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Scaling up local and regional food systems: Understanding and navigating opportunities and challenges in the Palouse region

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Abstract

Interest in local and regional food systems (LRFSs) as economic development and food resilience strategies has grown over several decades. Disruptions caused by climate change, the COVID-19 pandemic, and international conflicts have illuminated our vulnerabilities and increased motivation to build resilience by "scaling up" local and regional foods. Yet, scaling up LRFSs remains challenging and aspirational in many communities, suggesting a

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need to further explore their development as contextualized and hybrid systems. Drawing from a survey of landowners and interviews with producers, resource managers, and others, this study focused on the Palouse bioregion of the U.S. Northwest. This was done to illustrate the complexity and potential of scaling up LRFSs in the context of land and water constraints, diverse stakeholders, and multiple, potentially conflicting land-use goals. The results identify points of tension between small-scale produce and large-scale dryland commodity systems, but also identify points of complementarity. Conflict, dialectic, and hybridization can help each scale become more environmentally and economically sustainable. While land access is a barrier, our landowner survey identified over 1,000 acres (405 hectares) potentially available for growing produce for LRFSs. Landowners expressed a diverse set of values and orientations to agriculture, which shapes land access and provides opportunities for different approaches. Water supply constrains irrigated agricultural development rather than prevents it in this region; however, water-efficient irrigation practices and pond development hold promise for agricultural, hydrologic, and habitat improvement. Short food and values-based supply chains for artisan grains can leverage and support both types of production in the Palouse bioregion, highlighting an area for continued compatible development.

Keywords
values-based supply chains, short food supply chains, place-based food, rural development, community resilience, land access, water scarcity

Introduction

Climate change, geopolitical conflict, and other crises, such as pandemics, threaten food variety, affordability, and availability (Aminetzah & Denis, 2022; Johansen, 2023; Mead et al., 2020). Such supply chain disruptions reveal vulnerabilities and have increased the urgency of developing local and regional food systems (LRFSs) that can promote resilience through shortened supply chains, diversified production, increased profit and land access for producers, and employment of climate-smart agricultural practices (Béné, 2020; Hammon & Currie, 2021; Marusak et al., 2021; Richards & Vassalos, 2021; Saul et al., 2021; Seidel et al., 2021; U.S. Department of Agriculture [USDA], 2020, 2023; Worstell, 2020).[1] In this article, we explore opportunities and challenges for scaling up LRFSs using Latah County, Idaho, and adjoining Whitman County, Washington, in the U.S. Palouse bioregion as a case in point.

The Palouse bioregion spans much of southeast Washington and part of northwest Idaho. Over the last century, production in this region specialized in the export of dryland agricultural commodities. In 2024, 53% of land in Latah County and 58% in Whitman County was used for wheat, barley, lentil, and chickpea production (USDA, National Agricultural Statistical Service [USDA NASS], 2024a, 2024b). The study area is predominantly rural, and while dryland commodity

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Competing Interests
The authors have no relevant financial or nonfinancial interests to disclose.

Ethics Approval
This study was certified exempt by the University of Idaho Institutional Review Board (4/26/2018, No. 18-083) and performed in accordance with ethical standards.

Consent to Participate
Informed consent was obtained from all participants included in the study.

Authors' Contributions
Conceptualization: SN, DS, SP, CD, FL, JJ-M, and RH; Methodology: SN, DS, SP, CD, and FL; Formal analysis and investigation: SN, DS, SP, CD, and FL; Writing—original draft preparation: SN, DS, and SP; Writing—review and editing: SN, DS, CD, SP, FL, RH, JJ-M, JK, and HS; Funding acquisition: FL, DS, SN, CD, SP, JJ-M, and RH.

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[1] Resilience can be understood as "the capacity to deal with change and continue to develop" (Stockholm Resilience Center, n.d.).

production dominates the landscape, there is also momentum behind LRFS development focused on small-acreage diversified farms (Table 1).

As in many U.S. communities, multisectoral stakeholders in the area have worked to build LRFS capacity, such as by expanding market opportunities, providing technical assistance, and exploring value-added processing for produce and livestock (Bauman et al., 2019). Strong interest in diversified LRFS development is further evidenced by the existence of five farmers markets, a grocery store that spent US$802,521 on local products in 2019 alone (Moscow Food Co-op, 2020), roughly 30 restaurants that feature local ingredients (Palouse-Clearwater Food Coalition, 2017), and intermediated market demand throughout Idaho's 10 northern counties (Liao et al., 2019). The largest of the farmers markets, Moscow Farmers Market, boasts over 200 vendors and considerable economic impacts (DePhelps & Peterson, 2020). The main impetus for the current study was the observation that while there is a great deal of interest, small-acreage diversified farms, and market opportunities, the region lacks sufficient vegetable and fruit production to fully meet local demand. One study estimated the Palouse would need an additional 2,174 acres (880 ha) of vegetable and 326 acres (132 ha) of fruit production to meet local demand and identified access to land and labor as barriers (Manheim Solutions, 2013, p. 176). Furthermore, while the Palouse is not currently considered a water conflict area, surface water is limited, the long-term sustainability of the groundwater supply is uncertain, and there is tension between development interests and water conservation (Beall et al., 2011).

The Palouse illustrates the complexity of scaling up LRFSs in places with farmland access constraints, potentially conflicting land-use and agricultural goals, and water resource issues (Liao et al., 2023). The thesis of this paper is that scaling up LRFSs is desirable but remains challenging and aspirational in many communities, suggesting a need to further explore their development in the context of intersecting sociocultural, land, and water constraints. We investigated the research question: what are challenges and opportunities to scale up a more diversified fruit and vegetable agricultural landscape in the Palouse bioregion of the U.S. Northwest? First, we review the literature related to scaling up LRFSs to situate our study. We then describe our mixed-methods approach before presenting our findings. We conclude by discussing the feasibility and roles of developing a more diversified production landscape and the implications for policy, implementation, and future research.

Literature Review

Interest in LRFSs as economic development and food resilience strategies has grown over several

Table 1. Select Study Area Characteristics

	Latah County, Idaho	Whitman County, Washington
Population	41,301	48,012
Population per square mile	36.7	22.2
Number of farms	989	933
Total land (acres)	688,576	1,381,952
Land in farms (acres)	324,990	1,218,301
Average farm size (acres)	329	1,306
Number of farms by size		
1 to 9 acres	97	84
10 to 49 acres	368	162
50 to 179 acres	276	150
180 to 499 acres	120	142
500 to 999 acres	58	106
1,000 + acres	70	289

Data source: U.S. Department of Agriculture, National Agricultural Statistics Service, 2022a, 2022b.

decades (Feenstra, 2002; King et al., 2010; Renting et al., 2003; Sitaker et al., 2014). Although commonly depicted as superior and independent from conventional and larger-scale food systems, the extent to which LRFSs deliver improved, different, or separate outcomes is contextual (Born & Purcell, 2006; DuPuis & Goodman, 2005; Martinez et al., 2010). LRFSs are more accurately characterized as hybrids: they weave together alternative and conventional systems, including local to broader scales of production, and supporting relationships based not only on shared, but often compatible or conflicting values (Bloom & Hinrichs, 2011; Mount, 2011; Saul et al., 2022). In addition, all food systems are evolving in the context of increasing environmental uncertainty, raising questions of how a changing climate and future water availability will affect where, how, and what crops will grow (University of California Applied Climate Science Lab & University of Washington Hydro Group, 2022). Adding to these issues are questions about how to link supply chains and meet food security needs.

Small-acreage farms and research about them tend to be concentrated near population centers; however, the need to increase access to high-quality fresh produce in rural areas is paradoxically high (Coleman-Jensen et al., 2017; Food Research & Action Center, 2020). Small-acreage farms and their role in LRFSs present unique opportunities for economic development (Carlisle et al., 2019) and help diversify agricultural lands to improve adaptive capacity during climate change, as large-scale commodity agriculture dominates U.S. rural farmland (Petersen-Rockney et al., 2021; USDA NASS, 2024a). Midscale farms also can play an important role in building LRFSs (Lyson et al., 2008). However, midscale farms have greater need of labor, processing infrastructure, and profit-taking intermediaries, which are common constraints to scaling up (Mount, 2011; Richards & Vassalos, 2021).

Building production capacity may necessitate increasing the number of acres farmed, increasing the number of farms, reallocating land from the production of other crops, or using season extension or controlled environment production. These strategies require additional human and financial capital and risk as producers scale up or reorient their business (Mount & Smither, 2014). Land access and tenure are also critical for small-acreage and beginning producers, but rising farmland values, consolidation, and conversion to non-agricultural development can make buying or leasing land difficult (Calo & Master, 2016; Carlisle et al., 2019; Horst, 2019; Horst & Gwin, 2018). Many producers have trouble finding suitable land near their markets, or the land they can access requires considerable soil rehabilitation (Calo & Master, 2016; Horst & Gwin, 2018) or lacks infrastructure like on-farm housing or irrigation (Carlisle et al., 2019; Iles et al., 2023). Irrigation systems are expensive barriers for many, especially as water rights and access grow increasingly contentious and constrained (Carlisle et al., 2019; Mancosu et al., 2015). Permanently acquiring land or negotiating lease rates is expensive, time-consuming, and producers may be unfamiliar with zoning boundaries and land use policies (Carlisle et al., 2019; Iles et al., 2023).

The financing and profitability of small-acreage farms is also affected by time and labor demands, where many subsidize farm profits through off-farm incomes (Iles et al., 2023). Short-term lease financing is challenging to secure because institutions typically lend to those who can confidently pay back the loan in a set period, creating a barrier but also an opportunity for longer-term lease agreements (Adenuga et al., 2021; Carlisle et al., 2019). Other land access constraints include lack of capital, credit, or necessary relationships with farmland owners or the possibility of family succession (Calo & Master, 2016; Carlisle et al., 2019; Valliant et al., 2019). For large-scale farmland owners, the permanent transfer of land to small-acreage farms is rare due to zoning, legal fee, and capital tax barriers as well as family dynamics and complex emotions regarding inheritance, tradition, and legacy (Adenuga et al., 2021). Other constraints include the age of farmland owners and disinterest in selling (Iles et al., 2023; Valliant et al., 2019).

These complexities underscore the need to further explore development of LRFSs as place-based, contextualized, and hybrid systems. Furthermore, the similarities of the Palouse region to many other regions with large-scale production agriculture in

the U.S. West and Midwest make it an appropriate area for the study of challenges and opportunities for scaling up diversified production in LRFSs.

Methods

We used a mixed-methods approach that involved interviewing and surveying small-acreage producers; interviewing representatives of local and state governments and others involved in land use, water planning, and policy; and surveying agricultural landowners. We audio recorded and transcribed all interviews with permission. The purpose of our mixed-methods approach was to use "the results from the first method to inform" the second method (development), to examine "different overlapping aspects of [the] phenomenon" (complementarity), and to add "depth and scope" (expansion) (Onwuegbuzie & Collins, 2007, p. 284). Our interviews and surveys were also designed and sequenced to gather information needed to develop extension programming and to support modeling not included here. We describe the interview and survey methodologies in depth below.

Producer Interviews and Survey

In 2018-2019, we interviewed nine small-acreage producers in Whitman and Latah counties to gain their perspectives on opportunities, challenges, and technical assistance needs for scaling up fruit and vegetable production. Interviews averaged 75 minutes and were semi-structured with open-ended questions. Prior to the in-person interview, the participants completed a web-based survey with open- and closed-ended questions that gathered information on demographics, budget, irrigation, soil management, production, equipment use, and land access challenges.

Five of the operations represented were in Whitman County, and four were in Latah County. Two were orchards and seven grew a mix of fruits and vegetables. Five also raised animals. Their average farm size was 10 acres or 4 ha (range = 1–25 acres); however, the average number of acres dedicated to growing fruits, vegetables, or both was 5.9 acres (2.4 ha), ranging from half an acre (0.2 ha) to 18 acres (7 ha) (median = 4 acres). Three of the farms had at least one paid employee, not counting the farm owners. All sold to direct-to-consumer markets, and all but one sold to intermediated markets. Their average gross revenue in 2017 was US$30,419 (range = US$6,350–US$65,000). Participants had been growing produce for sale from 4 to 40 years (median = 10 years), and seven were first-generation growers.

Key Informant (Non-Producer) Interviews

In 2018–2019, we interviewed 10 key informants, including planners and representatives from state agencies, city governments, and the Palouse Basin Aquifer Committee (PBAC). PBAC cooperates to manage long-term water supply and comprises representatives from the cities of Pullman, Moscow, and Palouse; Whitman and Latah counties; Washington State University; University of Idaho; and ex officio committee members representing the Washington Department of Ecology and Idaho Department of Water Resources. These interviews were semi-structured, averaging 58 minutes, and covered participants' perspectives on the opportunities and barriers to scaling up fruit and vegetable production and the policy context for this type of development.

Landowner Survey

In 2020, we surveyed agricultural landowners in Latah and Whitman counties to assess how many acres could potentially be available for small-acreage producers to buy or lease, what types of agricultural practices landowners would want on their property if they leased to small-acreage growers, land use and succession plans, and landowners' perception of irrigation water availability. For the sampling frame, we started with a list of all agricultural landowners in the two counties obtained from CoreLogic (2016). We wanted to survey only landowners of parcels that could feasibly support fruit or vegetable production, so we narrowed the sampling frame based on a logistic regression probability analysis of soil characteristics; precipitation and temperature; and proximity to markets, highways, and existing fruit and vegetable farms following the methods described in Liao et al. (2019). Figure 1 shows the probability that parcels in Whitman and Latah counties are suitable for fruit or vegetable

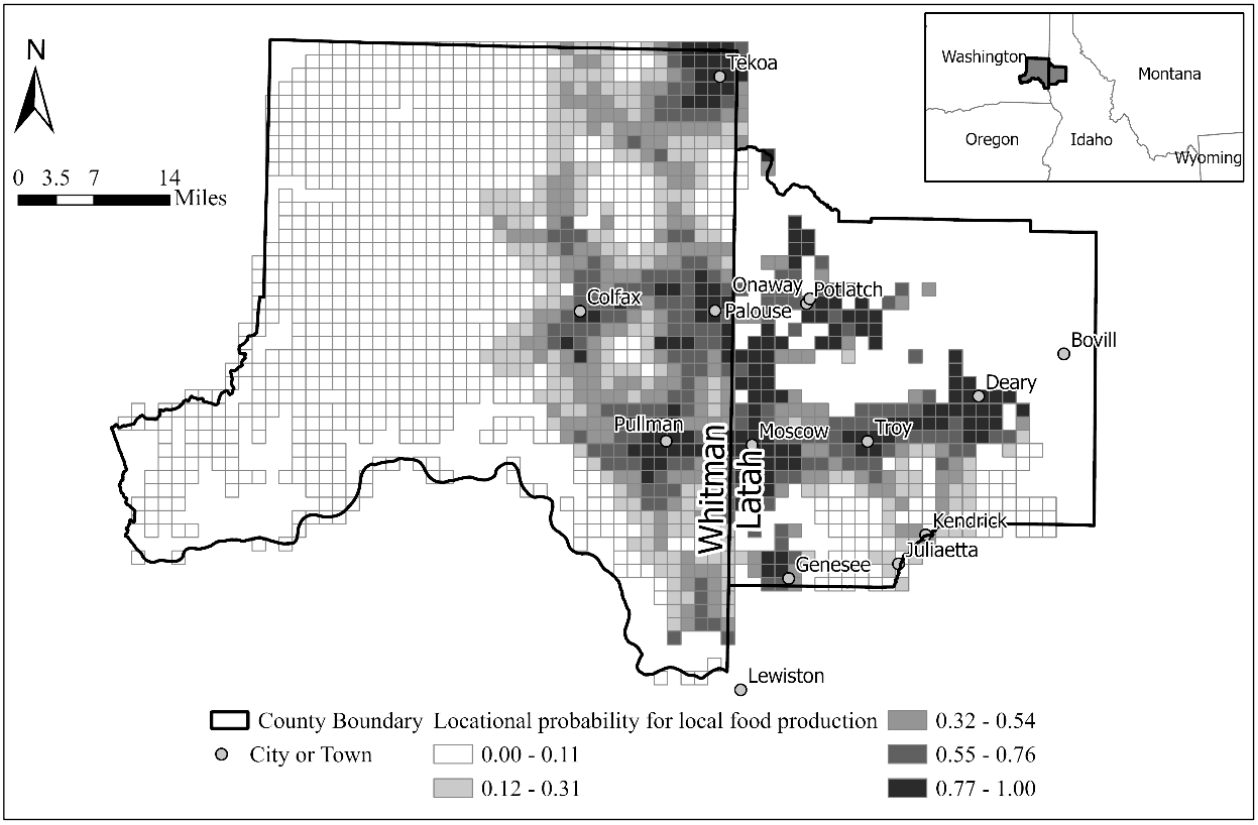
production. All landowners of a parcel with a 0.31 probability and higher received the survey.

We used a mixed-mode approach to implement the landowner survey, which included multiple mailings: (1) a cover letter with the paper survey, US$2 incentive, and a postage-paid return envelope; (2) a follow-up postcard with a link where they could participate online; (3) a replacement paper survey with a cover letter; and (4) a final postcard with the survey link (Dillman et al., 2014). Of the 511 landowners who received the survey, 327 participated, for a 64% response rate. Sixty-three percent owned land in Latah County and 43% in Whitman County (n = 318). Seventy-nine percent had dryland agriculture, 24% had livestock production, 11% had fruit production, 8% had vegetable production, and 16% had some other land use on their property (n = 318). Eighty-four percent lived on or next to the land they own (n = 312), 45% farmed or ranched their own land, and 56% leased land to a farmer or rancher (n = 319).

Analysis

We used Microsoft Excel to generate descriptive statistics and figures summarizing our quantitative data from the small-acreage producer and landowner surveys. We analyzed the qualitative data from the interview transcripts and open-ended survey responses with ATLAS.ti software using an inductive approach (Charmaz, 2006). Two researchers independently completed an initial coding phase that involved labeling and grouping segments of data into preliminary categories and subcategories based on a subset of the raw data (i.e., independent parallel coding) (Charmaz, 2006; Thomas, 2006). The coders then met to discuss, refine, and integrate the resulting codes into a single framework and to ensure intercoder reliability. Next, they coded the remaining data, continuing to refine and organize the categories, and meeting regularly to discuss the process and data interpretations (Charmaz, 2006). We then identified quotes to illustrate themes. Researchers' personal and professional backgrounds can influence data interpre-

Figure 1. Map of the Probable Suitability of Parcels in Whitman and Latah Counties for Growing Produce



tation. Therefore, the coauthors, who represent multiple backgrounds (e.g., sociologists, soil scientists, geographers, economists, and extension professionals) also met to discuss and refine data interpretations. A project advisory board provided stakeholder checks to further ensure the credibility of the findings (Thomas, 2006).

Findings and Discussion

Themes emerged related to social, economic, and environmental considerations that can shape the feasibility of scaling up fruit and vegetable production as a part of diversified LRFS development. Notably, most fruit and vegetable producers we interviewed were uninterested in substantially scaling up, owing to their challenges and lifestyle values. Two of the most salient factors that producer interviewees identified as affecting their interest and capacity to scale up were land ("We've looked at land … close to town and we wouldn't be able to afford it") and water ("Number one is going to be water. I mean just water, water, water"). The other most salient themes limiting their interest and capacity to scale up were labor ("Labor is real hard to get"), capital ("Access to capital to scale up whether it's to buy the land or to buy machinery to allow that"), and seasonality ("Our growing season can't really keep our community in fresh produce"). We synthesize the remaining findings from the producer interviews and survey, key informant interviews, and landowner survey organized by two interconnected, overarching topics: land and water.

Land

While all fruit and vegetable producer interviewees had secured land, they commonly identified challenges finding affordable land suitable for farming with adequate or predictable access to irrigation water, near where they already farm, or near their markets or social network. Responses to the open-ended questions on the landowner survey indicated that a large majority were uninterested in selling their land for any purpose. Specific themes included concern about the negative environmental, agricultural, and cultural impacts of breaking land into smaller parcels or integrating non-agricultural land uses ("Selling small parcels invites problems in various forms: non-farm-friendly neighbors, weed patches, sub-division"), incompatibility with family use—typically dryland farming—and succession plans ("This has been our family farm since 1887"), and water impacts ("I am concerned about the aquifer [and] the extended family currently [farming it] share an understanding of this fundamental concern"). However, 23 respondents (8%) said they would be willing to sell their land for fruit and vegetable production (n = 297), collectively representing a minimum of 238 to 317 acres. Even 238 acres offers potential for this type of small-acreage production (roughly 40 more farms at the scale of producer interviewees), if growers were able to access and afford it.

Considerably more landowners were interested in leasing their land: 104 (35%) said they would be willing to lease it for fruit or vegetable production (n = 301). Those interested in leasing collectively represented 778 acres to 1,173 acres: eight said they would be willing to lease "more than 0, but less than 1 acre," 44 said "1–5 acres," 13 said "6–10 acres," 15 said "11–20 acres," and 23 said "more than 20 acres." Themes in the open-ended responses explaining landowners' interest in leasing included general support ("Sounds interesting and would support"), lack of other use ("I'm doing nothing with it—I wish someone could use it"), support for LRFS ("Local production and availability of produce for local community"), and landowners with land currently in dryland production who were open-minded to other viable agricultural uses ("If anyone can prove there is a better option, will listen and support any good suggestions").

The primary themes of why some landowners are uninterested in leasing for fruit and vegetable production included that the property is for their personal use or too small; not wanting people on their property; water inaccessibility; soil, slope, or frost characteristics; leasing not fitting into their succession plans; and skepticism about the economic viability or capacity of small-acreage produce growers ("These enterprises have historically been undercapitalized. After an enthusiastic startup they fade away after a season or two. Structures and fences are poorly done and are a cleanup liability"). Finally, many respondents farm or are in lease agreements they are not interested in changing ("I already have 100% leased to farmers of

wheat/grain") or described dryland production as the best use of the land in general terms ("Dryland grain is best use").

Some landowners conveyed beliefs or concerns about the compatibility of fruit and vegetable production with conventional dryland agriculture ("Orchards, vineyards, vegetables, flowers not very compatible on the Palouse"), which could present complications for conventional dryland growers ("It would make it more difficult for producers growing commercial crops like wheat, barley, legumes, etc. when spraying those crops. I'm not against it, but not really for it"). Similar themes emerged from interviews with fruit and vegetable producers, centered on the practical and sometimes cultural complications of growing produce next to conventional dryland fields related to chemical drift:

> A limiting factor here in the Palouse is chemical drift. … In [YEAR] we had glyphosate drift onto … [many] trees, and they're all gone now. … Then in [YEAR] we got it big time … [and] had to pull out lots of trees. That set us back five to ten years. (Producer)

> We're an all-natural farm surrounded by conventional farming, and we get drifted on a lot. (Producer)

A related theme from the interviews with fruit and vegetable producers is that some dryland conventional producers do not view small-acreage operations as legitimate businesses, at least initially. The landowner open-ended survey data also supported this theme, as some respondents conveyed the belief that small-acreage farms are "hobby farms" or otherwise less than "real" businesses in contrast to dryland farms, or that smaller-scale fruit and vegetable production for LRFSs is less important than commodity production. Yet, several producer interviewees who had experienced chemical drift losses described working directly with their conventional neighbors to come to a shared understanding and commitment to resolving the problem:

> I have tried to take a neighborly approach. … And, for the most part, they're willing to talk to me. … They didn't realize that we were a business because, "we're so small, how could we be making money at what we were doing?" When I think profitability-wise acre for acre, we probably do better than them. … The next spring, when he had to spray, he came down my driveway and personally said, "hey, I'm doing this, but I'm watching the wind and if…[it] shifts, I promise you I'll stop." (Producer)

The survey also asked landowners how interested they would be in specific enterprises (Figure 2) and the extent to which they would support or oppose specific production practices and infrastructure (Figure 3). Some landowners were interested in leasing to all enterprises we asked about, and a greater portion expressed support or neutrality rather than opposition to specific practices and infrastructure. Many who were interested said they would consider leasing for any viable enterprise, but that the details would be important ("Permanent structures are less desirable but not out of the question. It is mostly about who and how they/we do it").

Of the landowners willing to lease, greater proportions expressed strong support for organic production, and chemical pesticide use stands out as a practice with comparably the most opposition (Figure 3). However, in the open-ended responses, many landowners explained they prefer organic production but view conventional inputs as appropriate or tolerable in some cases ("We like to minimize chemical pesticide use but acknowledge that it can sometimes be the best option"). Some landowners were strongly supportive of every practice, and most did not have strong preferences.

These findings reflect the numerous existing land management practices and uses in the study area that LRFSs must recognize and navigate. Although tension and conflict can occur between small-acreage fruit and vegetable production and conventional dryland practices and farming culture, data also suggested ways the two systems can be mutually supportive and compatible. For example, both types of farming benefit from landowners prioritizing farmland preservation or making land available to agricultural operations. Furthermore,

many of the same conditions that support export-oriented dryland agriculture also support LRFS-oriented production:

> In general, agriculture is the mainstay of the county, so we have codes and policies in place that protect agriculture. … It's not just wheat growing … vegetables and fruits are a part of ag, so it would come under the same protections. (Key informant)

Water

As fruit and vegetable producer interviewees highlighted, water access is critical to expand irrigated agriculture ("Water is the limiting factor"). Key informant interviewee perspectives coalesced around the expectation of a water-constrained future ("Any sort of major water-consuming endeavor on the Palouse is going to be met with water as a restraining factor"). Other salient themes from key informant interviews included uncertainty

Figure 2. Landowner Survey Respondents' Level of Interest in Leasing for Select Types of Production

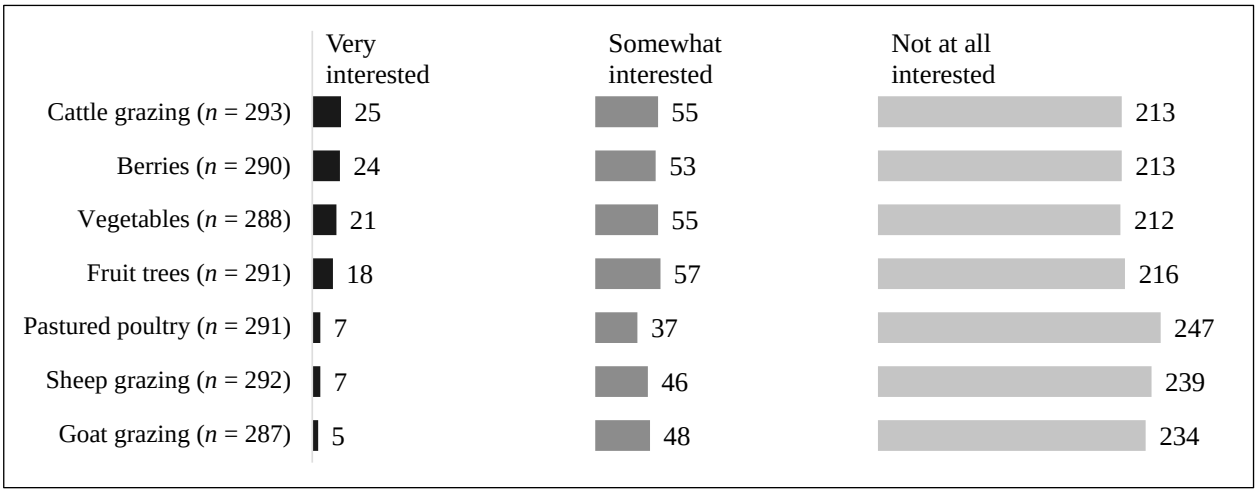
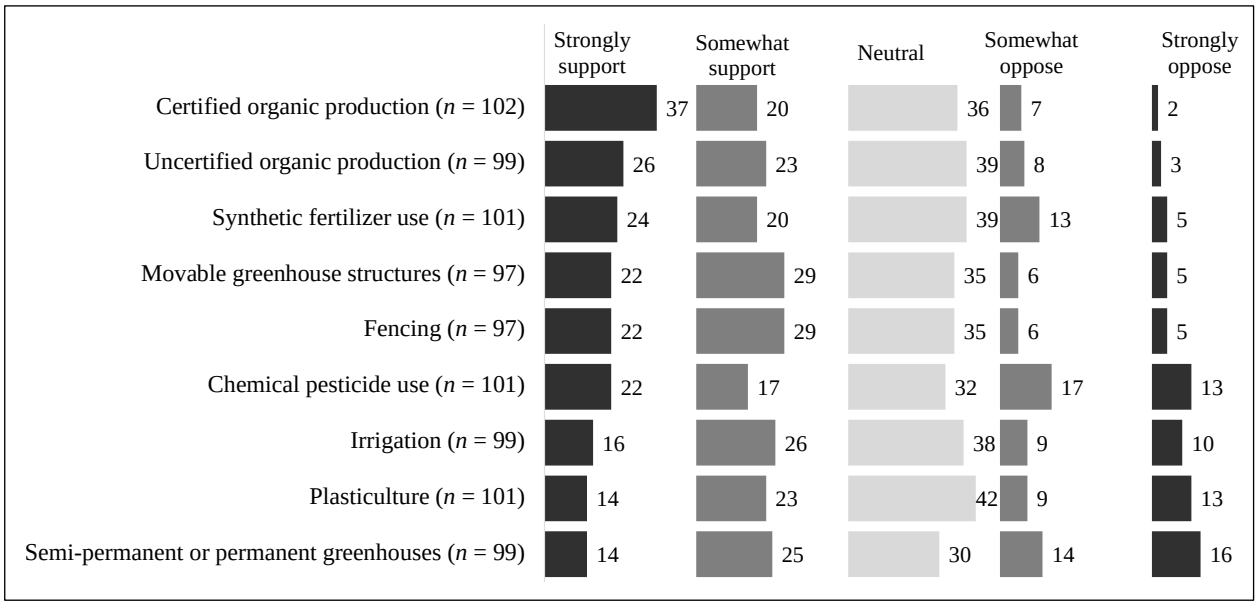


Figure 3. Landowner Survey Respondents' Support or Opposition for Production Types and Infrastructure on their Leased Land, by Number Interested in Leasing



regarding how climate change, population growth, public opinion, and conservation measures in the study area will affect water quantity and access over the long term. Water policy was also identified as a factor. As the Washington Department of Ecology (2025) explains, "Waters of the state belong to the public and can't be owned by any individual or group. Instead, a person or group may be granted a right to use a volume of water, for a defined purpose, in a specific place" (para. 1). In Washington, a water right is required for "any amount of surface water for any purpose" and for ground water for any purpose except for domestic or industrial uses of less than 5,000 gallons per day (gpd) or irrigation of a half-acre or less of lawn or non-commercial garden (Washington Department of Ecology, 2022, para 1). Although key informants described the potential, albeit extremely limited, to acquire an existing water right in Whitman County, the state is not issuing new ones.

In Idaho, new water rights are still granted in Latah County, where, without a permit, the daily limit for domestic water use (i.e., homes and livestock) is 13,000 gpd on up to a half-acre. While water may be more accessible in Latah County, water adjudication is in process in North Idaho, which will shape future use. Key informants expected permitting to be more restricted and water availability to decrease at some properties over the coming decades due to geology and nearby water use, an effect some producer interviewees described already experiencing. Local political entities recognize the problem of declining aquifers, and long-term planning is underway. Water development at the public works scale is fraught with difficulties and expensive, and will primarily support existing uses rather than an expanded agricultural industry (Anchor QEA, LLC, & HDR Engineering Inc., 2017). The long-term trajectory is toward more restrictive water management and availability, and political and ecological processes present risk and uncertainty to irrigated agriculture and other commercial development.

Despite constraints and caveats, key informants saw the potential for continued irrigated agricultural development:

> If they're smaller production and … using conservation techniques, I don't know that it would be a problem at all. … But most of [our aquifers] are not easy to recharge [and] making sure that people have drinking water before we're watering plants is the priority. (Key informant)

Key informants reflected a nuanced collective understanding of development potential and a widely shared desire to manage water resources to support multiple values. The cultural and political context for increasing irrigated agricultural production is as complex as the ecological and hydrological one, with compatible and conflicting factors to navigate:

> I think in general people appreciate … agriculture around here and … how influential [the Moscow Farmers Market] is on the community. People like to have locally produced things … but there also are a lot of people that are highly concerned and very plugged into the water issue, and so if they saw it as a real concern for water consumption, I think that there would be conversations about "is this the best place to do that?" (Key informant)

A theme from key informant interviews was the belief that agricultural water use is insignificant on the Palouse relative to other uses and more important than some, such as lawn and golf course irrigation. Some key informants expected that whatever development occurs will not use enough water to impact other users or the aquifer significantly:

> If it's 20 or 30 farms that are using a million gallons a year, that's 20 or 30 million gallons a year when the City of Moscow is using 900 million gallons a year. … It's when you [have] farms that are using 30, 40, 50 million gallons a year each [that] you start having a little bit more concern. (Key informant)

Landowner survey participants generally held similar views to key informants about water access. Many indicated that their properties do not have

adequate water to sustain fruit and vegetable farming. These respondents explained that their wells do not have capacity ("We have limited water: 1.5 gallons a minute"), described the constrained water environment more generally ("In this area you do not have enough groundwater to support irrigation") or pointed to economic constraints, such as the expense of drilling a well ("I'm not opposed to it; I just think it would be cost prohibitive at this time"). Some said water rights are a limiting factor ("Currently water rights (permits) are unattainable"). Another theme was opposition to irrigating with groundwater: "This [area] does not have capability for irrigation. We can't pump from lakes, reservoirs, or rivers. Irrigation would be detrimental to our groundwater."

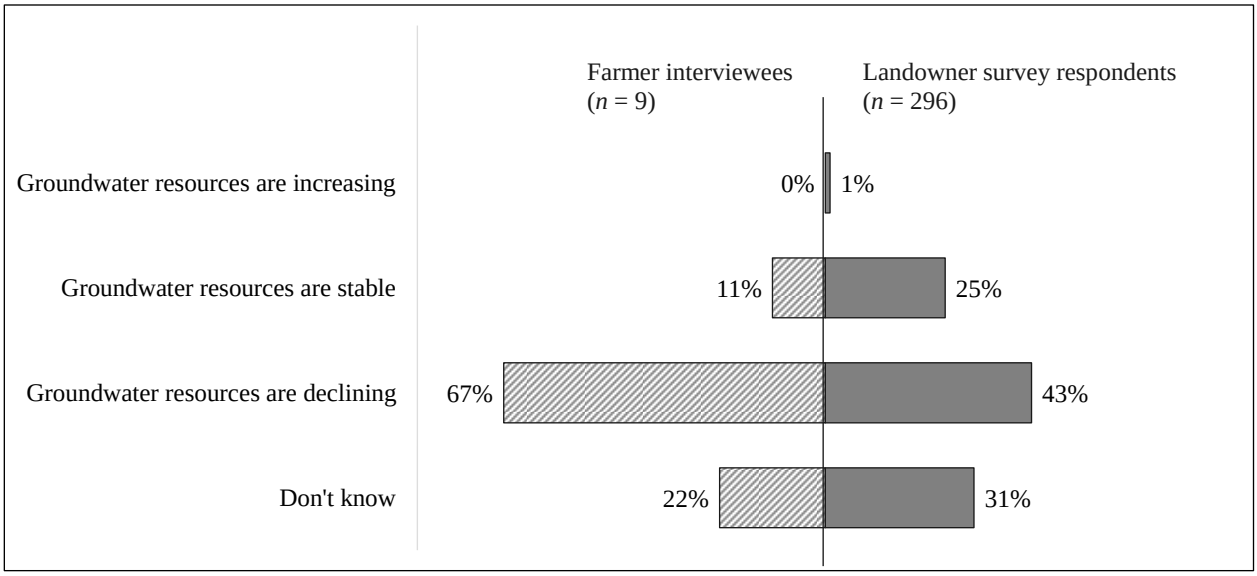
We asked fruit and vegetable producer interviewees and landowner survey respondents about the state of groundwater resources in the Palouse region (Figure 4). A greater proportion of landowner respondents believed the aquifers are stable in comparison to the proportion of producer interviewees. However, both groups relayed uncertainty, and the largest proportion of both groups believed groundwater resources are declining.

Even given constraints, several strategies emerged from the data to secure access to water for fruit and vegetable production. For example, some irrigated production may be supported within the limits for industrial or household use, depending upon jurisdiction. In Latah County, the 13,000 gpd exempt limit is enough by some estimates to support small-acreage, diversified production (Fuson, 2022). Another way to overcome water constraints is to use very little of it. Measures such as subsurface drip irrigation, mulching, and improving soil water storage by building soil health can help, and are practices that fruit and vegetable producer interviewees widely said they are implementing:

> We use a lot less water than a lot of the alfalfa or hay farms in the area because they're using overhead sprinkler irrigation … so I don't think the [water] quantity … is an issue for us because we're pretty efficient with our drip irrigation.

The current permit-exempt limits may be enough for water-efficient indoor operations in either state. Using water-efficient indoor systems could enable the startup of new farms with minimal impact on the local ecosystem and reduce conflict with conventional producers by protecting crops from chemical drift. This approach has higher startup costs and may be limited on leased land, given landowners' concern about permanent structures (Figure 3).

Figure 4. Perception of the Current State of Groundwater Resources in Palouse Region Aquifers



Another avenue to setting up a new farm is to buy one that already has water. Fifty-seven percent of landowner survey respondents said they own a water right (n = 296). Latah County had 424 irrigated acres (172 ha) and Whitman County had 4,583 acres (1,855 ha) in 2022 (USDA NASS, 2022a, 2022b). According to key informants, the only likely potential opportunity to start a midsized irrigated farm is to convert or diversify existing irrigated land, such as alfalfa production, from an existing operation as occurred nearby in Washington's Walla Walla Valley.

To increase water availability, some landowner survey respondents suggested irrigating out of ponds ("Building ponds and using the water for irrigation seems like a good idea to me"), a strategy some fruit and vegetable producer interviewees said they are already implementing ("We irrigate out of the pond, so we didn't have to … draw out of our well"). Local conservation districts and agencies are already providing funding and technical support to landowners to implement pond development for habitat and hydrologic values, such as improved water retention, surface flow, and aquifer recharge. Paired with high-efficiency irrigation systems, ponds could provide irrigation water and advance restoration priorities at local and watershed scales. Some landowner survey respondents and producer interviewees suggested future development suitable to Palouse environmental conditions might focus on livestock ("May not have enough water for irrigation but could pasture livestock"), dryland artisan, specialty grains for higher-profit markets, or developing vertically integrated grain operations that include milling or malting.

Conclusions

As our small-acreage producer interviewees articulated, accessing suitable farmland is challenging in the Palouse context, as it is in many places. Yet, our landowner survey found over 1,000 acres potentially available for growing produce for LRFSs, which is enough to substantially increase diversified production. Landowners expressed a diverse set of values and orientations to agriculture, which conditions access and provides opportunities for diverse approaches. Farms are for sale periodically, many landowners expressed interest in leasing, and new farms continue to start up. Increasing landowner and seeker awareness and use of connecting programs (e.g., Idaho Farm Link) is an important strategy for facilitating this type of LRFS production.

Water provides a hard limit for the foreseeable future to many types of agricultural development on the Palouse and beyond. For small farms, this constrains and conditions development rather than prevents it. As was frequently raised by participants, golf courses in Latah and Whitman counties alone use 204,400,000 gallons per year (U.S. Geological Survey, 2010), more than what is needed for expanding fruit and vegetable production at the scale considered in this study. Whether water goes to small farms or to other uses is a question of values. Building a new golf course would be challenged because of its water use; agricultural development should expect similar treatment. In many U.S. communities, small farm development is likely to occur in contested, constrained landscapes with competing visions for how to use limited resources.

The dialectic between small-scale produce and large-scale dryland commodity growers is a point of interaction and hybridization across systems, bringing different understandings and values not only to LRFS expansion but also to conventional supply chains. The issues we highlighted between these grower types are likely relevant where large-scale commodity production dominates the landscape as in much of the rural U.S. West and Midwest (USDA NASS, 2024a) and could be more broadly explored in future research. Despite barriers, it benefits society for all food systems to be as socially, environmentally, and economically sustainable as possible. Interaction, tension, and conflict between actors and systems can lead to positive adaptation that benefits all. For example, short food supply chains initially developed to support small-acreage diversified farms are now providing local and regional supply chain and market opportunities for grain products (Crossley, 2022). In addition, participants identified integrating produce, livestock, or value-added enterprises as strategies to diversify and integrate additional family members into existing grain farms.

If LRFSs are to have an important role in strengthening human resilience in a resource-constrained and uncertain world, development must be intentional to be complementary and compatible with existing land uses and community priorities. Both export and LRFS-oriented farms are embedded in culturally, politically, economically, and ecologically unique places. Many participants argued that the dominant dryland agriculture is well-suited to the Palouse, and that irrigated agriculture is questionably so. Using water efficiently and participating in watershed and habitat restoration are examples of how farms can implement sustainable practices with positive environmental impacts in water-constrained landscapes. In our study area, farms can help build hydrologic capacity, restore ecosystem function, and contribute to resilience in the watershed, for example, through pond development. Water resource challenges and solutions may be context-specific, but the need to address them is universal. The goal for this type of development is to realize the promise of local foods for supporting not only economic but environmental and social well-being. If small farms improve the many uses and values in a landscape, then they are truly contributing to socially, culturally, and ecologically embedded and resilient systems.

This study identified new constraints and opportunities for LRFSs to compatibly expand with existing agricultural production systems. It contributes to the literature by helping to "unpack" water and land access opportunities and constraints for LRFS development, exploring how these issues "are understood by those connected with them" and mapping a "range of positions" (Ritchie et al., 2013, p. 31). This study also has explanatory value as it examines "the factors [and] influences that underlie" (p. 32) decisions, attitudes, and behaviors affecting capacity to increase production and LRFS land and water access. Our mixed-methods, in-depth, and nuanced exploration of the issues provided diverse perspectives to inform future policy and outreach. Our interview results are not statistically generalizable, and our broader results are bound by place. However, the literature points to the importance of place and context of agricultural production when examining LRFSs, and we uncovered dynamics that can be explored in future research (Feenstra, 2002; Saul et al., 2022).

As the Palouse illustrates, scaling up LRFSs can be an aggregation of small, scalable activities rather than a single development to reach regionally significant economic impacts. Research is needed to better understand both community and regional impacts of this type of development in the context of larger-scale systems. Research is also needed that supports regional-scale planning that integrates local development as an important goal. In many areas, this will be a new type of planning that builds on and supports other more narrowly or generally focused efforts. There are large grant-funded projects in the United States focused on regional-scale planning for more specific goals, such as business development, or broad implementation of new producer practices. Understanding the differences in approaches and outcomes among these projects is one example of a fertile research opportunity. Our ongoing research builds on this study to explore integration of small- and midscale farms into regional supply chains, and the role of LRFSs in addressing broader community development goals.

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