of culture for the native peoples of the region.

Diverting an additional fifty acre-feet of water from the Snake River in Bingham and Power counties would not have a massive or immediate impact. However, diverting additional water in every county that pulls water from the Snake River in order to support a new marijuana market, could have real and disastrous consequences throughout the Idaho and the Pacific Northwest. This does not, however, mean that there should not be a marijuana market in the state. Across the United States, people vote in favor of legalization, even in very conservative states like Idaho. What it means is that it is imperative that irrigators are smart about how they use water and employ water conservation tactics, like drip irrigation, rather than traditional sprinkler systems, or plant more drought tolerant crop varieties. In this way, marijuana growers may be a step ahead, as a significant amount cultivation is done in greenhouses using methods like drip irrigation because they make the most sense for the growing method. Despite the compounding issues of overallocation and the dangers that issuing new water rights could bring, it is not a question of to legalize marijuana or not, it is a question of how best to conserve water to protect both the ecosystems and the interests of a new marijuana market.

Furthermore, even as legalizing marijuana rightfully brings up difficult questions about water resources, it also provides an opportunity of combat significant environmental harm. Illegal cultivation can seriously degrade and damage ecosystems. Legalizing marijuana and creating a legal market would presumably make it much easier for growers to engage with the legal market and operate legally than it would be for them to continue operating as they do. Growers could move away from the environmentally damaging trespass grows to running operations on agriculturally zoned land with oversight from regulatory bodies, thus reducing the petrochemicals that make their way into ecosystems and unregulated diversion of water that come along with these trespass grows. While this does not entirely eliminate the potential for growing on public lands or for growers to engage in an underground or black market, legalization provides an easier and, most importantly, regulated path to engaging with the market and generating profit. No one piece of legislation, not matter how carefully formulated or complex, will solve every issue that currently surrounds marijuana, but something is undoubtedly better than nothing.

Conserving water has already proven to be difficult as rivers continue to be overallocated and systems continue to be strained, but there are paths forward. Shifts in cropping patters to less water intensive crops and increased dryland farming have the potential to help conserve water

and protect ecosystems in the Snake River Basin, as does changes in technology. Should farmers move away from water intensive crops that provide little input to food systems, like alfalfa, irrigation demand could be reduced. Similarly, as research continues to be done on precision agriculture and water conservation, new techniques and strategies have been developed that can also assist in conserving resources. The most notable of these is, of course, drip irrigation, which delivers water directly to the base of the plant and reduces evaporation and runoff. There is also significant room for research into crop varietals and selective breeding to produce drought resistant breeds of staple crops that can continue to produce with less input. Widespread adoption of these kinds of strategies could be the thing that both protects ecosystems and allows for new and innovative markets.

Marijuana cultivation has the potential to bring with it new environmental impact. It requires land, infrastructure, and agricultural chemicals, especially if not grown in a greenhouse. It is a lucrative crop and legalization is likely to spark arguments and upset, but it is also an opportunity for the American West, and the nation as a whole to reconsider how resources are allocated and treated and that is what is necessary for solving the growing water crisis.

Conclusion

Federal legalization of marijuana continues to be a contentious topic and a timeline is difficult to pin down, however, it is likely to come eventually. It is a crop that demands a significant amount of water for a relatively low output, however, it is profitable and favorable in the public eye, therefore it is to the benefit of all to understand how to best regulate a potential market and its inputs. American agriculture is highly regulated and highly important to global food systems, which means that understanding marijuana cultivation is incredibly important in order for the systems people rely on to continue functioning well.

There is still a need for robust studies on the actual water demand and yield of marijuana under different growing conditions and these studies, once they are done, will be crucial to helping regulate and manage the new market. Unfortunately, the gray legal status of the crop means that it is difficult to conduct research for find funding to conduct that research, but it will be essential to managing resources and legalization continues across the nation and the impacts of climate change continue to be felt around the world. Much of American policy is reactive, but federal legalization of marijuana is a unique opportunity for proactive policy that protects

producers, consumers, and the environment. The only thing missing is the research for that to be done.

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