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Production Challenges in Forage Systems: Needs Assessment in Northeast California

Abstract

A thorough understanding of the local farming challenges and needs is critical for the success of agricultural extension services. A survey was conducted to identify the key challenges and demands of irrigated forage systems of the Pit River watershed (PRW) of California. The survey was disseminated through local workshops and digital platforms in the spring of 2024, gathering a total of 102 responses from various stakeholders, predominantly farmers and ranchers. Production cost (73%) and irrigation management (53%) were highlighted as the primary areas of concern by respondents. Soil management and knowledge related to irrigation emerged as priorities for most forage producers to continue sustainable crop production. Such findings underscore the significance of targeted interventions to enhance agricultural resilience and productivity in Northeast California, acknowledging the diverse needs across California's agricultural regions. Overall, these survey results underscore the need for (a) local needs assessment and (b) increasing the extension personnel to address the efficient water and soil management in forages while reducing the input costs in forage production areas in the US.

Abbreviations: PRW, Pit River Watershed; UCCE, University of California Cooperative Extension

Keywords: agricultural Extension, forage production, needs assessment, northern California, Pit River Watershed, University of California Cooperative Extension

Introduction

California agriculture's combined commodities represent 10.4% of the U.S. cash farm receipts, led by the dairy industry producing 18.2 % milk of the total US share (California Department of Food and Agriculture, 2022). Hay production in California exceeded the value of a billion dollars in 2022 making it into the top 15 commodities in California (California Department of Food and Agriculture, 2022).

The University of California Cooperative Extension (UCCE) serves farmers facing a multitude of issues due to changing agricultural and environmental regulations, unpredictable weather patterns, frequent droughts, and water shortages. It is important to understand the most important farm-related issues of producers and stakeholders to steer extension programs in the right direction. The knowledge about local farming practices and existing barriers to adoption (Rudnick et al., 2023) could assist with resource allocation, focusing on high-priority areas, and providing research and extension vision (Martins et al., 2019).

Each region of California is different from another in terms of agricultural commodities, geographic conditions, weather patterns, cropping seasons, cultural and social practices, market access, etc. The northeast corner of California (Modoc, Lassen, and Shasta counties) is an important agricultural region producing about 12% of the hay crop (alfalfa and other dry hay) and >80% of the wild rice crop in California (USDA NASS, 2022). The Pit River Watershed (PRW), originating from Warner Mountains, is the primary source of agricultural water in a large part of the forage-producing regions of Modoc, Lassen, and Shasta Counties (Figure 1). The intermountain counties of Modoc, Lassen, and Shasta are known to produce high-quality hay due to their short growing

season and cool night temperatures (Orloff, 1997). Rising nut crop prices and increasing water pumping costs have driven a shift from field crops to nut crops in California's Central Valley, creating pressure on other regions - such as the PRW area – where forage production has recently increased as well to support California dairies (Gebremichael et al., 2021).

Efforts have been made to conduct needs assessment surveys to help set priorities that can be county- (Harder et al., 2009), state- (Kanter et al., 2021; Martins et al., 2019), region-specific (Ahern et al., 2003; Pires et al., 2024), multi-state (Cuppari et al., 2024) or national (Singletary et al., 2007). As the scope (region) widens for a survey, the overall response rate typically plummets in each county. Understanding current needs and resource allocation for specific counties or localities requires local surveys. Such local surveys are generally not conducted throughout the state, leading to state-wide surveys with low local response rates guiding state-wide priorities that might not represent the local issues.

Some multi-state surveys have documented not even a single response per county within the surveyed states (Pires et al., 2024), which might misrepresent the local community's needs and result in inefficient resource allocation. Kanter et al. (2021) documented significant survey responses throughout California for a needs assessment study, with more than 20 responses per county from the Central Valley but only eight responses from the PRW. A recent needs assessment survey on farmers' perception of climate-smart agriculture represented the PRW region with only one response in the statewide survey with >300 total responses (Ikendi et al., 2024). Thus, a local needs assessment from the PRW is necessary to confirm the documented statewide needs assessment and identify local issues.

The primary goal of this study was to conduct a local needs assessment of the agricultural community for the forage production region of the Pit River Watershed in California (Figure 1). The objectives of the study were to i) identify the major agricultural issues and management challenges faced by growers and ii) identify major needs/demands of the agricultural industry from UCCE. This study assessed the needs

of local agronomic industry stakeholders to strengthen local research and extension efforts and efficient resource allocation.

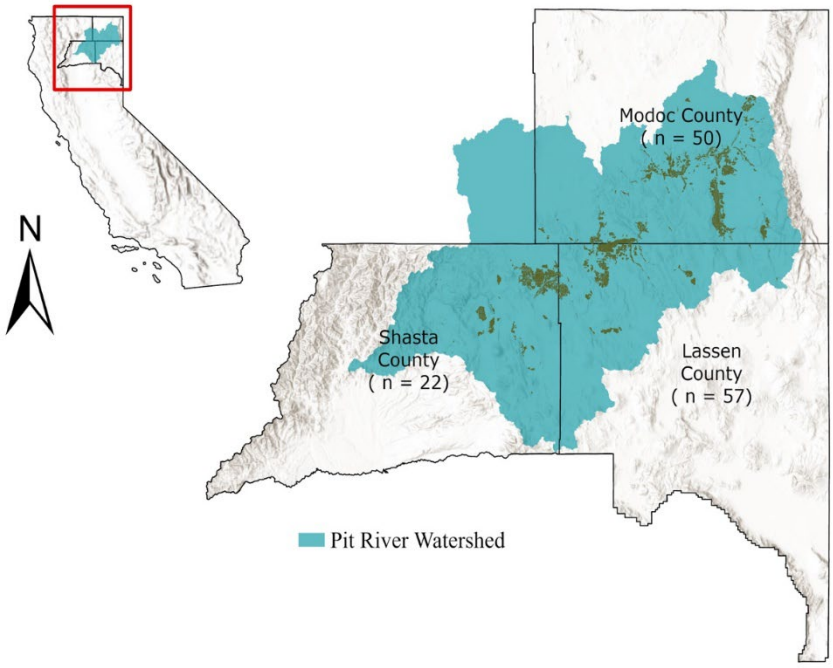

Figure 1. The map of California highlighting the study region is shown in red rectangle; the study region consists of Pit River watershed (shown in blue color), irrigated agricultural areas (shown in green color), three counties namely- Modoc, Lassen, and Shasta Counties with number of respondents (n) from each county.

Materials and Methods

The survey questionnaire consisted of 11 closed-ended questions (multiple choices, rank order) and one open-ended question to identify major commodities, farm challenges/issues, irrigation systems, interests in specific topics, and preferred education and outreach methods for the local agricultural stakeholders (Appendix A). The survey was reviewed by other UCCE advisors and specialists before the conceptualization and finalization. Also, the survey was reviewed and declared exempt by the University of California Institutional Review Board.

During Spring 2024, the paper survey was disseminated through various local agricultural workshops and meetings organized by UCCE in McArthur (Shasta Co.), Alturas (Modoc Co.), Susanville (Lassen Co.), and Cedarville (Modoc Co.) (Appendix B). An email was sent to an extension email list of Modoc (232 contacts) and Lassen County (133 contacts) to participate in the survey through Qualtrics, with a reminder email sent later. A survey questionnaire was also mailed out to 48 stakeholders in Shasta County via the US Postal Service. No incentives were provided for survey completion. All the responses, including in-person surveys, were recorded in Qualtrics at the end of the survey, and the complete data set was downloaded in the Microsoft Excel program to run descriptive statistics.

Results and Discussion

A total of 102 responses were collected for the local needs assessment survey. The respondents worked in one or more counties, with 49% in Modoc County, 56% in Lassen County, and 22% in Shasta County, respectively (n = 102) (Figure 1). Our response rate for the email lists of the PRW was >12%. The response rate was more than double compared to recent state-wide needs assessment surveys (Ikendi et al., 2024; Kanter et al., 2021), showing the significance of local surveys. The total number of respondents increased from 1-8 (Kanter et al., 2021; Pires et al., 2024) to >100 (this study), corresponding to >6% of the total producers from Modoc and Lassen Counties, indicating an extensive outreach by extension survey. The total number of producers in Modoc, Lassen, and Shasta Counties are 833, 865, and 2078, respectively (USDA NASS, 2022). Most survey respondents were in contact with UCCE, which might skew the results, considering the late responders may not have attended the in-person workshops and meetings.

In this study, respondents were categorized as producers (84%), followed by governmental agencies (12%), irrigation managers (7%), Pest Control Advisors/Certified Crop Advisors (5%), professional agronomists (5%), and allied industry (1%). Most respondents worked with hay production [grass (76%) and alfalfa (63%)], followed by

irrigated pasture (62%), small grains for both hay and forage (47%), and rice production (21%) (Figure 2). The spike in producers' participation in local needs assessments helps the local extension personnel serve better.

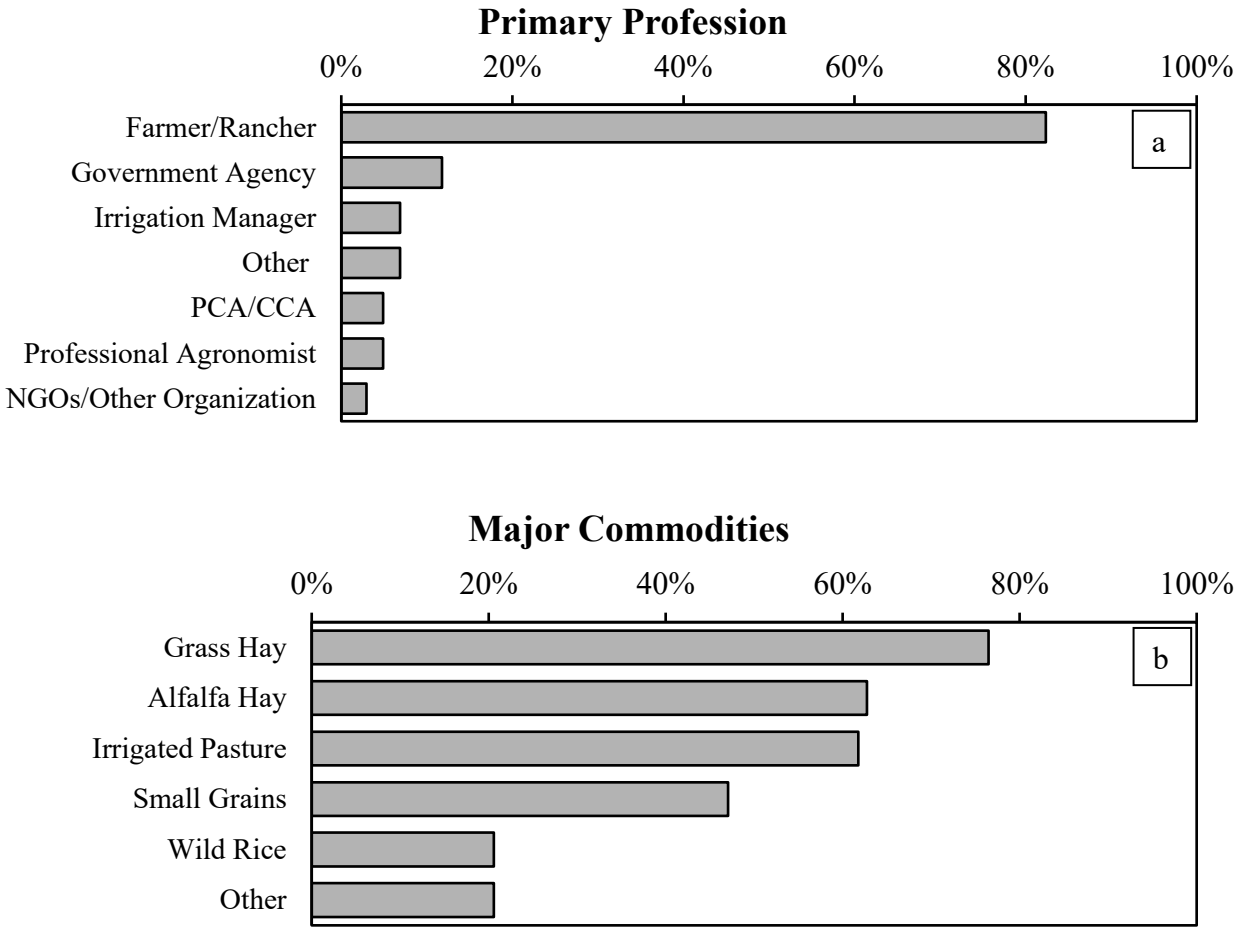

Figure 2. Survey respondents' profession and association with agricultural production (a); respondents producing different commodities (b).

Challenges in contemporary farm practices

The survey listed ten options to identify challenges or concerns prevalent in the crop production sector, along with an option to mention any other challenge besides the listed options. Production cost and irrigation management were the top two concerns chosen by 73% and 53% of respondents (n = 99), respectively (Figure 3). These results are similar to the statewide needs assessment that documented water use regulations

and costs as top concerns (Kanter et al., 2024, 2021). The factors beyond the farmer's control, such as international trade and export markets, can lead to unstable hay prices that are concerning for growers (Carter et al., 2023). The unprecedented formation of local agencies to comply with regulatory requirements in California is mainly driven by farmer funds, such as local Groundwater Sustainability Agencies (GSAs) (Harter, 2020). Moreover, California's frequent drought events greatly impact agricultural economics by reducing water availability and increasing crop water demands, hence increasing production costs (Escriva-Bou et al., 2022; Lund et al., 2018).

Irrigation management was ranked second in the farm challenges or concerns by 53% of respondents. Water-related concerns were ranked highest in the recent statewide needs assessment surveys, reflecting the challenge in agricultural water management (Ikendi et al., 2024; Kanter et al., 2024, 2021). Irrigation water management becomes a priority for riparian water and groundwater in drought-prone Californian landscapes (Liu et al., 2022), especially in the alfalfa-producing Western US (Putnam and Orloff, 2016), when groundwater regulations are being imposed, other sectors compete for water supply (Hrozencik, 2021), and high variability of precipitation and shifts in its patterns occur (Pathak et al., 2018).

Furthermore, 45% of respondents were concerned about nutrient management, 39% about pest management and commodity price, and 32% chose labor availability/regulations as a concerning factor (Figure 3). Nutrient management is necessary for optimizing crop yields, increasing nutrient use efficiencies, reducing environmental losses, and economic profitability (Singh et al., 2024b; Yadav et al., 2019) depending upon existing soil conditions (Singh et al., 2025b). Coupled nutrient and irrigation management further reduces environmental losses while maintaining crop yields, resulting in increased economic profitability and resource (water and nutrient) use efficiencies (Di Paolo and Rinaldi, 2008; Kamran et al., 2022; Singh et al., 2025a). The studies performed in Northern California for nitrate-contaminated water excluded the PRW region due to no or little availability (<10%) of data points (Burrow et al., 2013), leading to less focus on nutrient management in the PRW region.

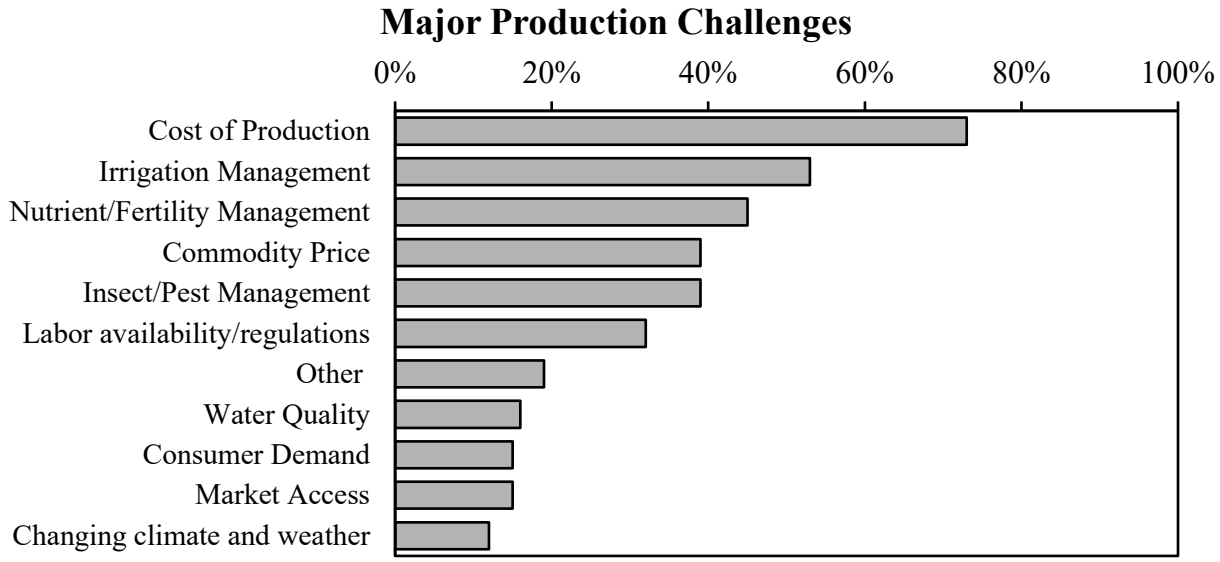

Figure 3. Percentage (%) of respondents highlighting the major challenges and concerns faced.

Pest populations are becoming increasingly resistant to management practices in California (Brunharo and Hanson, 2018; Rodbell et al., 2022), partially due to restrictions on the use of certain chemicals in pest control in the past (EPA, 2021; Kanter et al., 2021). For example, the chlorpyrifos ban controlling alfalfa weevil and aphids, or glyphosate-resistant alfalfa in California, are major concerns in the alfalfa production system (Long et al., 2019; Loveland et al., 2023). Additionally, weeds are often the primary limitation to crop yields with considerable water consumption (Norris, 1996; Singh et al., 2022). Seasonal farm labor needs are mainly (>70%) compensated for by unauthorized farm labor (Martin, 2017; Goodhue and Martin, 2014), which reflects the desperate challenges of farm labor in the state.

The production challenges ranking below 17% were identified in the categories of water quality, consumer demand, changing climate, and market access. Our study found that 88% of the farmers in the region do not have concerns about climate change, which is considerably (almost four times) higher than the state-wide survey by Kanter et al. (2021). Another statewide survey focused on climate-smart agriculture documented that 67% of the farmers believe that climate change is happening, out of which 53% agree with acting against climate change (Ikendi et al., 2024) but had very low or negligible representation from the northeastern counties of California. The growers from Northern

California (including the PRW region) attribute the changing climatic conditions to weather cycles and harsh geographies with a strong denial of anthropogenic climate change (Peterson-Rockney, 2022). In contrast, evidence suggests that climate change can impact forage yield and quality, and soil conditions (Morgan et al., 2004; Singh et al., 2024a; Singh et al., 2025b; Thivierge et al., 2023).

Irrigation management

According to the survey responses for irrigation method, 71% of respondents utilize flood irrigation, making it the most common practice, followed by center-pivot systems at 53% of respondents, and wheel-line irrigation being used by 36% of respondents (*n* = 91). Dryland agriculture production is prevalent in the PRW region, where 37% of the respondents have dryland production (Figure 4).

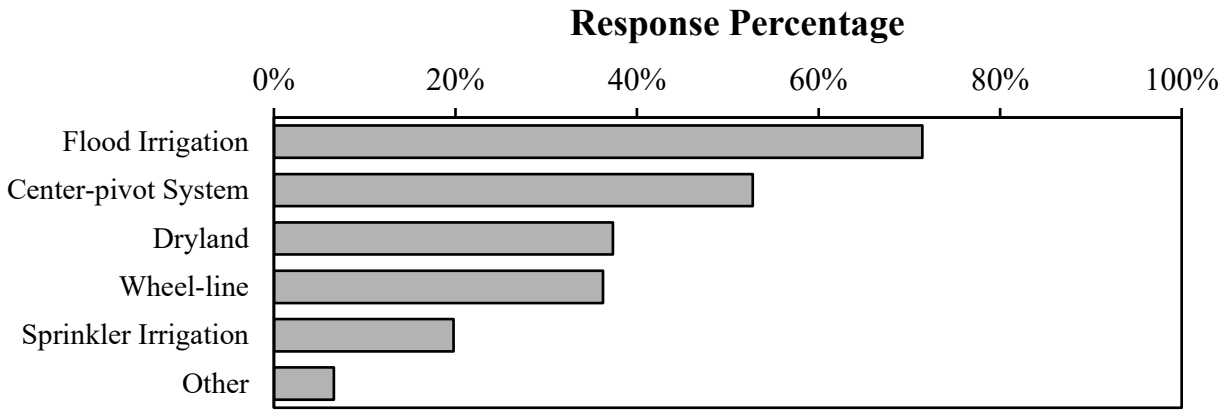

Figure 4. Different irrigation practices utilized by the percentage (%) of respondents (n=91).

Efficient irrigation practices are necessary for agriculture as inefficient irrigation leads to economic losses in terms of both crop yield losses and energy costs. In terms of irrigation scheduling, personal experience ranked as the top metric used on when and how much to irrigate, i.e., 89% of the respondents (*n* = 89) (Figure 5). Soil moisture sensors (18%) and evapotranspiration (ET) data (16%) are used for irrigation decisions, while only half of the respondents measured the irrigation volume. This survey suggests that flood irrigation and overhead sprinkler systems are the primary irrigation methods. Water use efficiency of these systems can be improved through technical assistance as

(a) only half respondents measure irrigation volume, and (b) the distribution uniformity of flood irrigation is low. Crop productivity is directly impacted by soil spatial variability, and lesser measurements might lead to overapplication of water (Anderson et al., 2023; Singh, 2021; Singh and Kukal, 2024).

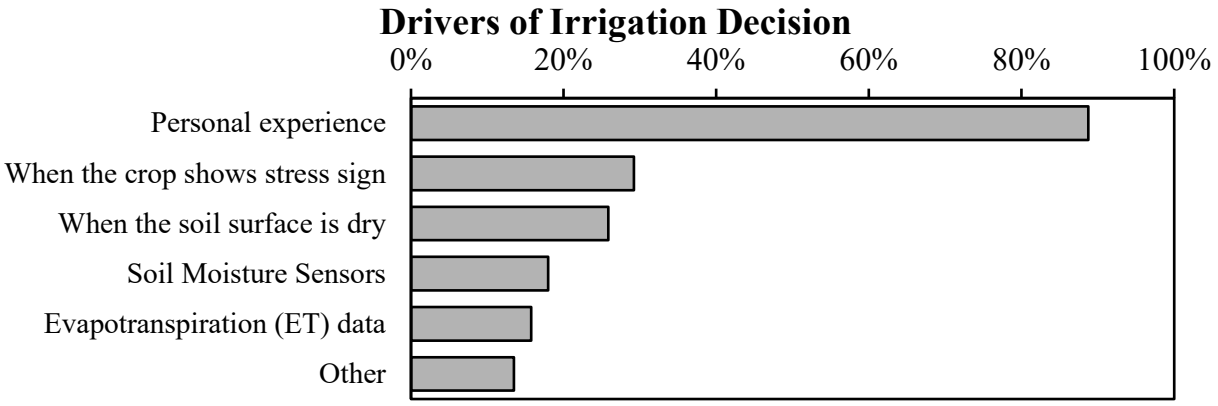

Figure 5. Factors that drive the irrigation decision-making process for respondents.

Outreach demand

The respondents were interested in learning about better farm management, with soil management ranking on top, with 57% of respondents wanting more educational and extension efforts in the region (n = 82) (Figure 6). Holistic soil management is necessary through regenerative management practices for improving crop productivity, water quality, and soil health (Singh et al., 2023). A recent survey in Utah reports that 52% of crop advisors do not have the required information and answers regarding soil health practices (Petrzelka et al., 2024), indicating the need for training and information. In California, the governmental incentive programs focused on soil health might serve as motivation for the growers to educate themselves about soil management (California Department of Food and Agriculture, 2025).

Following soil management, water-related practices were the desired topic of interest for learning among the respondents. Crop water requirements and irrigation scheduling ranked second among the topics backed by 57% of respondents, whereas innovative irrigation equipment (51%) ranked third in the list (n = 82) (Figure 6). This is a positive

sign for reducing irrigation water use in California, as Arizona has reduced the quantity of water used by 5% while increasing its irrigated cropland by 10% from 2007 to 2017 (Mpanga and Idowu, 2021). Automated surface irrigation techniques can be beneficial in regions with flood irrigation as a primary distribution system to conserve water and reduce labor costs as compared to manual irrigation (Champness et al., 2023).

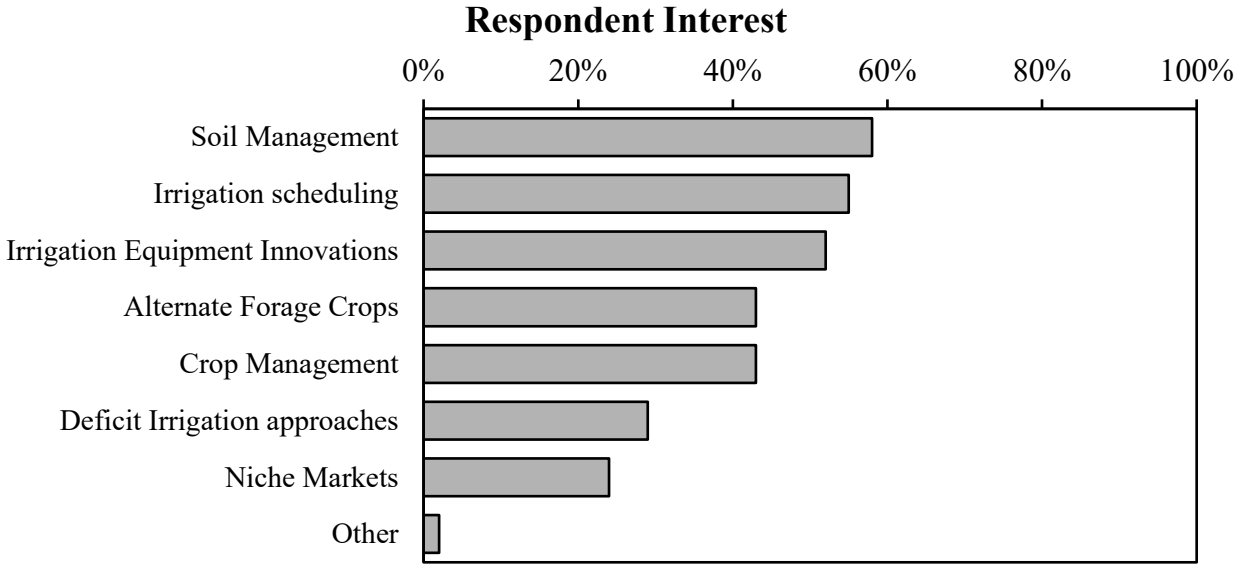

Figure 6. Percentage (%) of respondents interested in future educational and outreach efforts related to agricultural operations.

Other topics of interest included crop management and alternative forage crops; both being ranked as an important topic by 44% of respondents. From a crop management perspective, salinity and cultivar effects on alfalfa forage yield and nutritive value (Anderson et al., 2023; Singh, 2021) have been studied. Alfalfa decreases nitrate leaching potential and improves soil carbon, but at the cost of soil water (Singh et al., 2023). Therefore, the need for research on alternate forage crops arises which is limited in California, but there are few promising studies in the western US to find alternate cropping practices due to the volatile crop prices of traditional systems (Wieme et al., 2020). Deficit irrigation techniques and niche markets ranked low in the list, with <30% of the respondents showing interest in the region compared to other parts of California and the US (Montazar et al., 2020, 2016; Singh et al., 2025) and needs more attention as deficit irrigation improves water use efficiency and is not costly to adopt. As the

producers are 40% more likely to adopt practices supported by on-farm research than research conducted in university trials (Pires et al., 2024), local producer engagement in research should be continued. With the advancement and desire to adopt technology, social media can become a source of information and influence. According to Bagnall et al. (2023), mentoring from early adopters helps late adopters for easy adoption, as collaborative research is important for mutual learning among diverse stakeholder groups for adaptive management and efficient resource use (Hardie Hale et al., 2022).

Careful considerations should be taken into account when implying the results from this survey to other regions, such as different geographic conditions, commodities produced, and production factors that might be different than the region surveyed in this study. This study underscores the importance of assessing the local needs for any agricultural region.

Conclusions

Our survey demonstrated that production cost and irrigation management are among the major challenges in the forage production systems of the Pit River watershed of California. Nutrient and pest management are also seen as major farming concerns in the region. These challenges are reflected in the grower's desire to learn about soil management and water-related practices through local organizations. This survey covered ~6% of the total farmers in the region and found that locals do not prioritize water quality and climate change as the state-wise surveys suggest, while agreeing with the need for regenerative management practices (water, nutrients, pest) to increase resource use efficiency. In the face of ongoing farm challenges, need-based local education and extension outreach are necessary to provide growers with the required technical assistance for sustainable agricultural production. Local understanding of farming communities and industry is pivotal for efficient resource allocation and fruitful research and extension programs due to geographical diversity within state boundaries or regions. This study provides insights for the UCCE irrigated systems program in the

PRW region to help improve resource (water and nutrient) management and soil health by collaborating with stakeholders (farmers, ranchers, industry, and others).

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Appendix-A

Q1. What is your primary profession? (please select all that apply).

- ☐ Farmer/Rancher/Grower
- ☐ Pest Control Advisor, Certified Crop Advisor
- ☐ Crop Consultant/Professional agronomist
- ☐ Irrigation Manager
- ☐ Allied Industry (fertilizer, pesticide, seed)
- ☐ Government agency
- ☐ NGOs/Other organization
- ☐ Other (please specify) _____

Q2. In which counties do you do agricultural work in? (select all that apply)

- ☐ Modoc
- ☐ Lassen
- ☐ Shasta
- ☐ Other (please specify) _____

Q3. What are the major commodities/crops you work with? (select all that apply)

- ☐ Alfalfa Hay
- ☐ Grass Hay
- ☐ Irrigated Pasture
- ☐ Small Grains (including for hay or forage uses)
- ☐ Wild Rice
- ☐ Others (specify) _____

Q4. What are the challenges/concerns of your farming operations? (select all that apply)

- ☐ Irrigation Management
- ☐ Water Quality
- ☐ Insect/Pest Management
- ☐ Nutrient/fertility management
- ☐ Cost of Production
- ☐ Labor availability/regulations
- ☐ Consumer demand
- ☐ Changing climate and weather
- ☐ Commodity Price
- ☐ Market Access
- ☐ Other (please specify) _____

Q5. What is your irrigation method? If more than one, check all and give approx. percentage of your land under that irrigation method.

Method	Percentage of land
☐ Flood/Gravity/Ditch Irrigation	_____
☐ Sprinkler Irrigation	_____
☐ Wheel-line	_____
☐ Center-Pivot system	_____
☐ No Irrigation (Dryland)	_____
☐ Other (please specify)	_____

Q6. Where do you get your irrigation water? Please answer all that apply

Source	Percentage of total water
☐ Surface Water	_____
☐ Groundwater	_____
☐ Other (specify)	_____

Q7. Which of the following do you use to decide when and how much to irrigate? Please select all that apply

- ☐ Soil Moisture sensors
- ☐ Evapo-transpiration data
- ☐ Personal experience/observation
- ☐ When the soil surface is dry
- ☐ When the crop shows stress signs
- ☐ Other (specify) _____

Q8. Do you measure your irrigation water (i.e., Flow meter or any other method)?

- ☐ Yes
- ☐ No

Q9. Which irrigation topics are you most interested in learning about for managing your irrigated land? Please select all that applies

- ☐ Irrigation equipment innovations
- ☐ Crop water requirements & irrigation scheduling
- ☐ Soil management
- ☐ Crop management
- ☐ Deficit irrigation approaches
- ☐ Alternate forage crops
- ☐ Niche markets
- ☐ Other (specify)

Q10. What is your near term and long-term agricultural needs from University of California Cooperative Extension?

Near-term Needs (<2-3 years)	Long-term/Future Needs (>3 years)
_____	_____
_____	_____

Q11. How do you prefer to receive information and education material? Please rank from most desired to least.

___ Extension Newsletter
___ Online (Blogs, websites, webinars)
___ Social Media (Youtube, Facebook, Instagram)
___ Field days/In-person Workshops
___ Radio Program
___ Other (specify) _____

Q12. What education delivery media would you prefer? Please leave your email for electronic media and address for the print media.

☐ Electronic Media _____
☐ Print Media _____

Appendix – B

I. Winter Ag Meeting. February 29, 2024 – 8:00 AM to 1:00 PM. *George Ingram Hall, Intermountain Fairgrounds, McArthur, CA 96056.*

II. Newborn Beef Calf Health & Management. March 7, 2024. 5:30 PM to 8:30 PM. *Brass Rail, 395 Lake View Dr., Alturas, CA 96101.*

III. Agronomic Crops Workshop. March 21, 2024. 10:45 AM to 2:35 PM. *Side Iron BBQ, 724 Main Street, Susanville, CA 96130.*

IV. Modoc Ag Expo. March 22, 2024. 10:00 AM to 2:30 PM. *Modoc District Fairgrounds. 1 Center St., Cedarville, CA 96104.*