Nonpecuniary Effects of Farming on Behavior
From Washington State Farmers with Surface Water Irrigation

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Selected Paper prepared for presentation at the 2024 Agricultural & Applied Economics Association Annual Meeting, New Orleans, LA; July 28-30, 2024

Abstract

Climate change is placing additional pressure on the limited water supplies in the Western US. Most of the water in the region goes to agriculture so it is important to understand farmers' choices as they are the central drivers of agriculture. Farmers can participate in the lucrative water market to move water to higher value uses, but nonpecuniary benefits of farming can keep farmers in the field. There is a lack of research on the effect of nonpecuniary benefits on the behavior of farmers who (1) irrigate and (2) are in the western US. Building upon the methods employed by Howley (2015) with Irish farmers, I survey Washington state farmers who have surface water rights and larger farms than their European Union counterparts. I examine the relationship between nonpecuniary benefits of farming and farmers' decisions regarding (1) increasing future production, (2) remaining in farming, (3) holding an off-farm job, and (4) participating in water markets. Nonpecuniary benefits are non-monetary benefits from operating a farm that impact individual utility and may explain why some choose to farm despite more profitable opportunities such as water trading and off-farm labor. Initial results suggest both pecuniary and nonpecuniary benefits of farming play a significant role in Washington farmers' decision to remain in farming and not participate in water markets. Farmers will need even greater monetary benefits to decide to engage in water markets and undergo the high costs of navigating its institutional, legal, and market regulations.

Acknowledgement: This work was supported by United States Department of Agriculture (USDA) National Institute of Food and Agriculture (USDA Accession # 1016467) and certified as Exempt by the Washington State University Human Research Protection Program. I would like to thank Joseph Cook, Jonathan Yoder, and Michael Brady for suggestions to improve survey design, model, and manuscript. Also, I would like to thank Koroles Awad for his feedback on the theoretical model and Eric Hubbard for editorial comments.

Keywords: Nonpecuniary benefits of farming; Washington state; irrigation; water markets; surface water rights; farm production; remain in farming; off-farm job; farmer attitudes and behavior

1.1 Introduction

Most of the water used in the Western United States (US) goes to agriculture (Dorn et al., 2022), so it is important to understand farmers' choices as they are the central drivers of agriculture. Climate change, pollution, and population growth place pressure on limited water supplies in the Western US (Barnett et al., 2004; Dettinger et al., 2015; Okello et al., 2015; Yoder et al., 2022). More efficient irrigation methods are inadequate to address water scarcity so there is a need to investigate how water can be better allocated between competing uses (Hren & Feltz, 1998; Levidow et al., 2014; Grafton et al., 2018). Water markets can efficiently allocate water from low value to high value uses (Brown, 2006; Schwabe et al., 2020; Yoder et al., 2022). Agriculture can be considered a low value use while city utilities can be considered a high value use. Farmers can participate in the lucrative water market to move water to higher value uses, but nonpecuniary benefits of farming can keep farmers in the field. Nonpecuniary benefits can be any non-monetary benefits that impact a person's lifestyle and increase their general prosperity (Key & Roberts, 2009; Howley, 2015). There is a lack of research on the effect of nonpecuniary benefits on behavior from farmers who (1) irrigate and (2) are in the Western US. This paper fills this gap in the literature by examining the nonpecuniary benefits of irrigated farming in the Western US.

Farmers are self-employed business owners that allocate labor to maximize utility from leisure, consumption, and nonpecuniary benefits from farming (Cullen et al., 2020). In economics, it has been argued that people seek to maximize their utility by spending their income first on things they value the most (those items that have the highest "utility"). Revealed preference has been typically used to infer utility by looking at an individual's purchasing behavior. Income has been used as a substitute for utility so all farmers were treated as profit maximizers (Edwards-Jones, 2006; Romer, 2006). However, farmers have been observed making choices against their financial self-interest; like when they engage in loss-making production strategies (O'Donoghue & Howley, 2012) and allocate more time on-farm when there are greater returns in the off-farm labor market (Key & Roberts, 2009).

People farm for a variety of reasons so it is vital to consider financial, social, and psychological benefits of farming when looking at decision-making. Key and Roberts (2009) use the agricultural household model to look farmers' decisions, which consider nonpecuniary benefits of farming by looking at income between farmers with and without an off-farm job. It shows that farmers' decisions, which appeared to be against their financial interest, are explained by the substantial nonpecuniary benefits of farming.

Recent literature has argued that subjective indicators of well-being may serve as a better proxy for individual utility since self-reported well-being (stating how satisfied a person is with their life) is a more accurate representation than the financial choices they make (Hirschauer et al., 2015; Howley, 2015; Ocean & Howley, 2023; Stutzer & Frey, 2010). Howley (2015) empirically tests the relationship between farmers' perceptions of nonpecuniary benefits of farming in Ireland on behaviors such as off-farm labor market participation. He finds that while costs and returns are important, nonpecuniary benefits make some choices more attractive than others with financial rewards.

Most existing studies on farmer attitudes and nonpecuniary benefits of farming have been conducted in the European Union (Cullen et al., 2020; Howley, 2015; Key & Roberts, 2009; Ocean & Howley, 2023; Willock et al., 1999). There are fewer American farmers with an average farm five times larger than one in Europe (Dorn et al., 2022; Schnepf, 2021). This paper looks at farmers' attitudes and nonpecuniary benefits of farming in Washington state, located in Western US. Following the approach of Howley (2015), I test farmer perceptions relating to nonpecuniary benefits, derive constructors to reflect this, and model whether nonpecuniary benefits significantly affect farmer decisions. This allows me to compare my results with Howley (2015).

In addition, previous literature has not looked at the nonpecuniary benefits of farming with irrigation. I add three statements regarding the farmer's surface water rights used to irrigate their farm to the original twenty statements by Howley (2015). I use machine learning factor analysis and

word2vector to look at open-ended farmer statements to have robust results. I examine the relationship between nonpecuniary benefits of farming and farmers' decisions in Washington state regarding (1) increasing future production, (2) remaining in farming, (3) holding an off-farm job, and (4) participating in water markets.

1.2 Theoretical Model

There is a basic farm household model established in literature, where households choose between leisure and labor on and off-farm to maximize utility. The household is typically indifferent between working on and off-farm at the same wage rate. In this paper, I build upon Key & Roberts (2009) theoretical model to consider how nonpecuniary benefits of farming affects water market participation.

In this paper's theoretical model, I assume the household prefers working on-farm versus off-farm at the same wage rate because of the nonpecuniary benefits of working on-farm. To illustrate this, consider a unitary farm household that allocates it endowment of labor (*L*) between working on-farm (*l)*, working off-farm (*o)*, or leisure *(r) so* I have $r = L - l - o$. Household expenditures (*c)* are constrained by income from water market participation rate (*p where 0≤p≤1*) multiplied by seniority of the water right as a function of sale price *(s(y)),* plus farm profits$\big(\pi(l)\big)$ from water remaining for irrigated farming (if any)*,* plus off-farm income with was off-farm wage rate (*wo*).

(1) $\mathrm{c} = \mathrm{ps(y)} + (1 - \mathrm{p})\pi(l) + wo$

It is important to note that a farm household would only participate in a water sale if the financial incentive from participating in the water market is greater than the financial incentive from farming, so I assume *s(y)*≥ $\pi(l)$*.* If a farm household does choose to lease or sell all their water rights, they would have to fallow all farmland and on-farm labor *l* would equal 0. When l=0 the household would not receive any nonpecuniary benefits from farming. I also assume farm profits are increasing in farm labor at a diminishing rate ($\pi'(l) > 0,\ \pi''(l) < 0$).

To simplify comparative statistics, let the utility function be additive of the form:

(2) $u(c,l,r) = U(c) + B(l) + R(r)$

consumption $U(c)$, time spent working on-farm (nonpecuniary benefits) $B(l)$, *(B(l)=0 if l=0)* and from leisure $R(r)$. Let the marginal utility of consumption, the marginal utility of nonpecuniary benefits from farming, and the marginal utility of leisure be positive and diminishing ($U'(c) > 0,\ U''(c) < 0;\ B'(l) > 0,\ B''(l) < 0;\ R'(r) > 0,\ R''(r) < 0$).

The household optimization problem can be expressed as a function of water market participation and labor on and off-farm.

(3) $\max_{p,l,o} u\big(p,l,o;s(y)\big) = U(\mathrm{ps(y)} + (1-\mathrm{p})\pi(l) + wo) + B(l) + R(L-l-o)$

Consider the interior solution where labor is allocated to on-farm, off-farm, and leisure activities. The first-order conditions for a maximum are:

(4) $u_p = \mathrm{U'(c)}\big(s(y) - \pi(l)\big) = 0$

$u_l = \mathrm{U'(c)}[(1-p)\pi'(l)] + B'(l) - R'(r) = 0$

$u_o = \mathrm{U'(c)}w - R'(r) = 0$

The second-order conditions are:

(5) $u_{pp} = \mathrm{U''(c)}\big(s(y) - \pi(l)\big)^2 < 0$

$u_{ll} = -\mathrm{U''(c)}[(1-p)^2(\pi'(l)^2)] + \mathrm{U'(c)}[(1-p)\pi''(l)] + B''(l) + R''(r) < 0$

$u_{oo} = \mathrm{U''(c)}w^2 + R''(r) < 0$

$u_{pl} = -\mathrm{U''(c)}\big(s(y) - \pi(l)\big)(1-\mathrm{p})\pi'(l) - U'(c)\pi'(l) < 0$

$u_{po} = \mathrm{U''(c)}\big(s(y) - \pi(l)\big)w < 0$

$u_{lo} = U''(c)(1-p)\pi'(l)w + R''(r) < 0$

I calculate the determinant of Hessian and get

(6) $|\mathrm{H}| = u_{pp}u_{ll}u_{oo} + u_{pl}u_{po}(u_{lo} + u_{oo}) - (u_{pp}u_{lo}^2 + u_{oo}u_{pl}^2 + u_{lo}u_{po}^2) > 0$

Then totally differentiating the first order equations (4) with respect to p, *l, o*, and *B(l)* to solve for dp/dB with Cramer's rule (see details in Appendix) gives

(7) $\frac{dp}{dB(l)} = \frac{u_{pl}u_{oo} - u_{po}u_{lo}}{|H|} < 0$

The numerator in equation (7) is negative at its optimum which follows as labor increases and nonpecuniary benefits of farming increases, water market participation decreases. If the farm household only worked on-farm, then this would simplify to $u_{pl}/|H| < 0$.

1.3 Data

I ran an online cross-sectional survey over eight weeks from March to May 2023 in four basins in Washington: Methow, Okanogan, Walla Walla, and Yakima. One-hundred and five farmers with surface water rights took the survey. The data collected was part of a larger survey, where participants had the opportunity to earn $100 to $200. The survey recruited 2,322 surface water rights holders officially registered with the Washington Department of Ecology in four basins where agricultural irrigation is commonly practiced (Cook & Kumar, 2021). The participants were mailed physical invitation letters to participate with a code to access the experiment online in Qualtrics. A segment of participants were active farmers (105 out of 181 participants in the larger study), while others used their water rights for livestock watering, fire suppression, basic household needs, or wildlife protection.

Washington is in the northwest of the US (see Figure 1.1). Washington water law adopted the Prior Appropriations doctrine, which determines priority by who puts the surface water to beneficial use first in time, in 1917. Water law does not allow water to be privately owned, but the right to use that water can be sold, bought, or transferred (Washington Department of Ecology, 2006; Yoder et al., 2022). The four basins selected in this study are in central Washington, which has a dry climate with good soil fertility. Many farmers with surface water rights in the basins use large-scale irrigation to grow perennial crops versus annual crops. This has made Washington farmers the largest producers of apples, sweet

cherries, grapes, hops, and pears in the country. As Washington has less water available in dry years, irrigators face production uncertainty.

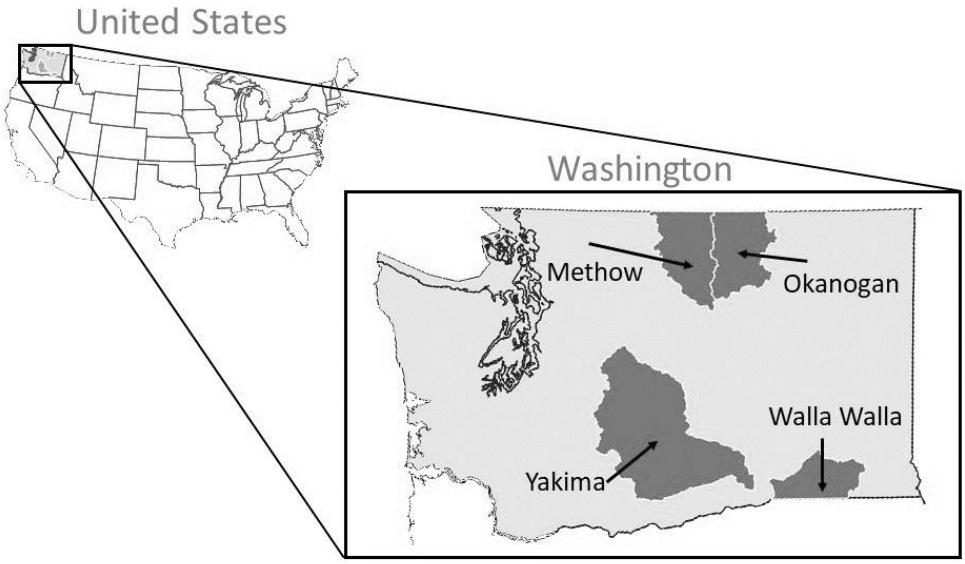

Figure 1.1: Participants have water rights in four basins in Washington state

Participants were allowed to select "Prefer Not to Answer" or "Skip" sensitive questions such as what their annual household income is. Therefore, there is missing data for some observational variables, for example, for income, only 94 out of 105 participants answer. Due to the limited sample size (105 observations). rather than dropping missing data for these observations, I impute them to the median value observed in the final data set. At the end of the survey, I ask farmers to tell us about their farm, agricultural production choices, and demographic information. I report raw data with un-imputed values in Table 1.1.

1.4 Survey Design

In the online survey, participants verified they are farmers with registered surface water rights. The Howley (2015) survey was conducted in-person. Participants were given 22 statements and asked to indicate to what extent they agreed or disagreed with them on a scale from 1 (completely disagree) to 7 (completely agree). Nineteen (19) of the statements were from Howley (2015) and three regarding the farmer's surface water rights were created and added by me. The statements were designed to cover a

wide range of pecuniary and nonpecuniary benefits of farming (see Table 1.2). For example, some of the original nineteen statements about farming from Howley (2015) are: *I think farming communities are a great place to live; I make a good living from farming; and Owning my own land is important to me*. Regarding the farmer's surface water rights, I added these three statements: *My neighbors would be upset with me if I leased or sold water rights; None of my friends or neighbors have a positive view about selling or leasing their water right; There is no amount of money that would make me interested in leasing or selling my water right*.

I compared results to the nineteen statements from Howley (2015) versus my study. I used the chi-squared test for independence to see whether farmers responded significantly differently. In this study, 11 of the 19 statements mean responses varied from the original study ($p<0.05$). There were no differences between the studies for statements regarding benefits for raising children such as: (1) *I believe a rural environment is a great place to raise children* and (2) *Growing up on a farm is great for children.* There were small differences between responses for financial incentives from farming.

After the statements, I ask participants to take a minute to think about their land with water rights. I tell them I would like to know more about their experiences of owning or working on that land. Then I ask, "Could you share the most important 'positive' thing that comes to mind?" This was an open-ended question, and they could type as much or as little as they wanted to. Their responses can help better understand the benefits of farming with irrigation.

Farmer decisions and demographic information were asked at the end of the survey. The summary statistics from Washington farmers with irrigation can be seen in Table 1.3. I have three of the same dependent variables as Howley (2015): (1) Future production, (2) Remain in farming, and (3) Off farm labor. I find higher means for these three dependent variables among the participants. For example, 40 percent of subjects plan to increase output over the next 3 years in this paper versus only 23 percent in Howley (2015). I also find 85 percent of Washington farmers with irrigation plan to remain

in farming for the next 10 years and 46 percent have an off-farm job. For the fourth dependent variable, I ask subjects if they have participated in a water rights sale or temporary lease instead of whether the farmer diversified their farm business over the last 7 years. I made this change because this is a more relevant and important question for us to ask farmers in the Western US. I find that 18 percent of farmers have participated in some kind of water rights sale or temporary lease.

Explanatory variables in this study differ from the original study because both farms and farmers in the Western US are different from those in Ireland. Western US farms are much larger, produce different products, and have different regulations than EU farms. For example, in the original study, farms are considered large when they are larger than 74 hectares or 183 acres. In the study, farms are large when they have more than 1,000 acres. Individual farmer characteristics vary between the two locations as well. For example, 17 percent of farmers completed high school in Ireland while 99 percent completed high school in Washington. So, for education, I look at how many participants completed post-graduate education and find 31 percent of subjects have *High education*. However, the people who participated in the study tend to have smaller farms and a higher education than average Washington farmers.

Sixty-seven (67) percent of participants in this study are older than 60 years old, 58 percent have been farming for more than 20 years, and 34 percent have an annual income of more than $130,000. Sixty-nine (69) percent of subjects were farmers with less than 100 acres of land while only ten percent have more than 1,000 acres. Only 31 percent have multi-generational farms where they acquire most of the land by inheritance, gift, or purchase from a relative. Most farmers grow annual groups such as hay or wheat and irrigate more than ten percent of their land. On the farms, subjects have an average of two full-time employees (including themselves).

Table 1.1: Benefits of Irrigated Farming

Statements given that farmers responded with 1 (completely disagree) to 7 (completely agree)	Howley (2015)		This Study	
	N	Mean (sd)	N	Mean (sd)
I believe a rural environment is a great place to raise children	355	6.36 (1.01)	105	6.58 (0.89)
Growing up on a farm is great for children	358	6.31 (1.04)	105	6.59 (0.79)
I enjoy the peace and quiet that comes with farming	352	6.24 (0.96)	105	6.55 (1.00)***
I love working outdoors	360	6.24 (1.04)	105	6.59 (0.98) ***
I think farming communities are a great place to live	360	6.22 (1.02)	105	6.37 (0.99)
It's great being able to work with nature	356	6.12 (1.13)	105	6.60 (1.00) ***
I believe being your own boss is the best thing about farming	361	6.11 (1.06)	105	5.93 (1.09)
Farming is more rewarding in terms of quality of life, independence, lifestyle, than it is in terms of money	362	5.80 (1.43)	105	5.93 (1.01) **
I feel like farmers look out for each other	358	5.80 (1.26)	105	5.71 (1.14) **
I talk regularly with other farmers about farming	356	5.79 (1.26)	105	5.30 (1.44) ***
I do not make a fortune farming, but the lifestyle is great	360	5.76 (1.33)	105	5.97 (1.16) **
I think people living in rural areas are generally nicer than those living in urban areas	347	5.69 (1.46)	105	5.52 (1.39)
I enjoy farming much more than I would other potential sources of employment	359	5.58 (1.68)	105	5.22 (1.34) ***
Being able to talk with other farmers is the best thing about farming	355	5.25 (1.31)	105	4.12 (1.41) ***
I could make more money in other employment, but I would miss farming	345	5.10 (1.86)	105	4.78 (1.46) ***
I make a good living from farming	348	3.84 (1.86)	105	3.90 (1.75)
Farming is hard work, but the financial rewards make it worthwhile	359	3.68 (1.81)	105	3.77 (1.60) *
There are substantial monetary rewards from my farm work	362	3.67 (1.87)	105	3.32 (1.61)
Owning my own land is important to me	363	6.29 (1.14)	105	6.72 (0.60) **
My neighbors would be upset with me if I leased or sold water rights			100	4.45 (1.77)
None of my friends or neighbors have a positive view about selling or leasing their water right			100	4.59 (1.52)
There is no amount of money that would make me interested in leasing or selling my water right			100	4.15 (2.20)

Note: Standard errors in parentheses and chi-squared test of independence shows if mean response differs between two studies with significance from *p<0.10, **p<0.05, and ***p<0.01.

Table 1.2: Key Differences between those who have or have not participated in water markets

Statements given that farmers responded with 1 (completely disagree) to 7 (completely agree)	**Not participated** N = 86	**Participated** N = 19
	Mean	**Mean**
I believe a rural environment is a great place to raise children	6.68	6.10**
Growing up on a farm is great for children	6.67	6.16***
I enjoy the peace and quiet that comes with farming	6.64	6.16***
I love working outdoors	6.61	6.53
I think farming communities are a great place to live	6.41	6.21
It's great being able to work with nature	6.65	6.37
I believe being your own boss is the best thing about farming	5.94	5.89
Farming is more rewarding in terms of quality of life, independence, lifestyle, than it is in terms of money	5.93	5.95
I feel like farmers look out for each other	5.69	5.84
I talk regularly with other farmers about farming	5.23	5.58
I do not make a fortune farming, but the lifestyle is great	6.00	5.84
I think people living in rural areas are generally nicer than those living in urban areas	5.5	5.63
I enjoy farming much more than I would other potential sources of employment	5.22	5.21
Being able to talk with other farmers is the best thing about farming	4.17	3.89
I could make more money in other employment, but I would miss farming	4.86	4.42
I make a good living from farming	3.83	4.83
Farming is hard work, but the financial rewards make it worthwhile	3.74	3.89
There are substantial monetary rewards from my farm work	3.27	3.58
Owning my own land is important to me	6.71	6.79
My neighbors would be upset with me if I leased or sold water rights	4.49	4.26
None of my friends or neighbors have a positive view about selling or leasing their water right	4.53	4.84
There is no amount of money that would make me interested in leasing or selling my water right	4.32	3.42

Note: Standard errors in parentheses and chi-squared test of independence shows if mean response between two groups is statistically different *p<0.10, **p<0.05, and ***p<0.01.

1.5 Factor Analysis

I use exploratory factor analysis to take the responses to the 22 statements and make latent constructs reflecting their perceptions into distinct categories of nonpecuniary and pecuniary benefits of farming with irrigation. In Howley (2015), the factor analysis produced three factors with an eigenvalue greater than one. The statements are divided into three factors that the author named: (1) Social and lifestyle, (2) Farm labor, and (3) Pecuniary benefits. When I use the similar principal-component factor analysis technique in Stata (known as factor, pcf), I get six factors with an eigenvalue greater than one (see Table A.1 in the Appendix).

In Table 1.4 below, I label factors one to six as: (1) Social and lifestyle, (2) Pecuniary benefits, (3) Farming rewards, (4) Water rights, (5) Own boss, and (6) My land. In the Social and lifestyle and Pecuniary benefits factors, I see similar statements in the original and this study, i.e. *Growing up on a farm is great for children* and *There is substantial monetary rewards from my farm work*. For the Water rights factor, the three water rights statements have larger values for it than any other factor so they are grouped to create this. Farming rewards, Own boss, and My land factors each have one statement that scores larger than in other factors.

The six factors are regressed to create six variables. These are used as explanatory variables to examine the association between the latent constructs reflecting farmer perceptions of the pecuniary and nonpecuniary benefits of farming with irrigation on farmer behaviors. The factor variables are used in addition to farmer characteristics on future production, remaining in farming, off-farm labor, and water sale dependent variables.

Table 1.3: Choices and Demographics of Farmers with Irrigation

Variables	Definition	N	Mean
Dependent Variables (Y)			
Future production	=1 if subject plans to increase output over next 3 years; =0 otherwise	100	0.40
Remain in farming	=1 if subject plans to remain in farming in next 10 years; =0 otherwise	100	0.85
Off farm labor	=1 if subject has job off farm; =0 otherwise	100	0.46
Water sale participation	=1 if subject participated in real life water sale or temporary lease; =0 otherwise	105	0.18
Explanatory Variables (X)			
Age 60 plus	=1 if in highest 3 age deciles (older than 60 years) ; =0 otherwise	105	0.67
Farm successor	=1 if subject has successor to work farm when they retire; =0 otherwise	105	0.25
High education	=1 if subject completed post-graduate degree (Masters, PhD, or other degree beyond Bachelors); =0 otherwise	105	0.31
High income	=1 if subject has higher than median income level of sample (earned more than $129,999 per year); =0 otherwise	105	0.34
Farm workers	Number of full-time farm workers (continuous variable)	99	2.03
Small farm	=1 if subject has less than 100 acres; =0 otherwise	105	0.69
Large farm	=1 if subject has more than 1000 acres; =0 otherwise	105	0.10
Perennial crop	=1 if subject's real operation includes perennial crops like orchards, vineyards; =0 if annual crop like hay or wheat	105	0.13
Family farm	=1 if subject acquired most of their land by inheritance, gift, or purchase from a relative; =0 otherwise	105	0.31

Table 1.4: Factor Analysis of Statements

	F1 = Social& lifestyle	F2 = Pecuniary benefits	F3 = Farming rewards	F4 = Water rights	F5 = Own boss	F6 = My land
I believe a rural environment is a great place to raise children	**0.700**	-0.401	-0.297	-0.011	0.248	-0.097
Growing up on a farm is great for children	**0.711**	-0.467	-0.211	-0.004	0.188	-0.158
I enjoy the peace and quiet that comes with farming	**0.738**	-0.438	-0.273	0.045	-0.147	0.081
I love working outdoors	**0.739**	-0.321	-0.276	0.015	-0.280	-0.028
I think farming communities are a great place to live	**0.763**	-0.325	-0.241	0.043	0.288	-0.051
It's great being able to work with nature	**0.757**	-0.366	-0.206	0.071	-0.310	0.053
I believe being your own boss is the best thing about farming	0.351	0.243	-0.085	-0.323	**0.616**	-0.245
Farming is more rewarding in terms of quality of life, independence, lifestyle, than it is in terms of money	0.434	0.105	**0.471**	-0.464	0.140	-0.059
I feel like farmers look out for each other	**0.666**	-0.079	0.075	-0.325	-0.117	-0.050
I talk regularly with other farmers about farming	**0.624**	0.370	0.178	-0.040	-0.297	-0.202
I do not make a fortune from farming, but the lifestyle is great	**0.677**	0.026	0.296	-0.053	-0.121	0.066
I think people living in rural areas are generally nicer than those living in urban areas	**0.488**	0.255	0.283	-0.106	0.263	0.355
I enjoy farming much more than I would other potential sources of employment	**0.639**	0.439	0.329	-0.188	-0.084	-0.016
Being able to talk with other farmers is the best thing about farming	0.517	**0.576**	-0.026	0.018	-0.238	-0.062
I could make more money in other employment, but I would miss farming	**0.483**	0.396	0.339	-0.261	-0.058	0.236
I make a good living from farming	0.256	**0.762**	-0.381	0.180	0.000	-0.042
Farming is hard work, but the financial rewards make it worthwhile	0.276	**0.728**	-0.474	0.225	0.008	0.046
There are substantial monetary rewards from my farm work	0.166	**0.741**	-0.454	0.168	0.116	-0.084
Owning my own land is important to me	0.347	-0.020	-0.053	0.317	0.211	**0.753**
My neighbors would be upset with me if I leased or sold water rights	0.266	0.082	0.439	**0.610**	0.187	-0.291
None of my friends or neighbors have a positive view about selling or leasing their water right	0.323	-0.029	0.397	**0.592**	-0.075	-0.100
There is no amount of money that would make me interested in leasing or selling my water right	0.325	-0.147	0.445	**0.498**	0.150	-0.055

Note: The highest percentage for the statement across the four factors is in bold and if another factor is within 10 percent of it, it is underlined.

1.6 Results

1.6.1 Logistic Regression

I use logistic regression to examine the association between farmer demographics and latent constructs reflecting farmers perceptions on pecuniary and nonpecuniary benefits on real world farmer behaviors. Logistic regression models allow us to assume a non-linear relationship between the explanatory and dependent variables. I regress four logistic models, one for each dichotomous dependent variable: (1) future production plans, (2) remaining in farming, (3) off-farm labor, and (4) water sale participation. Table 1.5 presents the results of all four Logistic regressions.

In the first regression, Model (1), I examine farmers' future planned behavior to increase production output. I find when farmers have a successor, they are significantly more likely to increase their agricultural output over the next three years ($p < 0.05$). The remaining variables are not statistically significant ($p > 0.10$). *Age 60 Plus* has a negative relationship with future production like the age variables in the original study. *High education, Large farm*, and *Water rights* have a negative relationship while the remaining variables such as *Farm workers* and *High income* have a positive relationship with future production plans.

In Model (2), I look at factors affecting the probability that farmers agree to the statement that they plan to still be farming in 10 years. Farmers with a higher income are significantly more likely to still be farming ($p < 0.05$). Farmers that receive nonpecuniary benefits from *Social and lifestyle* ($p < 0.05$) and *My land* ($p <0.10$) are also significantly more likely to continue farming. On the other hand, those with a small farm are significantly less likely to continue farming ($p < 0.10$). None of the other variables are significantly correlated with farmers' likelihood to continue farming in the next 10 years ($p > 0.10$). Several variables' signs have flipped from Model (1) to Model (2), such as *Age 60 plus* is positive while *Farm Successor* is negative.

Next, I look at farmers' labor allocation choices. In this study, 42 percent of participants reported having off-farm employment. The regression results show farmers with higher income ($p < 0.05$) and small farms ($p < 0.10$) are significantly more likely to have a job off-farm than those with a lower income or large farms. On the other hand, farmers over 60 years old ($p < 0.01$) and those with more negative feelings towards leasing or selling their water rights ($p < 0.05$) were significantly less likely to have a job off-farm. If there is an additional full-time worker on the farm, participants are also less likely to have a job off-farm ($p < 0.05$). The pseudo-R-squared for Model (3) is 0.421 which is about two times larger than the other models. The explanatory variables in this model are doing a better job at explaining labor allocation choices of farmers than the other behaviors.

Lastly, in Model (4), I look at farmers' water market participation to either permanently sell or lease their water rights. I find farmers with more full-time workers are significantly more likely to have participated in water markets ($p < 0.10$). Also, if the farmer has a large farm, they have significantly more likely to have participated ($p < 0.10$). Farmer age, education, income, crop type, and factor variables have no significant correlation with water sale participation ($p > 0.10$).

Table 1.5: Logistic Regression Results

	Model (1) Future Production	**Model (2) Remain in farming**	**Model (3) Off-farm labor**	**Model (4) Water sale participation**
Age 60 plus	-0.587	0.154	-3.254***	1.162
	(0.537)	(0.795)	(0.765)	(0.745)
Farm successor	1.548**	-0.785	1.389*	-0.343
	(0.649)	(0.960)	(0.837)	(0.877)
High education	-0.617	0.845	-0.623	0.858
	(0.585)	(0.800)	(0.716)	(0.749)
Farm workers	0.296	-0.464	-0.713**	0.548*
	(0.249)	(0.350)	(0.308)	(0.294)
Small farm	0.814	-2.758*	1.887*	-0.403
	(0.802)	(1.501)	(1.063)	(1.115)
Large farm	-0.432	-2.020	1.346	2.412*
	(1.131)	(1.570)	(1.239)	(1.258)
High income	0.633	1.865**	1.732**	-0.785
	(0.572)	(0.933)	(0.705)	(0.814)
Perennial crop	1.059	1.501	1.020	-0.396
	(0.833)	(1.458)	(1.113)	(0.993)
Family farm	0.634	-0.947	-0.329	-1.297
	(0.632)	(0.910)	(0.734)	(0.882)
Factor Groups				
Social and lifestyle	0.424	1.013***	-0.492	0.125
	(0.269)	(0.389)	(0.351)	(0.344)
Pecuniary benefits	0.138	0.528	-0.067	-0.021
	(0.280)	(0.398)	(0.349)	(0.350)
Farming rewards	0.348	-0.217	-0.358	0.353
	(0.269)	(0.370)	(0.306)	(0.349)
Water rights	-0.317	-0.083	-0.653**	-0.231
	(0.254)	(0.314)	(0.323)	(0.350)
Own boss	0.244	-0.150	0.452	0.049
	(0.269)	(0.319)	(0.341)	(0.308)
My land	0.259	0.544*	0.301	0.552
	(0.255)	(0.310)	(0.295)	(0.366)
Constant	-2.046**	4.890***	1.145	-3.211**
	(1.040)	(1.799)	(1.286)	(1.404)
N	99	99	99	99
pseudo R-sq	0.200	0.263	0.421	0.204

Note: Standard errors in parentheses and *p<0.10, **p<0.05, and ***p<0.01

1.7 Conclusion

This paper follows the approach used by Howley (2015) using Washington farmers with surface water irrigation to empirically test the relationship between nonpecuniary benefits of farming on field behaviors such as disinvestment, production, off-farm labor market participation, and water market participation. I add three statements regarding the farmer's surface water rights used to irrigate their farm to the original twenty statements by Howley (2015). This contributes to existing research by looking at nonpecuniary benefits on behavior from farmers who (1) irrigate and (2) are in the Western US. Results suggest both pecuniary and nonpecuniary benefits of farming play a significant relationship in farmer's decision to remain in farming and whether to participate or not in off-farm labor.

I use exploratory factor analysis to take the responses to the 22 statements and make latent constructs reflecting their perceptions into distinct categories of nonpecuniary and pecuniary benefits of farming with irrigation. The factor analysis produced three factors in Howley (2015), while it produces six factors from this data. These latent constructs are used as explanatory variables in the four logistic regressions. The four key dependent variables I use to test the relationship between nonpecuniary benefits of farming on behaviors are (1) Future production, (2) Remain in farming, (3) Off-farm labor, and (4) Water sale participation.

The Logistic regression results suggest that some pecuniary and nonpecuniary benefits play a role in farmer behavior. Therefore, it is important to look at more than just the cost and returns of farming when examining farmer decisions and utility. For example, Model (1) illustrates that farmers with successors are significantly more likely to increase future farm production over the three years. Farmers who plan to farm in the next 10 years are more likely to have a high income and receive social and lifestyle benefits from farming. As 42 percent of farmers have off-farm jobs in western US, older farmers with high income and more full-time employees are more likely to allocate all their time on the farm. Participants with small farms are more likely to have a job off-farm and less likely to remain in 10 years. Participants with large farmers are significantly more likely to participate in water markets.

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1.9 Appendix

Table A.1: Raw Choice and Demographics of Farmers Summary Statistics

Variables	N	Mean	Std. Dev.	Min	Max
Dependent Variables (Y)					
Future production	100	0.4	0.49	0	1
Remain in farming	100	0.85	0.36	0	1
Off farm labor	100	0.46	0.5	0	1
Water sale	105	0.18	0.39	0	1
Explanatory Variables (X)					
Age 60 plus	103	0.61	0.49	0	1
Farm successor	105	0.25	0.43	0	1
High education	105	0.31	0.47	0	1
*High income**	94	0.44	0.5	0	1
Farm workers	99	2.03	1.39	1	5
Small farm	105	0.69	0.47	0	1
Large farm	105	0.1	0.29	0	1
Perennial crop	105	0.13	0.34	0	1
Family farm	105	0.31	0.47	0	1

*Howley (2015) used farming income while this study collected total household income.

Table A.2: Principal-Component Factors Method

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	**6.559**	2.999	0.298	0.298
Factor2	**3.561**	1.393	0.162	0.460
Factor3	**2.167**	0.431	0.099	0.559
Factor4	**1.737**	0.588	0.079	0.638
Factor5	**1.149**	0.129	0.052	0.690
Factor6	**1.020**	0.264	0.046	0.736
Factor7	0.756	0.014	0.034	0.770
Factor8	0.742	0.071	0.034	0.804
Factor9	0.671	0.057	0.031	0.835
Factor10	0.614	0.100	0.028	0.863
Factor11	0.514	0.060	0.023	0.886
Factor12	0.454	0.050	0.021	0.907
Factor13	0.403	0.085	0.018	0.925
Factor14	0.318	0.054	0.015	0.939
Factor15	0.264	0.030	0.012	0.951
Factor16	0.233	0.002	0.011	0.962
Factor17	0.231	0.060	0.011	0.973
Factor18	0.171	0.020	0.008	0.980
Factor19	0.151	0.049	0.007	0.987
Factor20	0.102	0.011	0.005	0.992
Factor21	0.091	0.001	0.004	0.996
Factor22	0.090	.	0.004	1.000

Note: N =100, Retained factors=6, and LR independent vs saturated = 1407.83 (P>chi2=0.000)