Let Them Eat Grass: The Policy Structure of the Cattle Industry & Potential Solutions to Incentivize Regenerative Grazing Practices

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ABSTRACT

The cattle production industry in the U.S. has become increasingly concentrated, massive, and industrialized over the past 50 years. Conventional free-grazing followed by feedlot-finishing systems lead to severe environmental and public health consequences. Alternative systems based on regenerative grazing and adaptive land management have high animal health and welfare standards while revitalizing ecosystems. Controlled grazing leads to increased soil carbon sequestration, water infiltration, and microbial diversity. Policy in combination with economics has caused a high rate of rancher bankruptcy, as conservation programs support conventional production. Regenerative cattle ranchers in Northern California were interviewed about their experiences with conservation programs, and recommendations for overcoming barriers to an agroecological transition and changing the incentive structure of federal-level policy to benefit sustainable operations. Interview and policy review results were combined to make differing levels of policy recommendations. The first phase was designed to have the most waterfall effects and be feasible in the current context. For EQIP, funding for CAFOs should be phased out, funding caps for projects lowered, AGI and funding cap waiver criteria made transparent and subsequently stricter each year, and prioritization guidelines made to focus on innovative, cost-effective projects. Funding for research on regenerative systems and carbon removal potential should be raised, with an increased percentage taken from industrial agriculture research annually. Lastly, illegal use of Beef Checkoff funds for CAFO lobbying should be prohibited, and state boards should be split into two interest groups – for conventional and alternative producers, to guarantee equitable representation in marketing, education and research.

KEYWORDS

adaptive land management, rancher interviews, conservation programs, beef production, agroecological scalability

INTRODUCTION

Industrialized animal agriculture is environmentally degradative, worsening climate change and causing ecological disasters and environmental injustices. Overall, livestock supply chains are responsible for 14.5% of greenhouse gas emissions that result from "feed production, enteric fermentation, animal waste, and land-use change" (Jutzi and FAO LEAD Team 2006). Cattle account for two-thirds of this percentage primarily due to methane emissions from rumen fermentation (Jutzi and FAO LEAD Team 2006). The cattle industry consists mainly of concentrated animal feeding operations (CAFOs) called feedlots (Mathews and Johnson 2013). Prior to being taken to feedlots, cattle are grazed on pastures; however, this grazing is not controlled or managed, leading to preferential grazing, soil degradation, increased weed growth and subsequent usage of herbicides (Matthews and Johnson 2013). Feedlots have been shown to lead to countless environmental damages, many of which stem from the massive amount of waste produced and subsequent usage of waste lagoons for storage; some of these issues include carbon, methane, and nitrous oxide emissions, eutrophication and biodiversity loss, contamination of surface and groundwater, and soil erosion (Mathews and Johnson 2013). Industrialized cattle feedlots clearly have detrimental effects to both local and global environments, while uncontrolled grazing results in damaged land. As a result, more attention (in scientific and rancher communities) has begun to be placed on alternative methods of production and management that are more ecocentric, especially for cattle production.

Despite the widespread nature of industrialized cattle production, alternative methods based in the field of livestock agroecology are still utilized by a small percentage of ranchers. Regenerative, adaptive grazing practices and holistic land management have the potential to not only contribute less to climate change but to actually mitigate its effects and improve ecosystem health. Livestock agroecology bases its ideology on both prioritizing ecosystem health on the same level as production, as well as focusing on synergies between ecosystems and animals. As an example, rotational grazing – a type of regenerative grazing that attempts to mimic natural herd migration - has been shown to lead to accelerated plant growth, increased quantity and quality of forage, increased water and carbon content in soils, and increased organic content in soils that allows for a diverse microbial community (Teague and Barnes 2017). However, the small to medium-sized ranches that are the most likely to employ these types of methods are going bankrupt

at unprecedented rates (Dinterman et al. 2018). Not only does this mean that the industry continues to become more and more concentrated and henceforth destructive, it also means that rural livelihoods are being destroyed by the policy incentives in this industry.

Policies governing animal agriculture have historically caused concentration and industrialization of farms, leading to the unintended consequence of hurting producers that try to employ more sustainable methods. United States policies have favored a shift from the once widespread integrated and grazing-based livestock systems of the past to the current mechanized systems that have been completely separated from natural ecosystem processes (Carlisle et al. 2019). In the 1970s, over 50% of total agricultural area and 19% of farms were employing an integrated livestock model with grazing rotation, whereas in 2012, less than 2% of farms and 7% of agricultural area were following these practices (Garrett et al. 2017). In the same vein, operations have become increasingly massive and increasingly fewer in number (Graham and Nachman 2010). Specifically for beef, four companies are in control of about 84% of the entire market (Sayre et al. 2012). In terms of agroecological practices, government assistance falls short. Historical price supports combined with current subsidized insurance programs for industrialized animal agriculture farms have not only bolstered the advantages for these types of farms, but have also further caused the decrease in holistic livestock systems (Garrett et al. 2017). Although alternatives are less detrimental to the environment and can even improve the health of ecosystems, industrialized methods continue to be the most predominant form of cattle production as a whole which leads to the necessity of policy change to shift the incentive structure.

While considering the complications of food politics and the necessity of protecting rural livelihoods, it is essential that creative policies be introduced that will switch the incentive structure of the industry so that agroecologically-based ranches and production methods are able to become more prominent in the industry. Although the field of agroecology has grown exponentially in recent years, the literature has tended to leave out animal agriculture systems, perhaps due to societal controversy and/or powerful corporations and lobbyists for these industries. Specifically, only 5% of studies concerning agroecology consider livestock (Soussana 2015). Moreover, even fewer of these academic papers discuss the policy changes and subsequent challenges that relate to shifting to livestock agroecological practices – a gap I will attempt to fill in this paper.

The central research question that I seek to answer is: how can the current policy structure of the animal agriculture industry be changed to incentivize more sustainable methods of cattle production? In order to answer this question, multiple sub-questions will be addressed as well; namely: 1) What are implicit and explicit incentives in current animal agriculture policy and who do they hurt or benefit? 2) How can small to medium sized ranchers be prioritized to keep the industry from becoming further concentrated and unsustainable? 3) What barriers play a role in making both policy changes and physical management changes difficult? In order to answer these questions, I have conducted an extensive review of federal policies and programs, focusing on the potential effects on both CAFOs and sustainable ranchers, interviewed regenerative ranchers on their lived experiences and visions for industry change, and combined the information garnered from interviews and literature to recommend policy changes needed most imminently. The overarching goal of this paper is to construct a clear image of the policy issues in the industrialized cattle production sector and to propose strategic policy changes that shift away from the CAFO advantage while giving representation to smaller alternative ranchers.

BACKGROUND

Traditional animal agriculture methods and industry trends

Traditional animal agriculture methods typically consist of massive-scale industrialized operations, called concentrated animal feeding operations (CAFOs) which do not utilize ecosystem synergies or natural processes during production. In the past 70 years, there has been a prominent trend in animal agriculture, especially regarding meat production, towards extreme concentration of the industry (Ilea 2009). Currently, over half of all animals raised for consumption come from the most massive level of CAFO which occupy a mere 5% of total land used for this purpose, emphasizing both the consolidation in the industry as well as providing insight into the probable conditions and major environmental effects of these operations (Graham and Nachman 2010). This progression has been based on principles of profit maximization and economies of scale, meaning that the consequences of concentration on the surrounding environment have been the lowest priority in order to avoid cost-intensive (but less detrimental) methods (Iles and Marsh 2012). This

concentration inevitably has led to negative externalities that are not currently accounted for in the agricultural system.

A typical cattle CAFO consists of 1000 animal units at the minimum, confined in pens in huge numbers with no access to grazing ("Animal Feeding Operations | NRCS" n.d.). The ground is primarily made up of dirt/mud, manure and urine ("Animal Feeding Operations | NRCS" n.d.). Corn and soy-based feed along with antibiotics to promote weight gain are brought to the cattle rather than allowing any grazing, as the goal is to cause fast growth rates ("Animal Feeding Operations | NRCS" n.d.). This technique is referred to as feedlot-finishing, in which cattle are grazed for about six months and then brought to be finished on a feedlot for another six months ("Animal Feeding Operations | NRCS" n.d.). The term 'finished' refers to the period of time in which cattle are brought to a feedlot before being slaughtered, with the purpose being to have the cattle gain as much weight as possible (500-600 pounds) in as little time as possible. It has been estimated that about 97% of cattle in the U.S. are feedlot-finished, with the remaining 3% being some variant of "grass-fed" (Stanley et al. 2018). The fact that livestock production today has overwhelmingly been separated from any other crops even in the form of grazing is one of the major causes of its unsustainable attributes (Sayre et. al. 2012). All in all, the confinement of large numbers of animals in such a disproportionately small space has created a system about as far from the "natural" state as possible and as a result, about as environmentally degradative as an operation can possibly be.

Environmental and public health impacts of industrialized animal agriculture

Livestock supply chains are responsible for around 14.5% of greenhouse gas emissions that result from cultivation and transportation of feed crops, rumen fermentation, manure breakdown, and land-use change (Jutzi and FAO LEAD Team 2006). This review will focus on agroecological solutions that pertain to cattle due to their overwhelming impact when compared to other animals in the industry.

In terms of local environments and surrounding ecosystems, industrialized cattle operations have extremely detrimental effects. CAFOs containing cattle are shown to lead to an increasingly long list of environmental impacts including land use change and associated effects on habitat and biodiversity loss, eutrophication of bodies of water as well as contamination of both

surface and ground water, carbon, methane, and nitrous oxide emissions, and soil erosion (Layman 2018). Many of these effects arise as a result of the massive amount of waste produced by CAFOs, which ultimately also lead to a plethora of public health issues in surrounding communities directly relating to decreased air quality and increased water contamination due to the use of waste storage facilities referred to as waste lagoons (Walker et al. 2005). Waste lagoons are commonly uncovered and unlined which leads to much leakage and overflow that contaminate both ground and surface water sources; natural disasters such as hurricanes also lead to extreme overflow events that can cause massive amounts of contamination (Walker et. al. 2005). Following anaerobic decomposition of manure in waste lagoons, the remaining broken down liquid is sprayed over fields, leading to air pollution and subsequent respiratory effects (Marks 2001). Furthermore, waste lagoons are overwhelmingly located adjacent to communities of color that are poverty-stricken, highlighting rampant structural racism as people are color are disproportionately impacted by health effects from waste lagoons and sprayfields (Wendee 2013). Additionally, these operations have extremely low animal welfare standards, which leads to major ethical dilemmas.

In terms of grazing, use of pastures prior to feedlot-finishing in theory sounds like a positive, but in actuality is not managed at all and cattle are simply put into pasture and allowed to free graze on one plot of land. Continuously-grazed pastures suffer because grass species are never able to develop deep root systems, causing soil and forage health to deteriorate after each use (Dowhower et al. 2020). Overall, the industrialized system of animal agriculture has become too focused on mass production and has led to extreme consequences from an environmental standpoint. Alternative agroecologically-based methods need to be implemented in order to stop this environmental degradation before it is too late.

Theoretical framework for livestock agroecology

Agroecology focuses on encompassing all environmental effects in the entire ecosystem involved in food production, with one important aspect being that it places food production and ecosystem health at the same priority level (Dumont et al. 2013). At the same time animal welfare is greatly improved since the health of animals is essential for maintaining the system's sustainability long-term (McGlone 2001). The field of livestock agroecology is not as developed as regular agroecology. However, Dumont's five principles serves to inform the design and

implementation of sustainable animal agriculture operations (Dumont et al. 2013). For transparency, these principles were based on general agroecological principles proposed by Altieri and modified to apply to animal production (Altieri 1984).

The first principle is to implement management practices to improve the health of animals reared (Dumont et al. 2013). Specifically, this principle highlights the need to focus on the causes of common animal diseases as a way to prevent and decrease their occurrence (Dumont et al. 2013). In practice, this includes ensuring that conditions are not overcrowded, dirty and damp, as this leads to bacterial growth and epidemics (Soussana 2015).

The second principle aims to reduce is reducing the inputs required for production (Dumont et al. 2013). A huge amount of arable land is required to grow corn and soy for animal feed which utilize a lot of chemical fertilizers, pesticides and water in the process (Soussana 2015). Therefore, the options for improvement include either increasing the efficiency of feed utilization by animals or feeding animals cheap or natural resources that do not interfere with human food sources (Soussana 2015). One way to go about using natural resources is by preserving and supporting ecosystem services in places like grasslands which can then be used for grazing with decreased need for inputs when managed properly (Soussana 2015).

The third principle is reducing pollution by optimizing the metabolic and biogeochemical functioning of animal agriculture systems (Dumont et al. 2013). The main idea here is that a synergy can be derived from mixing crops and animals in a strategic fashion, in which animal manures become a resource rather than a problem and provide soil microbes with plentiful sources of energy (Dumont et al. 2013). This is important because it leads to improved regulation of biogeochemical cycles and fluxes such as increasing soil organic carbon sequestration as well as limiting soil nitrogen losses (Dumont et al. 2013).

The fourth principle is improving and promoting diversity within animal production systems to better their resilience (Dumont et al. 2013). The intensification of animal agriculture has dramatically decreased diversity, meaning that improvement of this factor has much potential for increasing system resiliency (Soussana 2015). The core idea is that using multiple species allows for capacity to fill spatial and food niches in the same area, increases efficient vegetation usage and also reduces risk of major disease outbreaks (Dumont et al. 2013). Increased diversity of foraging options is also essential in grazing systems because it acts as a buffer against "climatic variability" (Soussana 2015).

Finally, the fifth principle is conserving biological diversity in agroecosystems by altering management practices (Dumont et al. 2013). In terms of grazing and plant/surrounding ecosystem biodiversity, changing the timing and intensity of grazing as well as rotating livestock so that certain plots are temporarily ungrazed can help to lessen biodiversity losses (Dumont et al. 2013). Preserving plant diversity in grasslands has also been shown to increase overall productivity (Soussana 2015).

These five principles should serve as the basis for proper management of sustainable livestock systems. While management techniques are variable and must be adapted to fit each specific location, the benefits to the environment and animal health and welfare are significant.

Regenerative grazing and adaptive land management

While unmanaged continuous grazing is destroying vast amounts of land, well-managed grazing can actually revitalize ecosystems. This type of grazing is combined with an overall land management ideology that is defined by its adaptive, flexible nature and is based on the principles of agroecology discussed previously. Specifically, adaptive land management can be defined as "a formal, systematic, and rigorous approach to learning from the outcomes of management actions, accommodating change, and improving management" (Holling 1978).

For cattle systems, this occurs through grazing, with the most common practice being some form of rotational grazing. Rotational grazing is based on the idea of mimicking the natural migration patterns of herd ruminants in the wild, before industrial farms took over. In a rotational grazing system, one section of a pasture is allowed to be grazed at a time, allowing the rest of the pasture to be in a state of rest and recovery; in practice, pastures are split up into a number of smaller sections called paddocks, and cattle are rotated through the different paddocks (Undersander et al. 2002). One essential aspect is that there is not a set schedule for movement of the herd to a different paddock; instead, the technique should be adaptive, and the timing should be based on the state of the soil and grass among other factors relating to climate, time of year, type and number of cattle, topography, etc. (Teague and Barnes 2017). Rotational grazing has been shown to lead to accelerated plant growth, increased quantity and quality of forage, increased water infiltration and carbon sequestration in soils, and increased organic content in soils that allows diverse microbial community to thrive (Sprinkle 2018). As rotation continues, the soil health and

nutrient contents of the grass improve, which leads to more grass growth, and healthier diets (Teague and Barnes 2017). Some challenges include the fact that it requires more time to allow cattle to grow in this natural way (allowing cattle to live for up to a year longer than regular systems) and does necessitate skilled management for success (Teague et al. 2013). There is a clear correlation between how well the grassland grazing is managed and the production of grass – a direct measure of the amount of carbon in the soil (Teague et. al. 2013). All in all, regenerative adaptive ranching requires a very different mindset than traditional simplified production. It is inherently much more complex, but that complexity also brings high potential for significant environmental benefits, both on a local ecosystem level as well as on a more global environmental scale.

Farm Bill: commodity programs

The Farm Bill is the major agricultural policy mechanism used by the federal government, and appears to provide both direct and indirect incentives towards simplified, mechanized agricultural practices. One part of Title I in the Farm Bill is directly relevant towards the topic of this paper - namely, commodity programs. Commodity programs supporting corn and soy farmers create artificially low prices for these products (Gurian-Sherman 2008). The majority of cultivated corn and soybeans in the United States ends up going towards feed for livestock, and for cattle, is brought to the animals in feedlots along with antibiotics to stimulate fast growth in the cheapest, easiest way possible. Because animal feed costs constitute a significant percentage of operation costs for a factory farm, the relationship between feed prices and CAFO costs is important to examine for implicit incentives (Gurian-Sherman 2008).

Before 1996, federal policies focused on mechanisms to control the supply of grain, leading to a high market price above production costs and guaranteeing profits for farmers (Gurian-Sherman 2008). Since 1996, Title I programs have focused less on supply controls to support certain prices, and as a result the production of corn and soy has continually increased causing their market prices to have decreased substantially (Gurian-Sherman 2008). From the 1996 to 2005 Farm Bills, corn prices decreased by 32% while its production increased by 28%; similarly, soy prices decreased by 21% while production rose by 42% (Gurian-Sherman 2008). Because of this gap between production and market price received by producers, Title I of the Farm Bill has to

compensate farmers when the price of these commodity crops drops below their production costs (Gurian-Sherman 2008). Without these subsidies, farmers who produce commodity crops would not be able to stay in business without supply controls.

The changes brought about in the 1996 Farm Bill which led to incentivization of CAFOs can be attributed mainly to the move away from supply controls, and most relevantly, the beginning of direct payments (Keeney 2013). Direct payments were introduced in order to replace the previous programs which had kept the prices of commodity crops above market levels, and were originally created with the intent of a transition rather than on a long term scale (Keeney 2013). The three objectives of this transition were to make sure farm support policy complied with WTO rules, to transition commodity crop markets to supply and demand price determination, and to give farm producers money to allow them to adjust to market supply and demand conditions in the absence of government intervention and support (Keeney 2013). However, direct payments furthered the CAFO advantage in the same vein as before as these fixed annual payments were given to farmers regardless of their decisions, practices, or market prices (Keeney 2013). While market prices for feed plummeted, farmers increasingly required payments to keep from going bankrupt and at the same time, CAFOs reaped the benefits of being able to obtain artificially cheap benefits. Direct payments were finally ended in the 2014 Farm Bill, but undoing the legacy and effects of 20 years of fixed annual payments in order to see the effects of this change will take a while; furthermore, because the government has created an insolvent business model, direct payments will be replaced by other subsidies to keep this unsustainable economic model in place for the time being (Angadjivand n.d.). In the meantime, the industry remains in a state caused by crop subsidies and direct payments in which industrial operations are both financially incentivized and advantaged.

In terms of CAFOs, without crop subsidies, producers would have to pay much more for feed, as the price would reflect reality rather than be artificially low (Gurian-Sherman 2008). For cattle feedlots, feed is estimated to account for around 16-20% of operation costs, with corn making up around 72% of feed costs (Gurian-Sherman 2008). This percentage may appear smaller than expected, with the reason for this being that the purchasing of calves makes up a large percentage of production costs and therefore grain costs correspond to less of the total (Gurian-Sherman 2008). Nevertheless, beef feedlots are put at a significant financial advantage due to crop subsidies as part of commodity programs. According to USDA data, the most massive feedlots

heavily dominate the industry, with the 168 largest beef feedlots containing over 32,000 cows each and producing over 64% of feedlot cattle (Gurian-Sherman 2008). These massive operations on average obtained about $2.2 million per feedlot in crop feed subsidies annually (Gurian-Sherman 2008). When considering alternative forms of cattle production in the context of commodity programs, it becomes clear that grass-based systems do not benefit at all from Title I crop subsidies (Gurian-Sherman 2008). Pasture production and grass rather than grain forages are not subsidized in any way, meaning that these producers are directly hurt monetarily by these programs and non-market practices (Gurian-Sherman 2008). Overall, commodity crop subsidies that compensate for low market prices lead to huge financial incentives for the use of grain as feed, and put alternative grass-based producers at an enormous disadvantage. The result is that CAFOs falsely appear more economically efficient than they are in reality, since they are not paying the full costs of their operations. Furthermore, and most problematically, feed subsidies give CAFOs an immense financial advantage over alternative production systems and further hinder the spread of more sustainable grass-based operations.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program set forth in the Farm Bill which gives farmers and ranchers both financial and technical support to be able to alter their practices in a way that prioritizes soil and water conservation (Stubbs 2010). EQIP was started in the 1996 Farm Bill with the aim of helping beginning, smaller, or marginalized farmers and ranchers. Originally, CAFOs were explicitly barred from applying so that the small farmers and ranchers that the program intended to help did not get pushed out (Smith 2017). EQIP is administered on a state level by National Resources Conservation Services (NRCS) agencies (Stubbs 2010). The NRCS is also in charge of establishing a list of national priorities which emphasize the areas that need the most work and determine the priority projects for funding. Funding for EQIP is laid out in the Farm Bill, with animal agriculture being allocated roughly 50% of total program spending (Newton 2019).

The way EQIP works is that producers can submit a plan which details the environmental and conservation goals and benefits that they will attain through using USDA-approved conservation practices (Stubbs 2010). USDA-approved conservation practices include the building

of structures (such as animal waste storage facilities) as well as land management practices (such as nutrient and grazing management). If a plan is approved, the USDA then pays the producer enough money to offset the cost of implementing each specific practice or can cover income lost due to implementation (Stubbs 2010). Specifically, the USDA can pay up to 75% of the estimated costs for implementation of the practice (planning, design, equipment/materials, installation, labor, management, maintenance, training, etc.) or as much as 100% of the projected income lost (Stubbs 2010).

The 2018 Farm Bill added a new rule: every state may choose up to 10 practices that they deem high priority (Newton 2019). The USDA will then pay up to 90% of the costs relating to the design, materials, and process of enactment for producers wanting to employ these practices (Newton 2019). The practices chosen must address the issue of excessive nutrients in ground and/or surface water (Newton 2019). Seeing as the main cause of this issue is waste from factory farms, the majority of this money will go towards building waste storage facilities (waste lagoons) for CAFOs. This is a problem because funding the building and expansion of waste lagoons does not do anything to change the widespread use of harmful practices by CAFOs – on the other hand, the ability to acquire financial support incentivizes the continued use of these practices instead of motivating a transition to more innovative and less harmful practices. In theory, EQIP contracts should greatly benefit smaller ranchers and allow them to practice sustainable methods in an economically feasible way. However, in practice, there have been clauses and waivers added to EQIP that complicate the situation.

Annual funding for EQIP is mandatory, with the program given authorized amounts each year set out in the Farm Bill (Stubbs 2010). In terms of funding caps for individual contracts, the upper limit used to be $50,000 over a six-year time period given to a single producer/entity, but in the 2002 Farm Bill this was changed to $300,000 over the same time period (Stubbs 2010). Furthermore, there was an exception added in 2008 which increases this cap to $450,000 for projects that have "special environmental significance" (Stubbs 2010). Also in the 2002 Farm Bill, CAFOs were made eligible to receive aid for the first time, and NRCS prioritization guidelines were changed to focus on projects with the biggest pollution impact instead of the most cost-effective plans (Stubbs 2010). This higher funding cap and added exception along with the changed guidelines allowed CAFOs to be able to apply to fund their waste storage facilities (Stubbs 2010). Furthermore, another caveat is that each investor in a CAFO has historically been able to apply

separately to obtain the maximum amount of funding, so the biggest operations with the most investors can end up receiving significantly more money than the intended cap (Stubbs 2010). The inclusion of CAFOs caused the average funding per contract to increase from $7,800 to $16,000 after the 2002 Farm Bill (Stubbs 2010). The huge gap between the average funding per contract and the upper limit amount of funding exemplifies the issue of unequal allocation, with CAFOs garnering hundreds of thousands of dollars easily for huge waste management structures and smaller ranchers being given the minimal amount of funding.

The trend in EQIP funding has been that since the 2002 Farm Bill, the authorized funding level has continuously increased, but at the same time appropriation acts have decreased funding levels by $1.6 billion from FY2005 to FY2010 (Stubbs 2010). The purpose of the increase in funding provided by the 2002 Farm Bill was to increase the response capacity in accordance with the significant backlog of producer demand for contracts (Stubbs 2010). Even so, the "number of pending applications continues to exceed the amount of available funding" (Stubbs 2010). Allocation of EQIP money has also been shown to be very unequal; 20% of EQIP contractees account for 70% of EQIP funding (Smith 2017). About 12% of EQIP money goes to CAFO related practices with the highest amount of this money going towards waste storage facilities; the amount of money that CAFOs receive from EQIP is second only to irrigation funding ("CAFOs and Cover Crops" NSAC 2015). Considering the significant portion of funding that already goes to CAFOs, the continual decrease in actualized funding for the program will lead to less available money for small ranchers to work on sustainable management.

The final complicating factor in EQIP revolves around the Adjusted Gross Income (AGI) cap and waiver. The AGI provision was created to set an upper income limit on producers to be eligible to apply for funding (Stubbs 2010). The 2008 Farm Bill increased the AGI cap for conservation programs supposedly in an attempt to incentivize larger operations to become more sustainable (Stubbs 2010). This has been strongly critiqued as it has been shown that a lower cap benefits small producers and allows them to garner a higher percentage of funding (Stubbs 2010). Therefore, the higher cap benefits bigger industrialized operations and in combination with the guidelines prioritizing pollution abatement potential, these operations then acquire a disproportionately high percentage of overall EQIP funding (Stubbs 2010). Furthermore, the 2008 Farm Bill introduced a case-by-case AGI waiver decided by the USDA, which allows the income cap to be waived in certain instances (Stubbs 2010). The USDA can administer a waiver based on

written requests documenting that the stated land is environmentally sensitive or has some unique significance (Stubbs 2010). The number of waivers that can be allocated is unlimited and the power of administration is solely at the USDA's discretion; this has led to concerns that large operations like CAFOs will be major receivers of these waivers.

In sum, EQIP started out with the proper measures to support small farmers and ranchers both financially and technically. However, a series of changes made in farm bills changed this structure significantly. The 2002 Farm Bill seemed to start the prioritization of industrial CAFOs as it made them eligible to apply for funding, changed the priority of funding to projects with the biggest pollution abatement potential, and significantly raised the per project funding cap. AGI waivers, funding cap exceptions, and increased income cap have furthered this issue. The 2018 Farm Bill seems to further support CAFOs in its new rule where high priority practices that relate especially to excess nutrients in ground and surface water are eligible for even higher rates of funding. These factors in combination with the trend of decreased actualized funding for the EQIP program as well as unequal distribution of EQIP funding among different types of producers have caused the program to stray far from equitable and sustainable beginnings. All in all, the EQIP program was well-intentioned in its original state, but there have been many complications created through its execution that have changed the intended beneficiaries from small farmers and ranchers to large industrialized operations.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) was passed by Congress in 1969, with its main purpose being to integrate environmental consideration into the landscape of federal policy, decision making, and project planning (Sprinkle 2018) Along with the creation of NEPA, the Council of Environmental Quality (CEQ) was also established to oversee the act's implementation (Luther 2005). NEPA has two major parts: 1) it requires that federal agencies take into account each possibility of environmental impact of a specific plan prior to its implementation; 2) it requires that the agency inform the public of the plan and confirm that it has adequately assessed related environmental issues in the process of making its decision to move forward with a certain action (Luther 2005). If the agency sufficiently analyzes and specifies any adverse environmental impacts of their proposed plan, then they are not inhibited from subjectively "deciding that other

benefits outweigh the environmental costs and moving forward with the action" (Luther 2005). This is emphasized with the 1989 Supreme Court statement which reiterated that NEPA does not require specific end results, but instead simply just advises a process with the main goal being to merely prohibit uninformed actions (Luther 2005). Overall, many uncertainties around this act are a direct result of the fact that it sets up the basic agenda for assimilating environmental deliberation into federal decision making processes, but does not offer any further particulars on how this should actually be accomplished nor does it dictate any sort of environmentally beneficial end result.

NEPA's core requirement is the Environmental Impact Statement (EIS), a detailed account of environmental impacts expected from any federal action that will 'significantly affect the human environment' (Luther 2005). A federal action is defined as an action that is possibly under federal control, which would apply to "projects and programs entirely or partly funded, assisted, conducted, regulated, or approved by federal agencies" (Luther 2005). Within a year after NEPA was passed, Congress decided that the administrator of the EPA would be required to analyze and comment on each EIS, make these comments available to the public, and if the EIS was unsatisfactory, to hand it over to the CEQ (Luther 2005). Within an EIS, the information that is required includes: any harmful effects on the environment that are impossible to avoid should the plan be carried out, alternatives to the proposed plan, the "relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity" and "any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented" (Luther 2005).

In some instances when the significance of an impact is unclear, an Environmental Assessment (EA) is also required. The EA should provide detailed evidence to determine whether an EIS is necessary or to show a finding of no significant impact (FONSI) (Luther 2005). Despite all of this, the CEQ still was not given the authority to actually enforce these regulations. As a result, there are a suspiciously small number of EISs filed each year; for example, in 2004, a total of 597 EISs (draft, final, and supplemental) were proposed to the EPA (Luther 2005). The CEQ has stated that the majority of federal actions are 'categorically excluded' (CatEx) from providing an EIS and/or EA (Luther 2005). Categorical exclusions occur when a project is in a category that is "known to have no significant environmental impacts" (Luther 2005). In 2016, there was a ruling which resulted in the Farm Service Agency (FSA) determining that medium-sized CAFOs (for cattle:

with as many as 999 cattle) have no environmental impact and can therefore be entirely exempt from any NEPA analysis (Waltz 2018).

The main problem with NEPA in relation to the alternative cattle production methods previously described stems from the context in which the act was created. At the time that NEPA was passed, the dominant theory for thinking about the way ecosystems and the environment function was the 'equilibrium paradigm' (Thrower 2006). This idea of equilibrium reflects a view of ecosystems in which they are seen as systems in balance that are static and adhere to patterns of predictability (Thrower 2006). Therefore, the major goal of NEPA was to protect this static equilibrium; in this sense, requiring environmental impact statements detailing the exact results of an intended action was entirely plausible due to the high level of predictability of ecosystems. However, ecology has undergone a paradigm shift in regard to its core knowledge base, and the new dominant theory is referred to as the 'nonequilibrium paradigm' (Thrower 2006). The nonequilibrium paradigm is based on the concepts of ecosystems being complex, variable, and dynamic, including living and nonliving elements as well as chemical cycles and geological fluxes, and humans inevitably having great impacts on nature and being an integral factor in ecosystem dynamics (Thrower 2006).

NEPA is based on the requirement of environmental impact statements, which represent detailed predictions of environmental impacts from a planned action extrapolated from a 'static snapshot' of the ecosystem at a given time (Thrower 2006). However, modern ecological theory clearly demonstrates that this reliance on a static snapshot is not at all representative of the inner workings of an ecosystem nor its response capacity. Because of this, NEPA is very limited in its application to more innovative agricultural practices. Specifically, the concept of adaptive management is based on the realized necessity of experimentation, flexibility, and high response capacity in order to work within a complex ecosystem (Thrower 2006). Adaptive management relies on continuous "action and reaction in the absence of complete information" which allows the manager to alter their practices to ensure maximized environmental benefits (Thrower 2006). Because of the unpredictable nature of ecosystems and therefore this form of management, it is difficult for producers wanting to practice these alternative methods to be able to adequately write an environmental impact statement and/or assessment that analyzes and predicts the outcome of their intended practices beforehand.

Overall, NEPA appears to be flawed in two major ways. The first way being that requirements are so subjective and unclear that, in combination with the high rates of exclusion from the process, federal actions that almost certainly do have very significant impacts on the environment never have to conduct an EA or write an EIS. Specifically, this led to the ruling that feedlots with up to 999 cattle are assumed to have no environmental impact and are entirely excluded from NEPA requirements. This means that a lot of major projects such as the construction and expansion of a CAFO can be undergone without looking into alternatives or making information on the environmental effects available for public viewing and discourse. Secondly, when an agency fills out an EIS and/or conducts an EA, those agencies that follow adaptive management techniques are fundamentally at a disadvantage. As a result, they may receive feedback that their EIS was 'unsatisfactory' with this being published to the public when in fact the act is just too focused in on old ways of thinking about the environment and subsequent effects. These issues relate to the topic of this paper because they both allow industrial operations to exclude themselves from NEPA requirements of environmental impact statements and assessments and also implicitly discourage adaptive management techniques due to the details of these requirements.

Beef Checkoff program

Another program that has historically caused issues for smaller ranchers in terms of unfair representation is the Beef Checkoff program. USDA check-off programs have been authorized by Congress as a way to promote certain products with the goal of increasing demand and consumption, but in practice, there has been widespread misuse of funds (Viña 2005). Check-off programs attain their funding from mandatory payments based on the amount of a product that an entity produces, sells, or imports (Viña 2005). The money is supposed to be used to create a board representing the industry (the Cattlemen's Beef Board for the beef checkoff), which is in charge of a number of programs surrounding advertising, educating consumers, nutrition, production, research for strategic marketing, and development of new products (Viña 2005). The Beef Checkoff program was established in the 1985 Farm Bill and requires all producers selling cattle to pay $1 per-head ("What is the Beef Checkoff?" Beef Board n.d.). Typically, half of this dollar goes to the Cattlemen's Beef Board, while the other half goes to a state beef board, which can send some of these funds to the National Cattlemen's Beef Association (NCBA) for the purpose of

promoting beef on a national scale ("Court Documents -Cattle Lobby" 2019). It is illegal for the NCBA to use this money for lobbying efforts ("What is the Beef Checkoff?" Beef Board n.d.).

Many producers question the constitutionality of these programs as they argue that they should not be required to pay for advertisements that they disagree with (Viña 2005). These opposers often cite the First Amendment as a reason why check-off programs should be considered unconstitutional. In 2005, the constitutionality of the beef check-off program was challenged in court in the Johanns v. Livestock Marketing Association case (Viña 2005). It was argued that the beef check-off program goes against the part of the First Amendment which inhibits the government from "compelling individuals to express certain views or to pay subsidies for speech to which they object" (Viña 2005). The Supreme Court ruled that the program's advertisement was the "government's own speech" and therefore was exempt from the First Amendment challenge (Viña 2005). Specifically, the court began by stating that it had never analyzed the consequences of "government-compelled subsidy of the government's own speech" and came to the conclusion that "compelled funding of government speech does not alone raise First Amendment concerns" (Viña 2005).

According to the Beef Board's website, by law, funds from the checkoff program "cannot be used to influence government policy or action, including lobbying," but in reality this has not been upheld whatsoever ("What is the Beef Checkoff?" Beef Board n.d.). In a particularly shocking recent case, a group of independent cattle ranchers from Montana known as Ranchers-Cattlemen Action Legal Fund (R-CALF) USA started a lawsuit against the USDA regarding this issue ("Court Documents - Cattle Lobby" 2019). Documents from the case show that millions of dollars from the beef checkoff fund are being given to the top cattle lobby – the NCBA ("Court Documents - Cattle Lobby" 2019). In 2018, $3.83 million was spent on lobbying for livestock, with the NCBA being the top contributor (Lazar 2015). The NCBA's 2015 IRS report revealed that checkoff funds made up roughly 73% of their total annual budget for lobbying efforts ("Checkoff Abuses" n.d.). Furthermore, it was also discovered that about 72% of the NCBA's president's salary was taken from checkoff funds; NCBA membership includes less than 4% of cattle producers, which emphasizes the immoral nature of this act ("Checkoff Abuses" n.d.). David Muraskin, a senior attorney for Public Justice representing R-CALF, elaborates on the issue with this by discussing how it is another example in a long list where big, powerful corporations manipulate a system that is supposed to benefit smaller ranchers in order to further consolidate

their power ("Court Documents - Cattle Lobby" 2019). The main issues that rancher organizations such as R-CALF have with these ads is that they "communicate that all beef is equal" and do not provide any distinction between production methods ("Court Documents - Cattle Lobby" 2019). Because of this, ranchers argue, these advertisements greatly favor industrial and conventional beef producers and put smaller, independent, and more sustainably-focused beef producers at a disadvantage, especially when combined with the fact that the NCBA typically aligns itself more with the goals of large industrial producers ("Court Documents - Cattle Lobby" 2019).The lawsuit in Montana has been expanded to include 14 other states where this same issue of state beef councils acting as private entities and sending money to lobbying groups has been documented (R-CALF USA 2019). Overall, the Beef Checkoff's mandatory nature, egregious and illegal misuse of funds, and unequal representation of the interests of different cattle producers are unacceptable and have caused industrial operations to again be prioritized over smaller ranchers.

Conservation Stewardship Program and Conservation Reserve Program

The Conservation Stewardship Program was created to replace an outdated program in the 2008 Farm Bill, and its main purpose is to grant payments to farmers and ranchers based on the conservation practices that they have adopted (Duffy 2015). Its objectives can be split into two parts: to reward farmers and ranchers who already have high standards of conservation measures, and also to provide incentives for them to add additional beneficial practices on their land (Fox and Johnson 2018). This program's effectiveness appears to stem from its comprehensive approach which not only enrolls the entire operation in the program rather than just one project, but also recognizes the need for continuous and ongoing expansion of conservation efforts ("NSAC Special Report" 2020). Because of this recognition, contracts are more long term, with CSP offering producers 5 year contracts with renewal opportunities ("NSAC Special Report" 2020). The program works by providing producers with yearly payments based on their successful continuation of conservation practices as well as their use of more newly adopted practices ("NSAC Special Report" 2020). CSP is conducive to ranching, with one of the top 5 practices in terms of acreage in 2018 being prescribed grazing ("Conservation Stewardship Program" 2019). Ranchers interviewed about CSP in previous literature have cited numerous benefits, including: encouragement towards developing long-term management of grassland past the contract and

strengthening skills needed, incentivizing sustainable management methods for pasture-raised cattle, providing ranchers with a stable addition to their income which allows them to continue practicing conservation management even if a certain year is more financially challenging, and lastly, supporting ranchers in tracking changes on a long-term scale which allows for documented success and valuable information for future decision making (Ellis and WFA 2018). While CSP seems to be a well-designed, widely-used and overall successful program, it still has its fair share of issues. The same interviewees in a past study described some challenges with the program and changes that would make it more accessible, including: simplifying paperwork and reporting, increasing collaboration between producers and policy makers that control the development of the program, increasing the flexibility of program requirements to allow for adaptability for producers with unique ecological conditions for whom certain efforts do not make sense, and lastly, offering assistance to keep up with intensive monitoring requirements and record keeping, as some ranchers cited having to hire outside help to be able to abide by the protocols of CSP (Ellis and WFA 2018). Overall, CSP seems to be a successful program, but like many other programs, struggles a bit in implementation and accessibility. However, these implementation issues are not insurmountable and could realistically be changed to improve the program significantly. The last complicating factor is that funding for conservation programs in the Farm Bill is being decreased, even though producer desire to take part in conservation efforts is increasing, leading to a shortage of available funding (Ellis and WFA 2018).

The Conservation Reserve Program was created in 1985 with the main purpose being to pay farmers and ranchers to take environmentally sensitive or more erodible land out of production for over 10 years to allow it to recover (Cowan 2010). Its objective is to conserve and ameliorate soil health, water quality, and wildlife habitats by removing land from production and replacing the land cover with resource-conserving covers including different types of grasses and trees (“Conservation Reserve Program” NSAC 2019). One major deterrent in the past for ranchers using CRP was that the land had to be cropland that had been cultivated for at least a certain number of crop years, which outright excluded damaged grasslands that had been degraded from other practices and were not necessarily prime for use as a riparian buffer (“Conservation Reserve Program” NSAC 2019). However, this requirement was changed, so that now ecologically relevant grasslands that contain shrubs for grazing are eligible for the owner to apply for CRP (“Conservation Reserve Program” NSAC 2019). The main problem that I see in terms of

regenerative grazing systems is that these operations rely on their production practices and methods in order to increase ecosystem health. That is, grazing rotation and strategic land management is what heals the land, so if instead this land had to be taken out of production, it would not make sense for these types of ranchers to apply to the program. Historically, CRP has not truly permitted grazing; the 2008 Farm Bill conditionally allowed grazing to control invasive species under specific conditions but even under this, payments to the producer were reduced "by an amount commensurate with the economic value of the authorized activity" (Cowan 2010). CRP does not appear to fit well with regenerative grazing practices, and does not recognize its potential to improve soil health, water quality, and wildlife habitats. Therefore, ranchers practicing adaptive methods do not have much of an incentive to apply for CRP, as even if their grazing fits under the specific requirements, their received payments will be reduced due to continuing production despite its ecological benefits and necessity.

METHODS

Research framework

My research project is grounded in the idea of conducting a critical policy analysis that is based on a combination of rancher interviews and a review of the current literature. In my literature review, I found that most policy analyses that relate to this subject use a lot of economic analysis and historical modeling to then suggest changes to policy and programs that they think would be helpful in the future. However, there have been very little policy analyses that include ranchers in their policy proposal sections and that is a big gap that needs to be filled. Regardless of the amount of information I have read on the subject of ranchers, conservation programs and the Farm Bill, I will never be able to understand the complex effects that many different interacting factors have on an actual rancher. This is why I believe it is essential to include rancher interviews as a main informant of my policy design – participatory action research is an effective way to include the subjects of a paper in a way that allows their experiences to inform the results.

Data collection methods: rancher interviews

The target population for interviews was cattle ranchers who manage their land and livestock in a sustainable way, with my definition of sustainability including both greenhouse gas emissions and sequestration as well as ecosystem health and regeneration. Ranchers were contacted through email following personal research of each ranch and identifying those that outwardly spoke of their regenerative grazing methods and environmental goals (for example, on their website). I then conducted semi-structured phone interviews with the cattle ranchers. Semi-structured interviews allow for the interviews to ask the same questions as a baseline in order to be able to draw comparisons between them and identify similar sentiments and trends. However, this interview structure also allows for deviation from the questions based on rancher responses, which gives more flexibility for obtaining information that could not have been anticipated in the interview guide. A total of 8 ranchers were interviewed, with these ranches located in Northern California. For protection of the ranchers and to allow them to speak and critique freely, the names of the ranches will be kept anonymous. The average time of each interview was 60 minutes (with a range from 30 to 90 minutes).

In terms of the interview questions themselves, I created a semi-structured interview guide. Verbal consent to record was attained at the beginning of each interview, and each interviewee was informed of the anonymous, voluntary and confidential nature of their names and answers. The first section of the interview guide had the goal of providing context of each ranch and leading more into the realm of a narrative; questions asked revolved around the history of the ranch and ranchers, ownership status of land, grazing methods practiced, and main motivators for these methods. This section allowed me to understand each rancher's situation a bit better, build rapport, and cater following questions to make sure they would apply to the interviewee. The next section revolved around the effects of certain policies and programs, as well as each rancher's critiques, opinions, and recommendations for change. This section was the most flexible in terms of content, as the interviewee only spoke to the programs and policies that they had participated in and/or felt affected by. Within this section is also where interviewees could bring up other issues that they felt were important; this also allowed me to adjust interviews going forward and ask the next interviewee about an issue that the previous interviewee had discussed. The goal of this section was to understand the frustrations and challenges associated with some programs, the successes of

others, and the opinions of each interviewee on aspects they thought should change. The last section included more broad questions on barriers to transitioning to sustainable methods as a whole and what, if anything, would help, with topics discussed being: economics, monitoring and implementation, rancher networks and connectivity, research on regenerative methods, technology, and social perceptions.

Data analysis methods: interview coding

The interviews that were conducted of regenerative ranchers were audio-recorded, transcribed, and subsequently coded to find trends in challenges, sentiments, and recommendations between ranchers. The transcribed interviews were coded by hand to capture implied sentiments as well as outliers. Overall, a lot of interview questions were kept very open-ended in order to fully capture the rancher's experience and opinions. Based on methods by Knapp and Fernandez-Gimenez 2009, this strategy should be a purposeful choice to allow for a more open dialogue, but it also makes using coding software more difficult as it is harder to categorize rancher quotations (Knapp and Fernandez-Gimenez 2009). Coding the interviews by hand rather than using software such as NVIVO allows for a more subjective approach, so that interpretations and implications that may only be identified by an actual person are not missed. Also, this allows other comments that may not be a trend across interviews but are still relevant (and may inform future research and interviews) to be picked out.

A list of potential "codes" was written up to begin the process, with additional themes being added and adjusted throughout the process of reading interviews. Themes were adjusted while coding interviews, and 3 clear categories emerged with subcategories within each. This method of broad categories containing more specific subcategories is based on methods in Knapp and Fernandez-Gimenez 2009, and is an effective way at breaking down long narrative style interviews. The broad categories identified are as follows: challenges to adoption (of regenerative, sustainable grazing and land management practices), successes and failures of federal programs and recommendations going forward. Each category contains specific subcategories that contain common rancher sentiments. These common sentiments will be used as a direct informant for the policy design section, since the overarching goal of the subsequent part is to adequately represent rancher opinions.

RESULTS

Following coding, the interviews revealed 3 main categories of rancher experience/opinions, with subcategories defined within each main category. The following sections describe each category and subcategory and the main findings within each. These findings will be elaborated on and implications explored in the subsequent discussion section. For the sake of transparency, a fourth category did emerge, which covered a small number of California specific programs. However, state-level programs are beyond the scope of this project and were not thoroughly analyzed in the policy review, so this category was removed to prevent uninformed recommendations later on.

Challenges to adoption: steep learning curve, short-term profit loss, social isolation

Steep learning curve

100% of ranchers interviewed placed an emphasis on the steep learning curve of practicing adaptive management as its success is primarily dependent on the skill set and experience of the rancher. However, all ranchers also noted that once the learning curve is met and the rancher has an understanding of how to adaptively manage their land and respond to changes, the ranching operation actually requires less work than conventional systems as industrial operations require the addition of more inputs over time. Ranchers explained that well-managed land on a long-term scale undergoes a positive feedback loop - where the ecosystem continuously becomes healthier and therefore requires no inputs and much less of the active type of changes needed in the beginning to improve the land. Also important is that half of interviews did emphasize the time and requirement of presence that rotational grazing systems require, commenting that in order to successfully run this type of ranch, this would have to be the rancher's only and full-time job. All ranchers noted that they think this steep learning curve is a huge deterrent to other ranchers adopting these methods as well as their adoption on a larger scale.

Short-term profit loss

In relation to the steep learning curve of adaptive land and grazing management, all ranchers noted that profit decreases in the short term are to be expected. The reasoning given for this was as follows. A conventional system uses cheap synthetic inputs and feeds to focus on maximizing production, which in a certain sense makes maximizing profit easier. However, interviewees explained that on a long-term scale, regenerative systems can be more profitable because the rancher no longer has to spend money on synthetic inputs as the ecosystem becomes healthy enough to provide all nutrients and food needed for the cattle, and proper grazing causes soil and grasses to become healthier without the need for fertilizer, herbicides, etc. When talking about their experiences in the early stages of adopting adaptive management practices, all ranchers highlighted the extreme challenges and hardships that they underwent - with multiple mentioning mistakes that they made in the learning process that ended up costing them a lot of money and taking a lot of time to recover from. It was asked of me by 75% of ranchers to communicate clearly that these mistakes tended to occur at a time when these methods were in their early stages of development and that the situation is drastically different in this day and age. Even so, the reality is that on these smaller, family-owned ranches, their livelihood cannot be left up to experimentation - so the risk of losing profit is a risk that may not be worth it to a lot of ranchers if there is no support or assurance to help them with the transition.

Social isolation

In relation to both the above categories about hesitance in adoption, 6 out of 8 interviewees mentioned some form of social isolation or alienation that they had experienced or that they were aware of as being a significant deterrent to other ranchers. One interviewee stated that even today, she and her husband are deemed to be a bit ‘crazy’ by their neighbors (who practice conventional methods) and are looked at as ‘hippies’ with a rather negative connotation. Ranchers communicated that they had gained their knowledge and skill sets through a couple pathways, as follows. Firstly, the majority of ranchers had a history of cattle ranching in their family and were taught to follow the methods used by their parents and grandparents. These methods often tended towards synthetic inputs and profit maximization due to the timing of the green revolution, the

green-washing of many of these practices, and the need to adapt to stay in business with the rise of mass production. Secondly, some ranchers learned their skills from professors in college and are hesitant to go against what they were taught was the correct approach. In the words of one interviewee, the risk of adopting something new is causing a lot of ranchers to "continue to go bankrupt, but on a predictable path."

Successes and failures of federal programs: EQIP, CSP, CRP

EQIP

The resounding conclusion from 7 out of 8 interviewees regarding EQIP was that it is by far the best program out there for ranches such as their own. The positives of this program according to interviewees are as follows. It is the most straightforward program for landowners to understand and tends to be more successful because landowners can come up with their own projects but then are helped to make sure they are doing it in a way that should work and provide benefits in a cost efficient manner. However, 50% of ranchers interviewed had a phrase relating to the sentiment of just being "unlucky" in actually receiving enough funding.

CSP and CRP

5 out of 8 ranchers interviewed appreciated the intent of these two programs and many had taken part in them, but the general consensus was that these programs do not tend to be implemented well in multiple ways. Interviewees stated that because these programs are dependent on landowner reports, they are easily abused. Their time-limited nature prevents extreme abuses, but the lack of oversight means that they are not as beneficial or as efficient with funding as they could be. Interviewees also discussed issues with uninformed personnel delegating funding and pushing projects that may not be efficient in certain ecological contexts. Lastly, interviewees expressed frustration citing a general lack of personnel available making the programs less effective as a whole and less accessible to ranchers who do not have the time or ability to hire assistance to help with extensive monitoring protocols and paperwork.

Furthermore, 2 ranchers were aware of a program within CRP called the Grasslands CRP program that is much more conducive and helpful to ranchers practicing regenerative grazing. It

does not have the requirement of cropland that the original program contains, and actually can incorporate active land management rather than just taking land out of production. However, these interviewees stated that this program is not very well-known and as a result is not taken advantage of by ranchers as much as it should be, and is not given sufficient funding.

Going forward: funding, academics, rancher networks and connectivity

Funding

All ranchers discussed funding as a major problem that needs to be addressed for any progress to be made in the industry. 2 ranchers suggested that funding for conservation programs should be regulated based on the size of the operation - stating that this should be doable as it has been done before in terms of sex and ethnicity of ranchers. The main areas of funding that ranchers thought would be most effective if increased were EQIP, carbon sequestration programs, research in the field, and personnel for programs. Overall, generally ranchers supported increased financial support for the NRCS.

Academics

7 out of 8 ranchers interviewed highlighted the need for further research on regenerative grazing methods and adaptive land management in general. The general consensus was that despite so much rancher experience documenting the successes of these practices, they will never spread on a wide scale unless they are proven on a scientific basis as this is what is needed in today's society for something to be considered 'legitimate.' While this fact appeared to evoke a lot of understandable frustration among ranchers, they recognized that increased research to prove benefits would also most likely help ranchers looking to transition feel as though it was less of a risk. However, a major concern that interviewees had was the plausibility of demonstrating benefits in a traditional scientific structure; the problem, as explained, is that the most important part of this type of ranching is its adaptable nature and the assumption that ecosystem interactions are complex and require a certain level of acceptance of the unpredictable nature. This does not tend to be conducive to the traditional scientific method which is based on set methodologies and

only testing one factor at a time rather than trying to have a more holistic approach. Another major sentiment from interviewees was that because the process of conducting research and publishing takes such a long period of time, the scientific literature would continuously be outdated since new, innovative methods are emerging constantly. Regardless, all ranchers agreed that the research field is finally beginning to understand and work through this conundrum, so they were hopeful that the body of literature would start to catch up to current rancher knowledge.

Another relevant factor that came up many times in relation to academics is the importance of rancher connections to university programs and professionals. 75% of ranchers were part of the UC Cooperative Extension Program (or a similar program that connected them to scientists and academia) and described it as being completely invaluable and essential for their success. One interviewee explained that the program connected them to a scientist that helped to explain their watershed data, and also a range specialist that assisted them in implementing yearly monitoring of soil health. Given the common sentiment that it is often difficult to know whether or not practices are actually going to benefit ranchers and allow them to maintain a profit, proven research to demonstrate and model effectiveness would help to decrease this feeling of risk.

Rancher networks and connectivity

An overwhelming sentiment from all ranchers interviewed was the absolute necessity and importance of rancher networks in making the transition to more regenerative adaptive grazing and land management methods. An important factor in rancher networks is that they contain ranchers of all different experience levels; this way ranchers can learn from those who are successfully profiting using these methods as well as those in every step of the way that can then attest to, understand, and help with solutions to overcoming a huge variety of challenges that may come up along the way. Interviewees stated that this was necessary to overcome a lot of the hurdles previously mentioned and experienced by all. Specifically, ranchers discussed being able to learn from more experienced ranchers in how to overcome a multitude of site and context specific challenges, finding a community of like-minded ranchers to prevent social isolation, and learn about programs/organizations/academic groups/other opportunities to become involved in.

Another issue that was brought to my attention by only a very small subset of interviewees - 2 out of 8, but is, in my opinion, very important to mention is the issue of rancher connectivity.

That is, in some rural areas where communities of ranchers live, they do not have cellular data or access to the internet and only possess a landline phone. This was not an issue that I had anticipated and is also one that I think is easy to overlook as a researcher. One interviewee stated that they must drive 2 hours to obtain cellular service, and that the community of ranchers had been trying to get this issue dealt with for years to no avail. This is a major issue as it prevents inclusion in rancher networks, makes applying for grants and funding even more difficult, as well as just makes general daily activities more difficult. Paralleling this to the hierarchy of needs, it makes sense that ranchers who lack this basic service may be even more deterred from practicing adaptive methods.

DISCUSSION

My results help to describe the experience of ranchers practicing regenerative grazing methods in Northern California, how they have used and/or been affected by certain policies and programs, and their opinions on how to improve the aforementioned. As outlined in the previous sections, interview coding revealed three distinct categories, with subcategories within each. This section will analyze the major interview findings from these categories, combining these results with information obtained from published papers in order to draw conclusions about the future of policy in the industry.

Differences between expected and obtained results:
NEPA as a wide scale deterrent, Beef Checkoff as a largely unseen atrocity

The policy review written previously was based on information read in literature when conducting personal research on the topic. NEPA and the Beef Checkoff stuck out to me as being potentially problematic for smaller sustainable ranchers; however, my expectations turned out to differ slightly from the reality described in the multiple interviews conducted. Regardless, these programs that were not as directly problematic as anticipated are still important on a larger scale when thinking of the idea of a transition to more sustainable methods in agriculture as a whole as well as the general context that sustainable ranchers are existing in and hence affected by.

NEPA

Specifically, NEPA is a major deterrent to a wider-scale environmental transition, especially on the level of conventional operations adopting any subset of regenerative or more sustainable methods. NEPA does not necessarily impact small ranchers themselves as they may not apply for projects that would warrant an environmental impact statement or assessment, but it creates a context in the industry which disincentivizes adaptive methods that tend to be employed by these ranchers. The way it is written (discussed previously) leaves no room for adaptive management due to the requirement of specific actions and their exact results laid out in the plan (Thrower 2006). If adaptive management is to become more mainstream on a bigger scale, this needs to be changed to allow for flexible action and the inherent unpredictability of complex ecosystems to be accepted. It is not realistic to think that conventionally-focused producers will fully transition to sustainable-based management; instead, it is more likely that adoptions of smaller changes in practices will take place over time. In the same vein, conventional producers whose focus is on profitability are not likely to go out of their way or inconvenience themselves in adopting any sustainable practices if it would hinder their application processes. In terms of the ranchers I interviewed, while there were no specific comments on NEPA, there were comments related to the industry-wide non-acceptance of adaptive management. Specifically, one rancher expressed that "every incentive points you towards simplified, industrial types of practices … but in ranches with focuses like ours, everything is connected, subtle, and hard to explain which makes your management plan anything but simple."

Therefore, a more radical and fundamental change would be to alter the requirements of NEPA so that producers who do not solely use predictable and clear-cut conventional methods are able to adequately fill out an EIS. This is very important in scaling agroecological methods to become both more widespread as well as more appealing to larger operations that must fill out an EIS under NEPA. It must also be noted that NEPA is not an effective incentive for sustainability in general because it does not require that any changes be made to projects that are degradative to the environment. However, in the context of this recommendation, my focus is more on the atmosphere that the policy creates which does not allow for any adaptive methods due to their less than clear-cut nature. Because adaptive methods are the basis of agroecological management, this policy disincentives the adoption of sustainable practices by larger operations, which is what must happen if we are to have a mass transition at any point in time.

Beef Checkoff

Another program that I analyzed previously was the beef checkoff program. This program was clearly problematic and corrupt based on my research, which showed that money collected was illegally being used for political lobbying in favor of CAFOs and often at the expense of sustainably-focused ranches. However, ranchers did not have strong opinions on the program and many did not really know much about it at all, which further highlights the issues with how its money is being used. One rancher stated that although he was aware that the way the money was being used did not benefit his type of operation, he still supported the program because "regenerative ranchers are so underrepresented in society and somebody has to speak for us even if it's done in a way that's imperfect." Rancher statements in other interviews mirror this feeling of not being represented adequately by those higher up in the industry and even more so of being overshadowed by the dominant conventional farm image. Environmentalists as a whole have focused primarily on the "meat is bad" agenda without separating the types of production operations; this has caused ranchers who actually focus heavily on ecosystem regeneration, environmental sustainability, and animal health and welfare to be associated with factory farms which represent the opposite. Because ranchers of this variety feel widely unseen in society's (and especially environmentalists') eyes, it appears as though the general sentiment is that any representation is better than no representation.

The fact that this tax seems to be just accepted and ranchers do not feel as though they have the basis to question the fate of the money becomes even more unethical when combined with the reality of its effects. Money that is used 'properly,' (i.e. not illegally for lobbying purposes) overwhelmingly goes towards advertising, marketing and research for technologies that favor conventional operations and how to improve the mechanistic production line to increase profit and efficiency rather than research towards sustainable methods (Viña 2005). Furthermore, the illegal use of this money for lobbying efforts to push corporate conglomerate agendas in the policy arena has actually ended up hurting the smaller sustainable ranchers that must pay this tax as well (Viña 2005). For example, cattle lobbyists were responsible for getting EQIP changed so that CAFOs were eligible to apply, which has hurt ranchers tremendously as there are less funds available and as a result much more competition to obtain said funds. Because of these reasons, it is my

recommendation that each state as well as the national Beef Board should be split into two interest groups - those of conventional operations and those of sustainably-focused operations - with taxes collected from each operation going to its representative group. Lastly, the law needs to crack down on those responsible for using money to pay for lobbying, as this is unacceptable and is clearly stated as being illegal by the NCBA.

Barriers to adoption of adaptive methods:
steep learning curves, social alienation, public perception, rancher livelihood

Steep learning curves and the perception of risk

Ranchers made it evident that there is a steep learning curve of practicing adaptive management. In the words of one interviewee, "when you dial up the management, it's a lot easier to make mistakes," meaning that as management becomes more complex and nuanced, errors are easier to commit and in the same vein, these errors can have much more severe consequences. Another rancher had a similar sentiment, stating "when you increase the intensity of something, you raise the stakes." However, paralleling this increase in intensity and complexity of management is the increasing potential for ecological benefits and long-term sustainability of the operation, which in a sense justifies much of the risk.

What is important to note going forward is that ranchers also felt that the perception of risk was not fully warranted and was based on certain misconceptions. The most relevant misconception is the level of risk - there is always risk with adopting a new strategy, especially when the old strategy is more simplified, easier to manage, and in a sense more dependable (i.e. conventional systems that rely on synthetic inputs, do not take the ecosystem as a factor to consider, and just buy feed and antibiotics to get cattle up to weight after pasture). However, this risk should not be placed on uncertainty over whether these regenerative methods work. Time and time again, ranchers have documented the observed benefits of regenerative grazing on both an ecosystem and animal health level; yet, there exists a separation between rancher experience and successes using these methods and actual scientific research results documenting beneficial effects (Teague et. al. 2013). Ranchers interviewed described how they saw changes in the ecosystem firsthand and witnessed hands-on how the system became more resilient, the soil held more water

and contained more microbial life, and how the grass grew stronger and healthier with each season. The problem stems from the fact that ranchers felt as though they did not have a position in society with enough authority that their observations were believed or held as significant in any way. The extreme complexities of successfully managing rangeland are not commonly known by the mass of society, and even by scientists who study environmental issues related to the food system. However, interviews also revealed that more ranchers are partnering with NGOs and academia to track soil health data such as water and carbon content over time, leading to success being documented rather than solely observational. Lastly, there exists a problematic lag time between innovative land management practices and published scientific research to prove effectiveness (Knapp and Fernandez-Gimenez 2009). Interviewees lamented that new ideas and changes emerge in their communities quite often, so once a scientific study is published, it is often already outdated and does not reflect current innovative techniques.

In response to causes of hesitation, ranchers felt there were ways to combat this fear of the unknown going forward. Ranchers discussed their hardships in the early stages of the field of adaptive management, and attributed a significant portion of this to the nature of when this occurred. For example, one interviewee stated that in college, he learned "information from the time, which focused on scalability and maximizing profit and production through things like synthetic inputs and moving away from the 'outdated' pasture-based management that had been used for a long time." Today there is much more documented rancher experience and knowledge on what works and what does not, and how to combat issues and maintain profit better at all stages of a transition. There is also much more of a movement towards agroecology, with another interviewee documenting how she had seen within her lifetime a shift in society's view of the food system, saying that "practicing these methods 30 years ago was seen as elitist, anti-innovation and technology, and almost taboo, but now there's a level of acceptance of the damages caused by conventional ag and the regenerative 'back-to-the-roots' style of management is now seen as the more innovative, cutting-edge way to go." Because of this, ranchers felt that practicing sustainable management is much more feasible today as the information is available if you can get it or find someone to teach you. On that note, rancher networks were widely recommended as a way to help with the feeling of uncertainty (more on this later).

Social alienation and public perception

Social aspects were said to play another major role in causing hesitancy in transitioning to adaptive management systems. Currently in the industry, conventional systems are dominant - even at a smaller scale, it is much more common to use aspects of conventional systems like synthetic inputs - as they were heavily incentivized starting with the Green Revolution - than it is to go the opposite route and focus on regenerating the ecosystem. Because of the inherent risk of adopting something new and less predictable, the lack of social support currently is a major barrier. This, like a lot of issues in the industry, must be combatted through changes in the perception of cattle production - both by producers and consumers. One rancher interviewed grew frustrated when discussing how "public perception is extremely difficult in both directions from both consumers and fellow ranchers."

On the consumer end, there are the environmentalists who refuse to recognize that a form of meat production can be sustainable and therefore ranchers are looked down upon, and then there are those who refuse to accept that conventionally-produced beef is not sustainable which leads to hostility towards any environmentally-focused products. For so-called 'green' consumers, all forms of beef production tend to be put in the same negative light. The problem is that it is not widespread knowledge that there are cattle production systems that are sustainable and ecologically very beneficial. In other words, consumers tend to think about the production of their food a lot, but know very little if not nearly nothing about the complexities of how their food is actually raised. This can further lead to an economic risk that may not be worth it to some producers. That is, is there enough of a market for regeneratively-grazed beef for them to transition and potentially lose money in the short-term, be able to charge a premium and make up for losses/maintain profit margins?

For producers, there is the issue of perception in a different way. Rancher interviews discussed social isolation due to the stigma of neighboring ranchers who practiced conventional methods. With peers, there seems to be a high level of 'cultural hesitancy' in which some ranchers look at regenerative land management and a holistic style of ranching as elitist while others see it as backwards and outdated (Iles and Marsh 2012). Ranching is very labor-intensive work and being part of a community is essential, so the risk of being seen as "crazy backwards hippies" to quote one interviewee, may not be worth it to some. Again, sustainable rancher networks could help with this challenge in their ability to provide a community of like-minded individuals.

Rancher livelihood

Although the purpose of this paper is to look at policy barriers, another major barrier to sustainable production is simply personal economics. Capitalist agriculture means that operations that simplify, mechanize, and mass produce are those that make the most profits (Magdoff 2015). Unfortunately, 'rational agriculture' which gives equal importance to both the effects of practices as well as production itself does not fit in this model, and operations that follow this ideology tend to make less of a profit as their consideration of factors such as animal health and the environment is not rewarded monetarily (Magdoff 2015). Now, a system-level innovation would be to change this economic structure so that it takes into account both positive and negative externalities in an effective way, moving the industry so that those who practice 'rational agriculture' are not punished economically. However, that has a different scope with its own set of distinct challenges, and not all ranchers interviewed think that that change (i.e. taxes or subsidies on products depending on practices used) would even help the situation unless combined with other significant systematic changes.

Nevertheless, it is still important to note this economic difficulty especially in combination with the reality of needing to maintain rancher livelihood. It is easy for a researcher to feel that certain changes are clearly beneficial and should be adopted, despite profit losses in the short term. However, the situation changes when one realizes that this is more than just a system of production but instead is the source of income for a family and maintains their livelihood. This historically has not been a priority in policy, which is a major reason why more and more ranchers are working other jobs to make up for their inability to support themselves from ranching alone. And, with working other jobs comes less time able to be spent on the ranch, and therefore not enough time to adaptively manage the land and cattle. One interviewee expressed this issue, stating "another factor that people don't realize is that in order to do this type of ranching, you have to live on the ranch and work the land and animals every day […] but most ranchers these days have to have additional sources of income in order to support their families, so they don't have time to complicate their management." All in all, it is essential that rancher livelihood be at the forefront of policy recommendations. It is impossible to obtain reliable and long term environmental

sustainability without social and economic sustainability for those involved as well (Kebreab 2013).

NRCS conservation programs: issues and potential solutions

Environmental Quality Incentives Program

The overwhelming sentiment from ranchers is that EQIP is essential as a catalyst for sustainable change, but issues with overall funding and division of funds between producers have caused the program to both stray from its intended purpose and become less equitable. One clear change in EQIP's history can be pointed to as the origin of the deterioration of the program. That change is when CAFO's were made eligible to apply for funding. In combination with the added clause that states that funding priority should be given to projects with the most abatement potential rather than the most economically feasible as well as the significant increasing in funding caps, much of the funding was taken away from the smaller ranchers that the program was created to assist. Exceptions to further increase funding caps for certain projects as well as AGI waivers, both at the USDA's discretion, cause even more prioritization of CAFOs. As a result, much funding has been put towards massive waste management projects for factory farms, and the inevitable cleanup of issues such as overflow and excessive nutrient losses into receiving waters (Burkholder et al. 2007). The waste from these massive operations does need to be dealt with, but there is nothing sustainable about just expanding current and building more waste lagoons to dump it in. Funding for this is necessary to prevent and clean up contamination, but it should not be taken from an environmental program under the guise of 'conservation'. Another issue with EQIP that relates to this is how competitive it is to obtain funding. Interviewees expressed sentiments of feeling "unlucky" regarding obtaining funding from the program, when in actuality the odds are completely stacked against them. EQIP is under-funded as a whole which is made worse by decreased actualized funding caused by appropriation acts, and with the inclusion of CAFOs in application eligibility, the remaining applications for funds are hyper-competitive (Schahczenski et al. 2019).

Conservation Stewardship Program and Conservation Reserve Program

CSP and CRP were both described in a lackluster sense, with interviewees feeling that both programs were less effective and had less potential to be useful to regenerative ranchers than EQIP. These results fit with existing literature and conclusions from other interview-based studies emphasized in the policy review section, reiterating the issues of accessibility, implementation, and monitoring. Interviewees largely felt that increasing NRCS personnel would help significantly. More employees would allow the NRCS to cover their bases in terms of: outreach to encourage farmers and ranchers to take advantage of programs, to allow staff to get to know landowners and be able to provide better service by making suggestions for projects, to ensure proper implementation and monitoring of success, and to help landowners through the often complicated processes of applying for funding, filling out complicated paperwork, and adhering to program requirements. Furthermore, to address the problem of uninformed personnel delegating funding (resulting in questionable prioritization of certain projects that make sense in theory but not necessarily in the field), requirements regarding certain levels of expertise should be established. Those in charge of evaluating project proposals and prioritizing funding should either have extensive knowledge on the relevant practices in order to make an informed decision, or should heavily consult with experts so that funding is given to projects that are more likely to be successful and reap environmental benefits.

Other literature has suggested simplifying paperwork and reporting requirements, but given misuse that already occurs due to the dependence on landowner reports, increasing personnel available to help ranchers through these processes is potentially a more effective and realistic solution. In fact, it even appears that the long time dilemma of understaffing in the NRCS will be improved sooner than expected, hopefully ameliorating a number of the problems stated above. In a recent statement by NRCS chief Matt Lohr, he stated the plan to hire over 1,000 additional employees to strengthen county-based offices, specifically with the purpose of bettering the implementation of conservation programs (Davies 2020).

Going forward, more attention and focus in terms of sustainable ranching should be put on the Grasslands CRP program, which interviews revealed is not well-known in this subset of the industry. This sentiment on the program not being commonly recognized by ranchers was reflected in interviews as only 2 interviewees were aware of the program and its potential to benefit regenerative ranchers. This is another issue that could be ameliorated by increased NRCS

personnel. Ranchers felt that if county-based offices had more available employees, then they could have a better understanding of the ranches in their jurisdiction and as a result be able to recommend projects that could be beneficial to the operation as well as programs that could be advantageous for the producer. The 2018 Farm Bill renewed and clarified Grasslands CRP as being directed towards ranchers and producers who manage their land in a way that both "compliments and conserves wildlife and wildlife habitat" while still maintaining the land for grazing usage (Dowd 2020). Not all regenerative ranchers will qualify, as the program prioritizes areas that are the most ecologically significant, but the fact that a program exists which recognizes the harmonious relationship between regenerative grazing and ecosystem health is a promising beacon for change.

Farm Bill implicit incentives for industrial methods: subsidies, research funding

Subsidies

Interviewees reiterated findings from the policy review which showed that commodity programs and resulting crop subsidies lead to low feed prices for CAFOs and provide no benefit to ranchers that do not use cheap feed inputs. Agricultural subsidies for low margin crops like corn and soy are one of the most stable, fundamental and long-term receivers of Farm Bill funding. As a result, dealing with commodity programs is not only a complex economic issue, but also will be very difficult to change. Crop subsidies for commodity crops like corn, wheat, and soy are not directly given to industrial animal operations but instead to their own producers, with the resulting artificially low feed prices carried over as a benefit to CAFOs. Therefore, change in this area does not fall within the scope of my recommendations which are focusing on realistic alterations whose effects could be directly felt by ranchers.

The connection between farmers receiving high amount of subsidies and CAFOs paying significantly less for their feed represents an essential link to the scalability of agroecological practices. Subsidies provide both an economic advantage to industrial farms while also making them appear much more economically efficient than they would be if producers had to pay full price for feed. Moreover, this false sense of economic efficiency is relevant when rebutting

arguments against the scalability of agroecological methods, which are often rooted in the idea that sustainable operations are not economically or physically feasible on a mass scale

To illustrate the inclusion of feed cultivation as part of industrial cattle production, the emissions related to feedlot finishing can be examined. The NCBA states that feedlot-finishing typically takes 3-6 months, and calculated from the "best-case scenario" (cow eating minimum feed for minimum time – 15 pounds of 70% corn-based feed for three months), emissions from one animal are about 202 lbs. of carbon ("A Breath of Fresh Air" 2016). An average coniferous tree grown for ten years is able to sequester about 23 lbs. of carbon, meaning that based on meat consumption trends, about 290 billion trees would need to be planted to offset carbon emissions for feedlot, grain-fed beef produced in a single year ("A Breath of Fresh Air" 2016). Subsidized crops grown for livestock feed are associated with a distinct set of costs and environmental damages, resulting from vast monocultures, fertilizer and pesticide use, and harvesting and cultivation which requires significant amounts of oil ("A Breath of Fresh Air" 2016). Clearly, Farm Bill crop subsidies lead to their own host of environmental issues and costs, so their connection to feedlot-finished cattle is relevant when considering the different types of production systems as a whole.

Research funding

The way the scientific field operates causes innovative strategies to not be held as successful unless proven in a controlled research study, which is complicated by the lack of research documenting success as well as a lag time between innovative strategies in the field and strategies proven to be effective in the scientific realm. By the time a researcher conducts a successful field study that for example, demonstrates the soil organic matter content or carbon sequestration increasing in response to a certain grazing management method, and that paper is fully written and makes it through the rigorous peer review process to finally become published, a new land management strategy will have been innovated and begun to be practiced by ranchers (Knapp and Fernandez-Gimenez 2009). Another issue stems from the fact a holistic style of land management and resulting benefits seen on a long term scale are very difficult if not impossible to replicate in a scientific experiment. Proper management changes and adjusts multiple factors continuously to obtain best results, but it is very difficult for a 'well-designed' research study to

copy this and maintain validity in the peer review process. However, studies focusing on life cycle analysis or using on-ranch data over many years are a promising start in the right direction.

The other major problem stems from how research funding is being divided in the Farm Bill and what is being incentivized in the process. A portion of Farm Bill funding goes towards USDA Research, Extension, and Economics (REE), with a study analyzing projects starting in 2014 and finding that about $294 million dollars going towards projects with some aspect of sustainable agriculture (DeLonge et al. 2016). This portion represents just over 10% of the total budget put towards REE so even under broad sustainability criteria, sustainable agriculture receives only a small portion of funding (DeLonge et. al. 2016). Of this fraction, only 1% was found to go towards projects related to rotational or regenerative grazing and similarly, only 1% towards integrated crop-livestock systems (DeLonge et. al. 2016). Given the low percentage of funding given to sustainable agriculture research, it is imperative that funding be moved around and an increased percentage given towards environmentally-focused projects each year. Considering the excessive amount of money put towards industrial agriculture production projects, a percentage taken from the industrial pool and put into the sustainable pool should be feasible. Funding is necessary for the transition to regenerative agriculture for multiple reasons. Ranchers need to know what works and what does not work as their livelihood depends on production, and the most reliable source of information currently comes from scientific research documenting success. Furthermore, increased funding for research on regenerative ranching will allow for these methods to be taken seriously and seen as legitimate by the scientific and academic communities. Lastly, more funding means that research projects can begin to be completed at a faster rate, hopefully decreasing the lag time and keeping up better with innovative practices.

Rancher-scale topics: connectivity, networks, connections to academia and scientific research programs

Rural connectivity

While only a problem for one interviewee, rural connectivity is an issue that deserves mentioning. The rancher who struggled with this issue described the situation as follows: no digital connectivity, no cell service to the point of having to drive over 5 miles to get any connection, and

archaic infrastructure. The problem here is more than just pure inconvenience. When thinking about all the issues mentioned in this section, imagine how much more difficult these issues would be without the ability to use the internet or contact others for help. This issue is of a much wider scope than that of this paper, but it is important to recognize as a reality that many ranchers in rural areas face. Obtaining information on new practices, applying for funding, being connected to other like-minded ranchers, and getting help from extension or research programs are all severely hindered if rural connectivity is not established.

Rancher networks

A common theme throughout each interview was the necessity of mitigating the feeling of risk and the unknown when looking to transition to regenerative ranching practices. One of the best ways proposed to deal with the issue is the use of rancher-to-rancher networks, which connect ranchers with similar focuses and goals. The most influential strategy to prove the efficacy of regenerative methods is proof of success of these methods by peers (Iles and Marsh 2012). Rancher networks containing individuals with many different levels of knowledge and years of experience with this type of management are extremely valuable for a multitude of reasons. As one interviewee put it, "when you're trying something new that's not necessarily proven in fact, you benefit from a support group with people who have been at it for different lengths of time in different environments." Rancher networks also help to curb feelings of social isolation, as they allow ranchers to be part of a community of peers who share similar goals and understand hardships experienced in this setting. Furthermore, these networks are invaluable for creating new businesses partnerships, providing education and mentoring, allowing for peer to peer discussion which leads to innovation in practices and marketing, and providing a clearer path for professionals and academia to collaborate with sustainable producers. NRCS county-based offices could be a useful tool in this arena to help organize and connect ranchers to local networks and facilitate the creation of networks in areas that are lacking. Another option that is less intimidating than creating a network from scratch would be to work with larger networks to create satellites which would allow ranchers to start from a baseline structure with support for development. All in all, the spread of and involvement in rancher networks is essential in mitigating some of the risk felt by ranchers who are considering transitioning some or all of their practices towards being more ecocentric.

Ranchers connections to academia and scientific research programs

Contact between ranchers and outside organizations to help with evaluation, implementation, and monitoring is an essential link that allows for ranchers to have more sustainability successes. The major program mentioned by interviewees is the Cooperative Extension System (CES), which is an educational program under the USDA and working with the National Institute of Food and Agriculture (NIFA). Its purpose is to "translate research into action: bringing cutting-edge discoveries from research laboratories to those who can put knowledge into practice" ("Cooperative Extension System | National Institute of Food and Agriculture" n.d.). CES works through land-grant research universities with the goals of educating and assisting, in this case ranchers, by bringing essential, practical information straight to the producer. NIFA's role in this program is to distribute congressionally appropriated formula grants each year to supplement county and state funding ("Cooperative Extension System | National Institute of Food and Agriculture" n.d.). This program could be greatly helped by the improvement of another issue previously discussed - adequate funding for research in this area. As the basis of CES programs is research conducted in an academic setting, sufficient funding is needed for research on regenerative grazing and adaptive, ecocentric land management in order for this knowledge to be effectively translated to ranchers.

One interviewee who is a part of the UC Davis Cooperative Extension Program stated that "the program connected us with an agent and range specialist who helped us set up watershed and soil monitoring systems…and when we receive the data, the specialists interpret and explain it to us so that we understand what our next steps should be." These programs were described by interviewees as being very helpful in making sure beneficial effects on the ranch's ecosystem are not solely observational, but can actually be backed up by data. Similarly, other interviewees were involved with independent research organizations that also monitored factors such as soil carbon content to test the theory of regenerative grazing leading to carbon sequestration, with some being involved in long term research projects. Organizations mentioned included Point Blue Conservation Science and Fibershed Producer Program. One interviewee stated that Fibershed's collection of soil samples to test for the sinking of carbon has been essential in verifying that their

practices have been worth it, and that this type of management is actually working and making an impact on their land.

Approach to policy design and industry change

The resulting policy design will focus on being realistic rather than idealistic, taking into consideration the current state of the industry, the difficulties inherent to changing policies and incentives that are so ingrained, and the opinions of interviewed ranchers on most effective prioritization. I am basing the scope and levels of my policy recommendations on a paper discussing the future of the meat industry written by Wittenberg. In her paper, Wittenberg defines the different policy frameworks to consider moving forward, with the goal of a long-term combination of the three. Overall, she states that the main objective moving forward should be to create a policy framework that incentivizes "environmentally-enhancing innovation at multiple levels" (Wittenberg 2012). There are three levels differing in how drastic the changes are and therefore also differing in how potentially realistic they would be to implement: 1) incremental innovation - minor changes to processes or products, 2) radical innovation - stopping the use of certain technologies or processes, and 3) system-level innovation - a complete change to the industry on a much wider scale (Wittenberg 2012). In the current context of the industry, I have the opinion that a combination of mostly incremental and a few radical innovations should be the focus; therefore, that is what this policy design will primarily propose.

The three main recommendations: EQIP, Beef Checkoff, and Farm Bill research funding

While I have proposed a multitude of potential solutions in the previous sections, I believe that there are three areas to change that should be at the forefront after considering current limitations and complications. The first changes revolve solely around EQIP. In order to bring this program back to its intended purpose of supporting conservation efforts for sustainable farmers and ranchers, the CAFO eligibility clause will need to be repealed. However, to start, allotted funds for CAFOs should be phased out. One mechanism to accomplish this is to lower the per project funding cap each year, until it is closer to its original level. The operations that are granted the highest project funding (hundreds of thousands of dollars) are massive industrial farms, so

lowering the funding cap would be an effective way to decrease support of CAFOs. Next, the criteria used by the USDA to grant waivers at their own discretion to both allow for project funding higher than the stated cap as well as allow producers who are over the income cap to be eligible need to be made transparent to the public. Waivers should be regulated and criteria made stricter, so that funds cannot be allocated in an egregiously inequitable manner. Lastly, prioritization guidelines should be altered to focus on cost-effective innovative projects rather than simply rewarding the highest polluters. While these changes may be considered to be more radical than innovative, ranchers and research increasingly emphasize that changing EQIP will be a catalyst to industry change.

The next recommended changes apply to the Beef Checkoff program. Because use of checkoff fund dollars for political lobbying is clearly stated as being illegal by the NCBA, the first step should be to crack down on misuse of funds so that rancher money cannot continue to be used to support industrial operations. Next, each state Beef Board should be split into two interest groups, one for conventional industrial producers, and the other for environmentally-focused producers. Funds from each type of producer should go to their board, which can then provide equitable representation. This way, marketing, advertising, consumer education and research on different methods of production and technologies can be separate for each and much more beneficial and representative of the industry. This change would be efficient in the sense that it would affect multiple problem areas; splitting the board would increase funding for regenerative ranching research, separate production types and educate consumers through distinct marketing and advertisement which would help with societal perceptions, and decrease money available to be taken for lobbying purposes supporting industrial methods. If implemented properly, resulting waterfall effects should increase the legitimacy of regenerative ranching while also directly benefitting and providing resources to ranchers. Since the legality of the misuse of funds is not in question, this incremental innovation should be attainable. The second change follows in the footsteps of the first and proposes a clear-cut reorganization technique, so can also be considered more incremental than radical and therefore quite feasible.

The last recommended change has to do with funding for research on regenerative animal production systems. Sustainable agriculture as a whole is only given a small fraction of money laid out in the Farm Bill for REE, with projects covering agroecological farming practices, spatially diversified farms, rotational/regenerative grazing, and integrated crop livestock systems totaling

to less than 10% of that fraction when combined (DeLonge et. al. 2016). Given the excessive and largely unnecessary amount of funding put towards industrial methods, a small percentage should be moved towards REE for regenerative, ecologically-focused projects, especially those based on adaptive methods, with this percentage increased in each subsequent fiscal year for a gradual shift.

These three areas of change are intersectional to other problems discussed and therefore if implemented, would lead to benefits felt in other areas of concern. In this way, these changes are efficient and therefore should be at the forefront of efforts in the industry. Food politics and powerful corporate lobbyists representing big beef companies are a significant obstacle to overcome, but strategic legal approaches and feasible changes have the potential to overcome these barriers and as a result move the industry forward in its transition away from industrial dominance.

The next set of recommendations: conservation programs, NEPA, commodity programs

This next set of recommendations should not be the focus for immediate change, but is still important going forwards. These topics were elaborated on previously and are less urgent, so will be briefly summarized here. The first change discussed is an incremental innovation that is coincidentally the one change seeing progress currently – that is, increasing personnel in NRCS county-based offices in order to more successfully implement conservation programs. Increasing personnel in NRCS offices would also help to facilitate the inclusion in and spread of rancher networks, which itself strengthens ability to connect to academia and other outside monitoring and collaboration opportunities. The subsequent two topics are broad and fundamental, making them inherently more resistant to change. In order for a transition to agroecological production to occur on a wider scale and with larger operations themselves, NEPA requirements will need to be altered to allow for more flexible and adaptive management, accepting certain levels of ecosystem complexity and unpredictability as a whole. For the same objective, commodity programs will need to be completely reworked so that CAFO costs are not subsidized and in turn reflect reality. These last two changes, representing system-level innovations, are hard to imagine in the current context of the agriculture industry, but could become more tangible as incremental and radical innovations are increasingly supported and successfully pushed through the legal system.

Response to common scalability counterarguments

Emissions, land and cost concerns

When one pushes for pasture and grazing-based livestock production, the immediate counterarguments stem from doubts in scalability on a physical land use and emissions level as well as cost-based economics. The root of these concerns can be addressed by one fundamental principle: the only accurate way to compare and contrast differing livestock production methods is by completing a life cycle analysis, including the cultivation of feed crops (Pelletier et al. 2010).

Proponents of industrial livestock production argue that confined animal feeding operations are more cost efficient and more environmentally friendly in terms of greenhouse gas emissions than fully grazed livestock. Their reasoning is that giving the animals calorically-dense feed while keeping large numbers confined to a small space leads to the fastest growth and as a result less emissions and resource usage ("A Breath of Fresh Air" 2016). However, this viewpoint is very simplified and leaves out two key factors: the emissions and costs associated with feed production and the carbon sequestered in grasslands that offset higher methane emissions due to longer lifespans. When these factors are accounted for in a life cycle analysis, pasture-based production systems result in less overall greenhouse gas emissions and instead, significant environmental benefits (Pelletier et. al. 2010).

A related concern often brought up is the idea that grass based systems require far too much land to ever be feasibly scaled up. However, one must realize the true amount of land required for industrial production, which includes the vast amount of land used to grow corn and soy for livestock feed using in feedlots. While feedlots themselves may exist on a significantly smaller piece of land than a pasture-based ranch, all of the grain is produced elsewhere, and once that land is accounted for, this issue diminishes. Moreover, rangeland is often unsuitable for crop cultivation, so its use for grazing is actually very efficient; on the other hand, land used to grow feed crops could be used to produce food for humans, making this use of land inefficient (Wilkinson 2011). Even further, the mass production of commodity feed crops exists through the use of widespread monocultures and heavy pesticide and fertilizer application, leading to additional environmental degradation in the industrial beef production life cycle (Wilkinson 2011).

The last argument against grazing systems is that they are not cost efficient. In reality, CAFOs are actually artificially economically efficient, but if they were to pay the true cost of feed without benefitting from crop subsidies and had to account for the external costs of production damages, the situation would be completely different. The cost of environmental damages associated with factory farms instead falls on taxpayers, who end up funding expansion of waste lagoons, clean up of waste spills, contamination of water sources, and so on.

The one argument against scaling up pasture-based beef production that does contain valid aspects is whether these systems can produce at the same level as industrial operations. While pasture systems do have the potential to produce at a high level through land transitions and adequate federal support, they will likely not be able to produce as much beef. Now, in the context of the transition itself in which the industry contains both industrial and sustainable operations, this is not something to halt progress over. However, it is important to note that a reduction in meat consumption is truly essential in making animal agriculture more sustainable. Spending the same amount on meat but instead choosing higher quality, regeneratively produced meat and therefore consuming slightly less meat would have benefits in multiple areas, from environmental benefits stemming from increased carbon sequestration on grasslands to better public health due to a decrease in consumption of low-quality meat that is proven to cause numerous health problems ("A Breath of Fresh Air" 2016). The last factor to consider is that as regenerative pasture-based production spreads, economies of scale will inevitable decrease costs for consumers, a fact that has been observed in other countries that have less industrial agriculture. All in all, concerns about the scalability of grass-fed, regeneratively grazed cattle operations have been extensively analyzed by researchers, and it has become increasingly evident that industrial operations are not as efficient as the industry portrays, while the obstacles to scaling agroecological production are not nearly as impossible a feat as opponents insist.

Limitations and future directions

It is important to note that each interview reflects a rancher's own experiences and opinions, which differ greatly - therefore this reflects only a small segment of ranchers each in specific contextual situations. This research is not suggesting that results characterize all cattle ranchers, only a small subset in Northern California. The majority of ranchers interviewed

practiced a form of rotational grazing but preferred to be labeled as more adaptive, regenerative, and ecocentric rather than sticking to a set management routine. Variation within interviewees must also be addressed - although all ranchers interviewed are of smaller size in comparison to the average conventional cattle operation, some consisted of just a couple (husband and wife) while others had more employees and available capital. Lastly, ownership status of land varied, with some privately owning or leasing land while others having public leases and therefore having less freedom to start riskier projects or apply for certain funding. This variation provided a lot of valuable insight and highlighted the unique challenges experienced on different scales within the general target population.

Future research in this field could go in multiple directions. First, with more time, rancher characteristics such as size, ownership status, and programs used could be accounted for in order to obtain answers to the same set of questions from all interviewees rather than altering based on each ranch. This would allow for a more in depth look into a specific type of rancher experience and greater insight could be gained, especially in combination with data from each ranch regarding the timeline, projects, outcomes, and funding amounts for a specified program. Another direction could be to analyze the effects of state programs and state implementation of federal programs, with an emphasis on the possibility of spearheading a transition on this level. Lastly, more purely scientific research showing the effectiveness of more regenerative grazing methods is essential to change the opinion on this type of ranching and prove its efficacy on a wider scale, including profitability, productivity, and environmental sustainability. Research going forward needs to include ranchers in order to truly represent their best interests, and the main goal should be to influence policy. Research at the intersection of policy and science is essential for making effective changes in the next Farm Bill.

Broader implications and concluding thoughts

The dominance of concentrated animal feeding operations is the direct consequence of a food system focused on profit and profit alone. Powerful corporations with political clout and aggressive lobbying capabilities in both legislative and regulatory arenas have created an industry environment that is extremely resistant to environmentally-focused change. Damaging industrial production systems are pushing out sustainable farmers and ranchers from environmental programs and are able to fund their own operations under the falsity of conservation efforts.

Conservation programs were created with the intent of being proactive, holistic, and ecocentric. These characteristics do not at all align with the industrial approach of slapping on a band-aid to fix damages temporarily to avoid lawsuits rather than addressing the root of the problem and progressing towards long-term reliable solutions. Through conducting both a policy review and rancher interviews, this paper emphasized and highlighted the egregious incentive structure of the cattle industry in the current context. Moving forward, key strategic policy designs have the potential to trigger a positive feedback loop of sustainable agriculture research, policy change, societal education, and producer practice (Miles et al. 2017). Such an occurrence would motivate a just and widescale transition to ecocentric agriculture production, and more importantly, a newfound food system culture prioritizing the intersection of environmental sustainability, social and economic equity, and ecological resilience.

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