

EVALUATING ALTERNATIVE LOW-WATER-USE CROPS FOR THE GREAT BASIN

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Preface

In the western United States, hydrological cycles have changed considerably in the last 50 years. This is largely due to anthropogenic intervention (i.e. human involvement) and research predicts water supplies will reach a crisis stage (Barnett et al., 2008). As populations in western states increase, urban and commercial water demand increases competition for available supplies for agricultural uses (Diaz and Anderson, 1995). Water is an increasingly scarce commodity in the West, and as more water is diverted from agricultural use to residential and industrial purposes, producers in the Great Basin are facing the challenge of sustaining the economic viability of their enterprises with less water.

Policies have been used in arid climates in the West to enforce water conservation on agricultural producers utilizing irrigation, such as the Groundwater Management Act of 1980 in Arizona. These policies are not always effective (Wilson and Needham, 2006). Changes in water management are an alternative to imposing policies such as laws and taxes. Managers have investigated several options: recycling, desalinization, underground storage, conservation and water marketing, among others (Hanak, 2007).



Practices imposed by policies and water managers are one side of the coin. Equally, and possibly more important, are practices adopted by producers themselves. These practices consist of reducing the amount of water applied (deficit irrigation), changing the way water is delivered or switching to an alternative crop that uses less water. Producers may reduce the amount of irrigation water they consume by planting alternative crops. Alternative low-water-use crops may be an option for producers to remain solvent in regions where water is scarce and agriculture is under social pressure to reduce use (Gaur et al., 2008). The Great Basin can sustain economic viability through increased knowledge of alternative, low-water-use crops and the associated decision-making tools of efficient water-recourse use within agricultural communities.

This Western Region Sustainable Agriculture Research and Education (WSARE) professional development curriculum addresses the needs of agriculture producers regarding the following: 1) the economic, political and environmental benefits of reducing water use in agriculture; 2) the basic agronomics of alternative crops available to producers in the Great Basin; and 3) the components of evaluating the economic feasibility of low water use crops.

This curriculum features five separate modules, each of which includes a rationale, set of objectives and central topic. The worksheets and activities will assist participants in learning the material provided in each module. We hope that this curriculum may inspire readers to continue their education and implementation of low-water-use alternative crops in the Great Basin.

Module 1

INTRODUCTION AND WATER ISSUES



RATIONALE

For all residents of the arid West, including those in the Great Basin, water is becoming an increasingly scarce resource. The surface water in the Great Basin is over-allocated. Since there is more competition for the available water, agricultural producers may not receive the water they need to continue their present operations. This module provides an overview of the rationale for moving to alternative, water-reducing crops as a strategy for maintaining an economically viable agricultural industry.



OBJECTIVES

This module will enable participants to:

1. Understand the need to reduce water use and the potential benefits of alternative crops.
2. Compare their perceptions with the responses of some Great Basin water rights owners.
3. Increase awareness of issues surrounding water law across Great Basin states.
4. Estimate the amount of surface water available for the following year on a given parcel.



Why should alternative crops be considered?

In the western United States, hydrological cycles have changed considerably in the last 50 years due in a large part to human intervention and research predicts water supplies will eventually reach a crisis stage (Barnett et al., 2008). As populations in western states increase, civil supply, recreation, hydropower generation and other in-stream uses all increase competition for available water supplies away from agricultural uses (Diaz and Anderson, 1995). Water is an increasingly scarce commodity in the West and as more water is diverted from agricultural use to residential and industrial purposes, producers in all areas are faced with the challenge of reduced availability.

Over-allocation of surface water rights adds to the problem. Snowpack is the main source of water for rivers in the Great Basin. Even in a year where the snowpack level is at 100 percent, watermasters in the Walker River Basin are only able to meet 84 percent of agricultural water allocations (Yardas, 2007). Even in years with adequate or above average stream flows at the headwaters, downstream users are faced with chronic low supplies (Gaur, 2008).



How can I retain my agricultural lifestyle and still make money?

This question may be asked of Extension educators and other agricultural governmental personnel by producers who find themselves impacted by changing resources. Planting alternative crops that require fewer acre feet of water than traditional crops is an opportunity for producers to reduce irrigation water use, as well as remain economically solvent in regions where water is scarce.

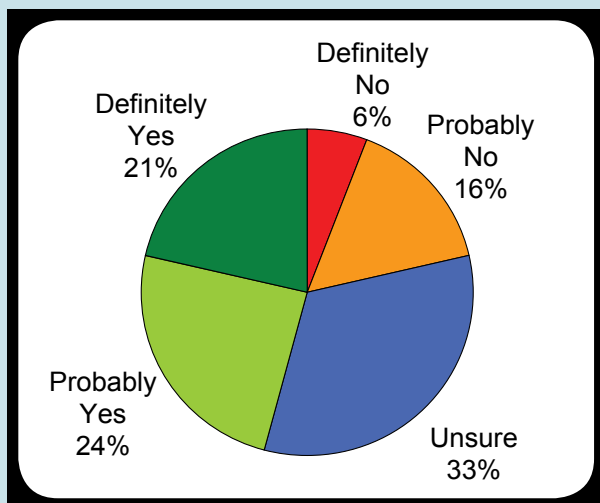


Figure 1: Willingness to Implement Water Conserving Crops on Existing Land

Agricultural producers have shown a willingness to implement water-conserving crops. In a survey of the Walker River Basin conducted in 2007 by researchers at the University of Nevada, Reno, landowners and producers in the Walker River basin were asked about their willingness to plant water conserving crops on their land. Overall, 45 percent of respondents indicated that they would consider making such a change, 33 percent were unsure and 22 percent would most likely not be willing to change to low-water use crops (See Figure 1).

This information was then broken down by the length of time respondents had been in agriculture. Respondents involved in agriculture for less than 35 years more frequently indicated that they were unsure about implementing low-water crops (by a margin of six percentage points) and less frequently responded that they were definitely willing to do so (also by a margin of six percentage points).

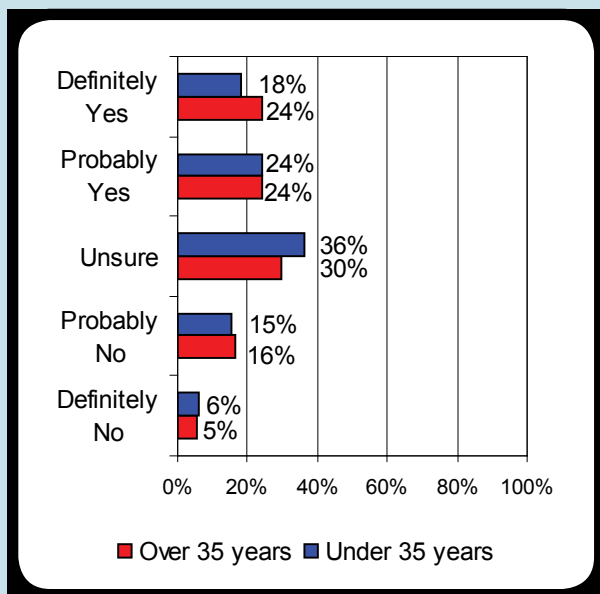


Figure 2: Willingness to Implement Water Conserving Crops by Years in Agriculture

The Walker River Basin example shows the largest percentages of any category are those producers unsure of their willingness to plant alternative water-conserving crops. By providing information, this curriculum will assist those who may be called upon by their constituents to answer the concerns of their producers and provide them with viable alternatives.

Are there potential issues with reducing water use?

Although agricultural producers in the Great Basin may be willing to adopt alternative production practices and crop mixes that conserve water, current water law across the Great Basin states may reduce producer incentives to do so.

Nevada Example

The first principle of Nevada water law is **prior appropriation**.

Prior appropriation was developed in the western United States due to water scarcity in the mining camps. The foundation of prior appropriation is seniority, “first in time, first in right.” The first user is guaranteed supply (subject to flow and water availability), the next senior has the second priority, and so on down the line, as long as the water still flows. Using a metaphor of the family and gallons of ice cream, the oldest child would be entitled to his or her full gallon allotment of ice cream because he was there first, then the next oldest child, etc. If the ice cream runs out before it gets to the youngest child, he or she doesn’t get any ice cream.

Only utilitarian extractive uses such as mining, farming, ranching, municipal, industrial and domestic uses that physically take water out of the river are eligible. Once the water is diverted, a water user automatically acquires a vested property right protected by the state constitution (Wilkenson, 1997). This vested right means the recipient is legally entitled to the water (benefit) and may seek relief in the courts if the benefit is not given.

Under Nevada water law, water may be appropriated for beneficial uses. A beneficial use is the right to utilize water and the benefits that the water provides without having the legal title of ownership. The Nevada public holds the title for Nevada water. However, the appropriation of water under beneficial use creates a **water right** for the user of Nevada water. The central idea of beneficial use is grounded in the term water right. A water right not only states a beneficial use of how the water is to be used, but also states where the water is to be used, the point of the diversion for the water and who is using the water. Agriculture, mining and timber were the most



prevalent beneficial uses for a water right from the 1800s through the mid 1900s (Singletary, 2005). Today, beneficial use establishes a process by which water-right holders retain their water rights by demonstrating how their water is currently being used.

Nevada water law is set forth in Nevada Revised Statutes Chapters 532 through 538. The state engineer and the Nevada Division of Water Resources are responsible for the administration and enforcement of Nevada water law (NDWR a., 2008). The 1939 Nevada Underground Water Act gave the Nevada Division of Water Resources under the state engineer authority and jurisdiction over groundwater in the state. Surface water authority and jurisdiction is a multifaceted web of local, state and federal laws and court decrees.

It is important to note a water right becomes both real and personal property once it is granted. This results in the ability of a water right to be conveyed or transferred. However, water rights are appurtenant, or attached, to the land and are usually conveyed by deed with the land. The one exception is if the seller specifically reserves the water right in the deed and has submitted a Report of Conveyance with the state engineer and Nevada Division of Water Resources. It is also possible to buy and sell water rights including changing the water right's point of diversion, manner of use and place of use by filing the appropriate paperwork with the state engineer and Nevada Division of Water Resources, which can also include federal decrees and the courts that govern the decree (NDWR b., 2008).

Current Water Law in Great Basin States

Nevada

Current water law in Nevada contains a 'use it or lose it' policy for groundwater rights. Groundwater rights, once granted by the state engineer, are subject to abandonment and forfeiture as described in NRS 534.090. For groundwater rights, the forfeiture time is five years of non-use. Surface water rights are subject to abandonment but only after a period of 10 years of non-use. As described in NRS 533.060, the right to use surface water has not been abandoned if, within the 10 years preceding the forfeiture claim, the owner of the right can show receipts or other documentation that

any of the following occurred: *“(a) The delivery of water; (b) The payment of any costs of maintenance and other operational costs incurred in delivering the water; (c) The payment of any costs for capital improvements, including works of diversion and irrigation; or (d) The actual performance of maintenance related to the delivery of the water.”* Returning to the previous metaphor, if any child does not eat the whole amount of ice cream he or she is entitled to at least once in ten years, pay for the milkman to deliver the ice cream or buy a new bowl or spoon with which to eat the ice cream, they lose the right to have that amount forever and only retain rights to the smallest amount they eat.

Utah

The ‘use it or lose it’ law also applies in Utah. Utah Code Section 73-1-4 states: *“When an appropriator or the appropriator’s successor in interest abandons or ceases to use all or a portion of a water right for a period of seven years, the water right or the unused portion of that water right is subject to forfeiture in accordance with Subsection (2)(c). . .”*. As long as the child eats the full gallon of ice cream at least once every seven years, they retain the right to the full gallon.



Idaho

Idaho water law Title 42-104 states: *“The appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such purpose, the right ceases.”* The child must eat all the ice cream himself or assign someone else to eat it. He or she cannot kick it out into the yard and let it melt into the ground.



Oregon

According to information provided by the Oregon Water Resources Department: *“Except for municipal rights and in certain other cases, if any portion of a water right is not used for five or more consecutive years that portion of the right is presumed to have been forfeited and is subject to cancellation. For example, if your water right is for irrigation of 40 acres and you irrigate only 20, the portion of land not irrigated for five consecutive years is subject to cancellation. However, diverting less than the full amount of water allowed under your right to irrigate the full 40 acres will not result in forfeiture, if you are ready, willing and able to use the full amount. If you have reduced the capacity of your water delivery system, you may lose any water not used beyond the capacity of your system.”* As long as the child is capable of eating the full gallon of ice cream and has not had lap-band surgery, become lactose intolerant or otherwise impaired his or her ability to do so, he or she retains the rights to the full gallon.

If I could lose my water rights, why would I consider alternative crops?

As water rights are possibly the most valuable asset owned by a producer in the Great Basin region, it is important that Extension agents and other consultants know why alternative crops are prudent. Although most water legislation in western states has not historically promoted using less water than was appropriated, this is changing due to conservation efforts. Each state in the Great Basin region has compiled differing strategies to reduce agricultural water use without penalizing those producers attempting to conserve.

Additionally, an important reason to consider alternative crops is the drought conditions that are prevalent in many of the states in the western U.S. It may be essential to the economic stability of producers to have an alternative source of income in case of contingencies.

The National Weather Service predicts the drought outlook for three months in advance; that information is available at http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html.



Water Conservation Strategies for Great Basin States

Nevada

According to the 1999 Nevada State Water Plan: “Water users have expressed a desire to obtain credit for water they save through conservation. With this credit, the water user could be allowed to use the saved water on additional lands or for additional homes, lease or sell the saved water, or dedicate the saved water to instream flows. The state engineer has explained that this option is already available under existing water law. In fact, the state engineer has approved applications allowing the use of existing water rights for expanded uses, as long as the expanded uses do not increase the total consumptive use, does not impact other water right holders, are not located in a fully-appropriated basin, and actual water savings can be demonstrated over time. Data shows that few water users have taken advantage of this option or even know it exists.”

Utah

Bill HBo051 was brought before the General Session of the Utah State Legislature in 2008. This bill changed the non-use period of a water right from five to seven years and protected a water right from forfeiture if the land where the water is used is under a fallowing program. This bill is now part of Utah Code Section 73-1-4.

Idaho

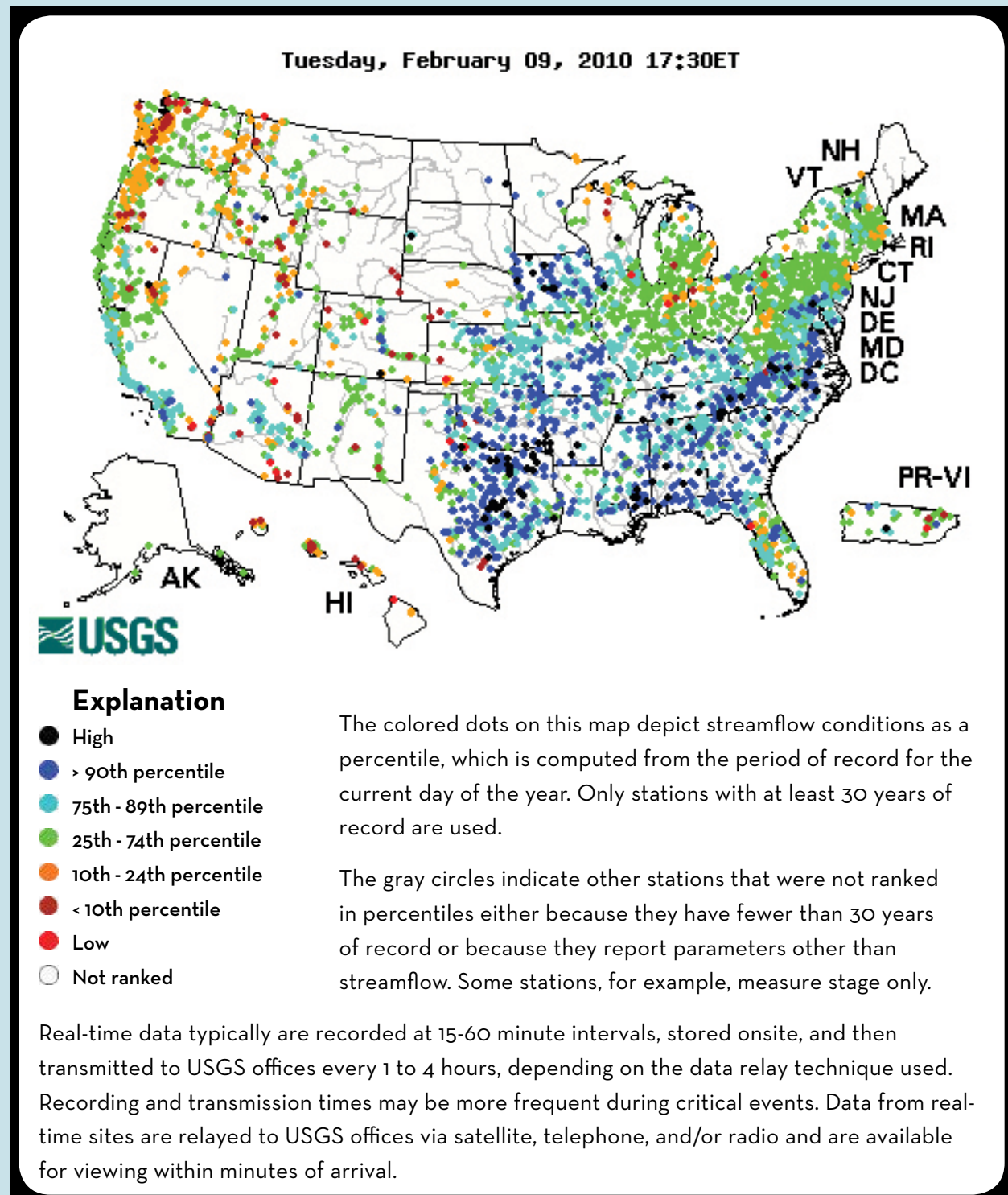
Idaho law allows for leasing of rights under Title 42-108B, which allows a producer to implement a low-water use crop and lease the unused portion of allocated water without forfeiting the right to its use.

Oregon

Oregon is the least restrictive with regard to forfeiture and water use. As stated in the previous section, you need not use the full amount of your allocation. The law only requires that you be “ready, willing and able” to utilize the entirety of your water rights.

How much surface water may be available this year?

Information about how much current discharge as measured in cubic feet per second is occurring at the closest gauging station is available online at <http://waterdata.usgs.gov/usa/nwis/rt>.



Snowpack is the main source of water for rivers in the Great Basin. The Natural Resource Conservation Service offers information regarding current snowpack levels as compared with last year and as a percentage of average on a basin-by-basin report at the following web site: ftp://ftp.wcc.nrcs.usda.gov/data/snow/basin_reports/.

BASIN - DATA CURRENT AS OF: 1/31/10 18:00		
BASIN - WIDE SNOWPACK SUMARY		
JANUARY 2010		
Basin Snow Course	Percent of Last Year	Percent of Average
Walker River Basin		
Basin Totals	103%	77%
Number Courses	5	5
	(LSWE = 35.0)	(SWE = 35.0)
	(LAST = 34.1)	(AVG = 45.7)

This information can be used by educators to provide estimates for their constituents of how much water will be available for the coming growing season to assist with decisions regarding crop choices.



WORKSHEET #1
WATER WORKSHEET

The first four questions should be answered by the producer:

How much water is allocated to the land parcel? _____ac/ft

What type of water right(s) is (are) allocated to this parcel?

Surface_____ Ground_____Storage_____

Does this parcel receive its full allocation:

In years with optimum water availability? Yes No

In years with drought conditions? Yes No

What are the restrictions, if any, associated with use?

What is the current flow rate and gage height (in feet) at the nearest gauging station? _____

This information can be found by accessing <http://waterdata.usgs.gov/usa/nwis/rt>.

What is the current amount of snowpack and what percent of average is it at?

_____ % of last year

_____ % of average

This information can be found by accessing ftp://ftp.wcc.nrcs.usda.gov/data/snow/basin_reports/.

EXAMPLE FOR WORKSHEET #1
NEVADA AG EXPERIMENT STATION

The first four questions should be answered by the producer:

How much water is allocated to the land parcel? 4 ac/ft

What type of water right(s) is (are) allocated to this parcel?

Surface 4 Ground _____ Storage _____

Does this parcel receive its full allocation:

In years with optimum water availability? ☒ Yes ☐ No

In years with drought conditions? Yes ☒ No

What are the restrictions, if any, associated with use?

02/11/2010 13:15 PST | 3.59 | 170

What is the current flow rate and gage height (in feet) at the nearest gauging station? USGS 10348000 TRUCKEE RV AT RENO, NV

This information can be found by accessing <http://waterdata.usgs.gov/usa/nwis/rt>.

What is the current amount of snowpack and what percent of average is it at?

167 % of last year

99 % of average

This information can be found by accessing ftp://ftp.wcc.nrcs.usda.gov/data/snow/basin_reports/.

Module 2

AGRONOMICS OF ALTERNATIVE CROPS



RATIONALE

To determine which alternative crop or crops are best suited to a particular producer, it is necessary to determine the soil and climatic conditions under which it/they will be grown. This will influence the amount of probable yield, which impacts the possible economic returns. This lesson explains what factors are important and how to acquire the pertinent data.



OBJECTIVES

This module will enable participants to:

1. Utilize the Natural Resource Conservation Service's Web Soil Survey to find and identify the prevalent soil on a farm or ranch.
2. Enhance knowledge about soil types found in the Great Basin.
3. Increase awareness of issues associated with typical desert soils.
4. Understand the values displayed in a soil analysis lab report and understand how to apply the information contained in the report to modify and improve soils.
5. Locate and use online data regarding climate for a particular location.



What alternative crops will grow in this region?

The first step in determining what crops may succeed in a region is to become familiar with the dominant soil types. The dominant soil on any given acreage can be found by utilizing a tool provided by the U.S. Department of Agriculture on the Natural Resource Conservation Service's website. The Web Soil Survey or WSS provides a tool for general farm planning (Soil, 2009), and is located at <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>. After water rights, the land itself is likely the most valuable agricultural asset owned by producers. As an online source of extensive information that can be accessed at any time, the WSS should be of great interest and usefulness to them.

There are three basic steps to using WSS:

1. Defining an area of interest



2. Accessing soil data



3. Printing or downloading a report (free at time of publication)



The main parameter shown on the soil survey report is the Official Soil Series Description name or names and the extent to which it occurs in the area of interest. By utilizing the Soil Data Explorer tab on the website, extensive information about all soils that occur in the area of interest can be found, including suitability for differing crops or uses, estimated yield for each crop on each type of soil and numerous physical parameters including usual pH levels and percentage of sand content. Fine soils derived from lacustrine (found in or near lakes) sediment are common in the Great Basin and can be saline and alkaline.



WORKSHEET #2

SOIL WORKSHEET

Use the Web Soil Survey to find the answers to the first three questions, define an area of interest, then access the corresponding data under the 'soil map' tab on the web site.

What is the dominant soil in the production area?

What percentage of the total is the dominant soil?
_____ %

What other soils are in the area of interest?

_____ at _____ % of total

_____ at _____ % of total

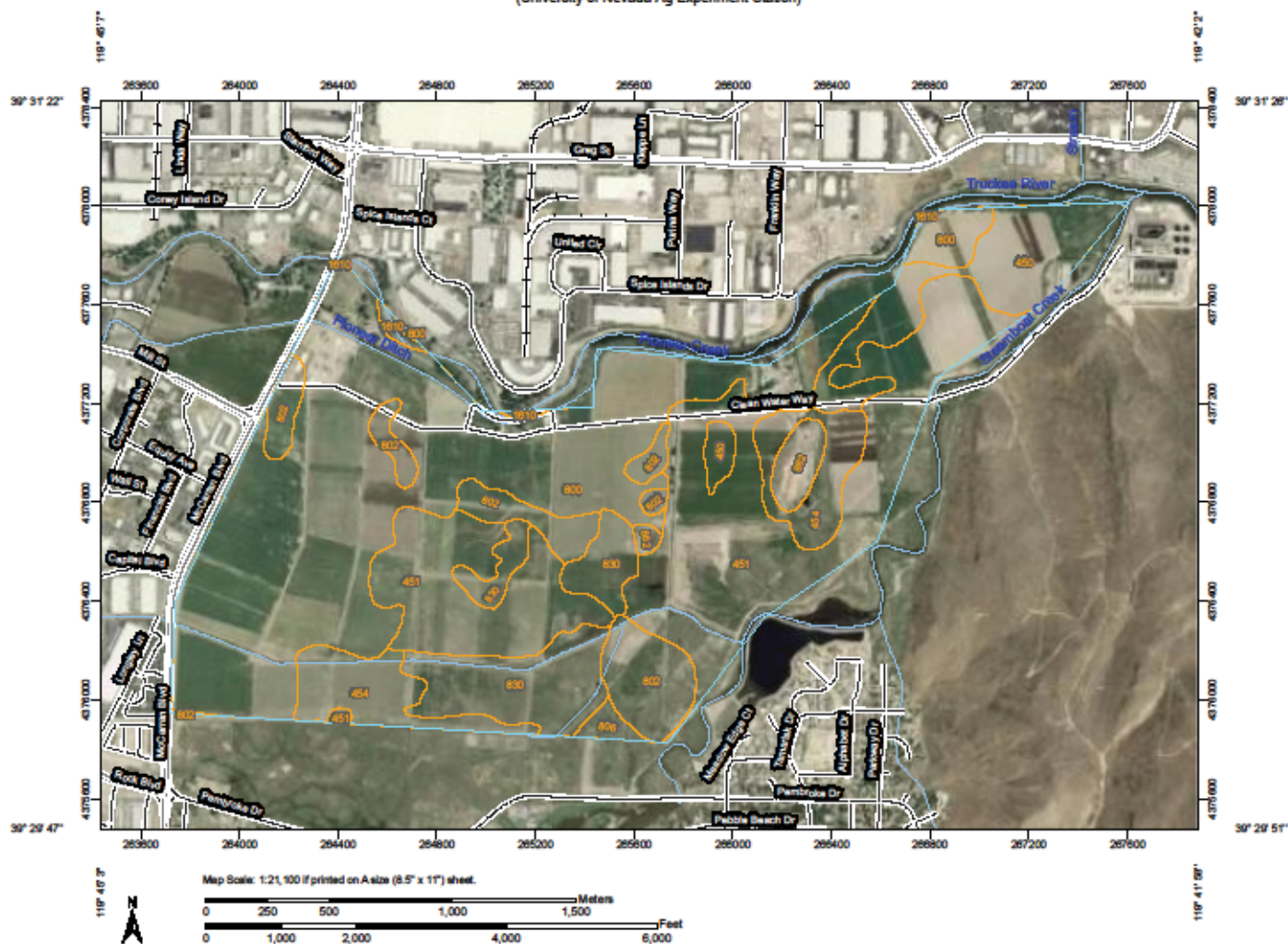
What is the usual pH of the dominant soil? _____

This can be found on the soil data explorer under 'chemistry' or on NCRS soil official series descriptions.

This means this soil is _____ times more alkaline/acidic than normal.

Since the pH scale is logarithmic, this calculation can be done by calculating the difference between the pH result and a neutral pH of 7, then using that number as a power of 10 to determine the degree of diversion from neutral.

Soil Map—Washoe County, Nevada, South Part
(University of Nevada Ag Experiment Station)



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

2/11/2010
Page 1 of 3

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
450	Voltaire loam	78.1	7.40%
451	Voltaire loam, slightly saline	288	27.50%
454	Voltaire silty clay, drained	71.4	6.80%
800	Truckee silt loam	418	39.90%
802	Truckee silt loam, strongly saline	77.8	7.40%
806	Truckee sandy loam, sandy substratum, strongly saline	6	0.60%
830	Fettic silty clay loam	87.7	8.40%
862	Reywat, very cobbly sandy loam, 8 to 15 % slopes	16.4	1.60%
1610	Water	4.7	0.40%
Totals for Area of Interest		1,048.10	100.00%

LOCATION TRUCKEE

NV+CA

Established Series

Rev. WED

12/1999

TRUCKEE SERIES

The Truckee series consist of very deep, poorly drained soils that formed in mixed alluvium. Truckee soils are on flood plains and stream terraces. Slopes are 0 to 2 percent. The mean annual precipitation is about 8 inches, and the mean annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Fluvaquentic Haploxerolls

TYPICAL PEDON: Truckee silt loam - irrigated cropland. (Colors are for dry soil unless otherwise noted)

0i--3 inches to 0; dark grayish brown (10YR 4/2) sod, dark brown (10YR 3/3) moist; violently effervescent; abrupt slightly wavy boundary. (0 to 4 inches thick)

A1--0 to 3 inches; gray (10YR 5/1) loam, black (10YR 2/1) moist; massive; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; violently effervescent; moderately alkaline (pH 8.3); clear smooth boundary. (2 to 8 inches thick)

A2--3 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; violently effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary. (6 to 12 inches thick)

C1--12 to 15 inches; light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and plastic; many very fine roots; many fine tubular pores; violently effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary. (2 to 8 inches thick)

EXAMPLE FOR WORKSHEET #2

The answers to the first three questions are available by using Web Soil Survey to define an area of interest, then access the corresponding data under the 'soil map' tab on the web site.

What is the dominant soil in the production area?

Truckee silt loam

What percentage of the total is the dominant soil?

39.9 %

What other soils are in the area of interest?

Voltaire loam at 27.5 % of total

at % of total

What is the usual pH of the dominant soil? 8.4

This can be found on the soil data explorer under 'chemistry' or on NCRS soil official series descriptions.

This means this soil is 25 times more alkaline/acidic than normal.

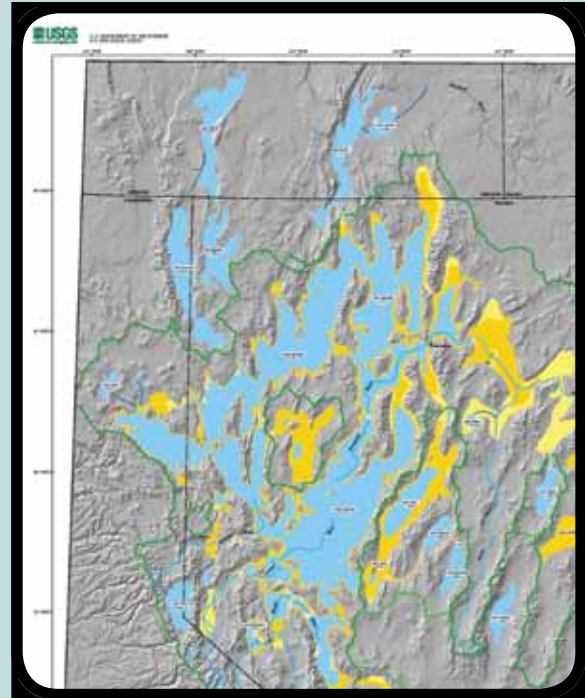
Since the pH scale is logarithmic, this calculation can be done by calculating the difference between the pH result and a neutral pH of 7, then using that number as a power of 10 to determine the degree of diversion from neutral.

$$8.4 - 7 = 1.4$$

$$10^{1.4} = 25$$

How can there be lacustrine soils in the desert?

A large portion of the agricultural land in the Great Basin was once underwater. During periods of the late Pleistocene (1.6 million to 10,000 years ago) when the climate was cooler and/or wetter than today, pluvial lakes, or lakes caused by large amounts of rainfall, occupied most of the topographically closed valleys of the Great Basin. The two largest of these, Lake Bonneville and Lake Lahontan, formed on opposite sides of the Great Basin. These two lakes incorporated multiple valleys and covered areas greater than 19,923 and 8,417 square miles, respectively (Mifflin and Wheat, 1979 in Caskey and Ramelli, 2004).

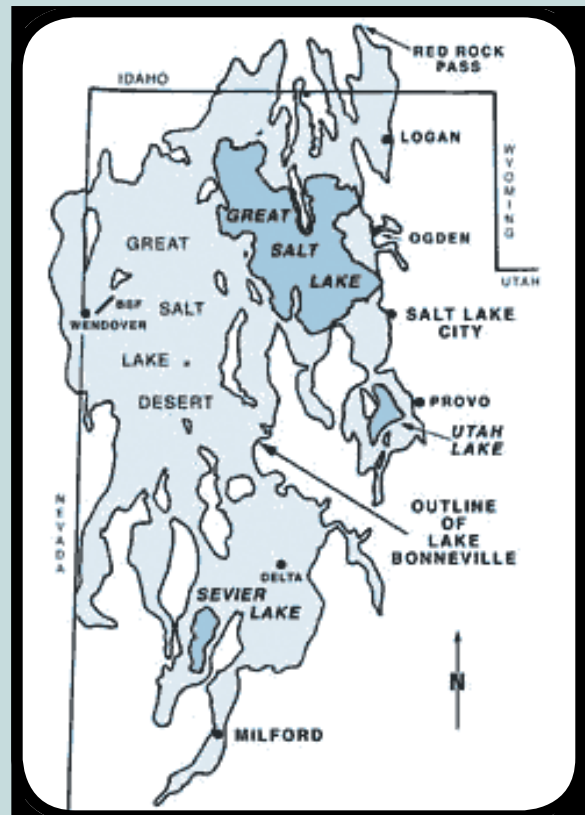


Extent Of Pleistocene Lakes In
The Western Great Basin
Marith Reheis

What issues arise from saline and alkaline soils?

Most plants have a limited tolerance for salty soils and there are no supplements that can be added to the soil that will counteract the effects. Even for species that tolerate some degree of salinity, yields may be reduced as salinity increases.

The level of acidity or alkalinity in soils is measured by pH on a scale of zero to 14, with seven indicating a neutral soil, measurements above seven indicating alkaline soil and measurements below seven indicating acidic soil. Seven, or neutral, is the preferred pH for most plants. Alkaline soils reduce available nutrients, especially micronutrients needed for plant germination and growth. The alkalinity of soil can be brought closer to neutral by addition of organic material such as peat or sphagnum peat moss or by adding elemental sulfur, but these are costly and time-consuming processes. It is usually preferable to grow crops that tolerate slightly alkaline conditions. There are several crops that fit this requirement.



Historic Extent Of Lake
Bonneville In Eastern
Great Basin

How can the salinity and pH of soil be determined?


For data on a finer scale than that offered by the WSS, there are two alternatives. Testing soil to determine the pH level is relatively easy, with kits being available at most home and garden centers. The preferred alternative is to take soil samples from several sections of the land and have them analyzed by a laboratory. This can be done using a soil probe or a simple shovel. Laboratory analysis has several advantages to the do-it-yourself kit. The laboratory tests for several components of the soil and displays the results on an easy-to-read graph that classifies levels as very low, low, medium, high, or very high in addition to reporting results in parts per million (ppm). The lab is able to make recommendations as to the type and amount of amenities that should be added based on the crops desired to be grown and the tonnage goals (if appropriate).

What components of the soil are detailed in a typical lab report?

The soil is analyzed for percentage of organic matter, salinity as dS/m (decisiemens per meter) or mmhos/cm (dS/m = mmhos/cm), pH level, and ppm of nitrogen, two forms of phosphorus, potassium, magnesium, calcium, sodium, sulfur, zinc, manganese, iron, copper, boron and chloride. Additionally, if the laboratory is advised about the potential crop, it can make specific recommendations regarding the amounts of nutrients as pounds per acre that should be added to the soil for maximum growth.



A & L WESTERN AGRICULTURAL LABORATORIES
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REPORT NUMBER: 08-310-040

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 FALLON, NV 89406-8951

CLIENT NO: 3436-D

 SUBMITTED BY: DAVISON

 GROWER: DAVISON

DATE OF REPORT: 11/13/08

SOIL ANALYSIS REPORT

PAGE: 1

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation	PERCENT CATION SATURATION (COMPUTED)				
		% Rating	ENR lbs/A	P1 (Weak Bray)	NaHCO ₃ -P (Olsen Method)	K ppm	Mg ppm	Ca ppm	Na ppm	Soil pH	Buffer Index	H meq/100g	Exchange Capacity C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
				ppm	ppm	ppm	ppm	ppm	ppm									
1	50446	3.4M	98	31 *	40VH	604H	729M	3843M	819VH	8.0		0.0	30.3	5.1	19.8	63.3	0.0	11.8
2	50447	3.3M	96	34 *	28VH	554H	566H	2730M	515VH	7.6		0.0	21.9	6.5	21.2	62.1	0.0	10.2
3	50448	2.6M	81	20 *	17H	680M	570M	3228L	2884VH	8.3		0.0	35.1	5.0	13.4	45.9	0.0	35.8
4	50449	1.7L	64	14L	6L	406H	286M	1749M	189H	7.4		0.0	12.9	8.0	18.2	67.4	0.0	6.3
5	50450	1.7L	64	20M	12M	334H	248H	1209M	48L	7.2		0.0	9.1	9.3	22.4	66.0	0.0	2.3

* Weak Bray unreliable at M or H excess lime or pH > 7.5

SAMPLE NUMBER	Nitrogen	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Excess	Soluble	Chloride	PARTICLE SIZE ANALYSIS			
	NO ₃ -N	SO ₄ -S	Zn	Mn	Fe	Cu	B	Lime	Salts	Cl	SAND	SILT	CLAY	SOIL TEXTURE
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Rating	mbars/cm	ppm	%	%	%	
1	7L	167VH	0.9L	7M	7L	3.1VH	4.6VH	H	1.4M					
2	9L	83VH	0.8L	7M	20H	4.0VH	2.8VH	H	1.0M					
3	14M	1147VH	0.3VL	5M	6L	3.1VH	11.1VH	H	6.4VH					
4	20M	76VH	0.3VL	13H	5VL	0.9M	2.0H	L	0.6L					
5	13M	12M	0.3VL	12M	6L	0.7L	1.4H	L	0.6L					

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).

** ENR - ESTIMATED NITROGEN RELEASE

*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM

**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P₂O₅

***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K₂O

MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-20 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

MB *Buttress*
 Mike Buttress, CPAg
 A & L WESTERN LABORATORIES, INC.

We do not advocate the use of this particular lab- this is just given as an example.

How should soil samples be collected, where can they be sent, and how much does it cost?

The most efficient way to collect soil samples is with a hollow tube soil probe (Kotuby-Amacher and Koenig, 1999). These are available at low cost online or by loan from some Cooperative Extension offices. Soil probes may give a more precise reading than using a shovel because of the composite material of the probe. Soil probes are either made from chrome-plated molybdenum or stainless steel, or are nickel plated, unlike shovels which are usually made of iron that can interfere with laboratory results. The first step for most producers will be to contact their local Extension Educator. The Extension Educator should be able to provide a list of soil testing laboratories and help describe the process.

Nevada

Cooperative Extension Master Gardener volunteers in some areas of Nevada conduct tests for a limited amount of parameters. For more extensive soil testing, producers should be referred to a list of private soil labs or out-of-state university labs, as there are no public soil labs in Nevada. Costs vary among labs. A 2006 study in Pershing County used GPS technology to analyze 15 soil samples in a two-acre grid, which resulted in costs of \$35 per acre (Breazeale, 2007).

Utah

In Utah, County Extension Agents and the Utah State University Analytical Laboratory have soil sample kits available, which include instructions on how to collect soil samples, a site information form used by the lab to interpret soil test results and a box for mailing samples to the lab. Utah State University County Extension Agents also have soil probes available for loan. The Utah State University Analytical Laboratory offers either routine or more complete tests with costs depending on individual requirements. A price list is available at <http://www.usual.usu.edu/>.

Oregon/Idaho

Oregon State University Extension has compiled a list of analytical laboratories that serve Oregon and the surrounding areas (including Idaho) that was updated in May of 2008, along with some 'buyer



beware' information regarding laboratories. This fact sheet is online at <http://extension.oregonstate.edu/catalog/html/em/em8677/>. Oregon State University has its own analytical laboratory. Further information is available at <http://cropandsoil.oregonstate.edu/cal>. Idaho has no state-run testing service, but Cooperative Extension personnel should be able to assist producers in locating a lab.

What climate information is needed to assess the viability of an alternative crop in an area?

A short list of some of the necessary information along with the rationale is provided below.

- Temperature – average minimum and maximum during the proposed planting periods to be compared with the tolerance of the proposed crop
- Precipitation – when and how much to determine needed irrigation amounts
- Snowfall – amount and timing
- Snow depth – as stated in the prior module, most surface water in the Great Basin is dependent on snowmelt so the amount and timing of snowfall along with snow depth will influence the amount of surface water available for irrigation
- Growing degree days (40° & 50°) – relationship between air temperature and plant growth measured in heat units
- Spring freeze probabilities – restricts earliest planting date
- Fall freeze probabilities – restricts latest harvest date
- Freeze free probabilities – average 'window' of time during which growing may be possible
- Precipitation duration probabilities
- Precipitation quantity probabilities – both duration and quantity may adversely affect certain crops during a particular growth stage
- Wind – some crops are adversely affected by intense or prolonged wind events

Where can this information be obtained?

This information is available online from the Western Regional Climate Center operated by the Desert Research Institute. It covers all western states and has a listing of more than 2,800 weather stations at <http://www.wrcc.dri.edu/Climsum.html>.

For producers in Idaho, northern Nevada and Oregon, the U.S. Bureau of Reclamation operates an agricultural weather network website: AgriMet, available at <http://www.usbr.gov/pn/agrimet/>.

Location	GDD (50 degree base)	Frost Free Period (28.5 degrees)
Lovelock	2839	108-206
Fallon	2671	115-196
Yerington	2647	92-236
Smith Valley	2592	87-139
Orvada	2351	97-188

WORKSHEET #3

CLIMATE INFORMATION

The answers to these questions can be found by accessing the information available at the Western Regional Climate Center.

What weather station is located closest to the farm/ranch?

What are the average winter low and summer high temperatures?

_____ winter _____ summer

How much average precipitation is received?

_____ in/yr

How much average snowfall is received?

_____ in/yr

How many growing degree days? _____ days

How long and when is the typical frost-free period?

WORKSHEET #3

CLIMATE INFORMATION

The answers to these questions can be found by accessing the information available at the Western Regional Climate Center.

What weather station is located closest to the farm/ranch?

Sparks COOP ID 267967

What are the average winter low and summer high temperatures?

23.0F winter 91.5F summer

How much average precipitation is received?

7.6 in/yr

How much average snowfall is received?

5.9 in/yr

How many growing degree days? 5164 days from 1988-2009 for an average of

245.9 days/yr days

How long and when is the typical frost-free period?

For 32.5 degrees, the shortest period of frostfree days was 129 days, the longest was 167 days. This usually occurs between April 15th and October 15th

Has the crop under consideration been grown in this area before?

Increased knowledge reduces the amount of risk associated with any new venture. If someone else has attempted to grow a particular crop, knowledge can be gained from their experience. The crop under consideration may have been grown by other producers or as a field trial by Extension or other government personnel. The best source for determining if the alternative crop has previously been grown in the area is to search the Cooperative Extension online and/or consult with Extension personnel. Some of the pertinent websites are:

Nevada

<http://www.unce.unr.edu/publications>

Idaho

<http://www.extension.uidaho.edu/crops.asp>

Utah

<http://extension.usu.edu/htm/agriculture>

Oregon

<http://extension.oregonstate.edu/answer.php#ag>

Western States

Another source for listings of possible alternative crops by state is the USDA's plant database at http://plants.usda.gov/alt_crops.html

Module 3

MARKET OPPORTUNITIES FOR ALTERNATIVE CROPS



RATIONALE

One of the most important considerations with any product, especially an alternative crop or new venture, is whether there will be sufficient demand for that product to generate sales. This lesson explains how to determine the scope of the market for a product, the expected profitability of the product, and provides an overview of the logistics involved in bringing a product to market.



OBJECTIVES

This module will enable participants to:

1. Understand how to access USDA online data to evaluate the potential demand and target market.
2. Understand the various market opportunities and methods of product distribution.
3. Examine the factors that are important to appropriate product pricing.
4. Identify the characteristics used to estimate profit potential.



Introduction

In a recent publication of the Western Extension Marketing Committee (Lobo et al., 2008), the authors find that new or specialty crops with good, long-term profit potential often share a subset of the following characteristics:

- Adequate size of the target market
- Extended production and marketing season
- Complementary to the farm operation
- Difficult to grow (steep learning curve)
- Expensive to start producing (high initial capital investment)
- Potential for value-adding activities

In addition, producers must assess the quality and availability of information related to:

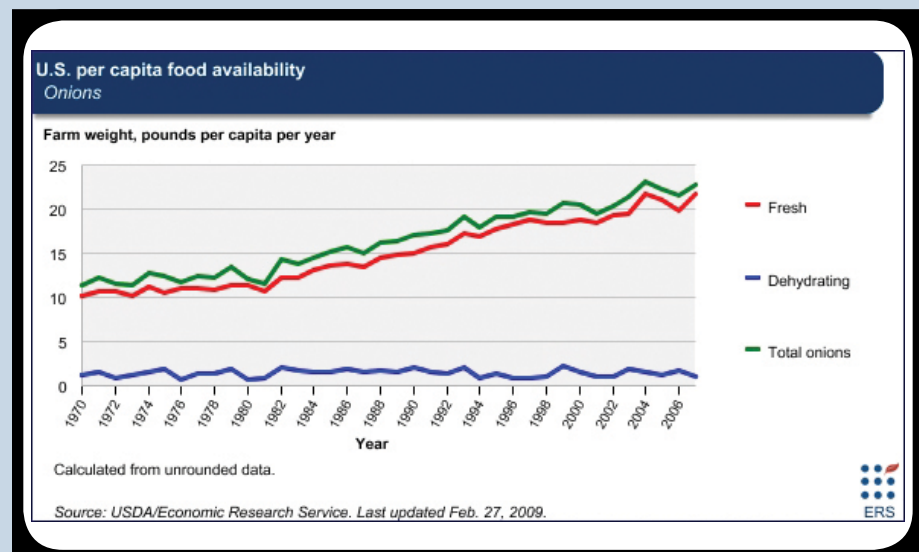
- Market data, research and analysis
- On-farm research and development
- Trends (demographic, economic, health, etc.)
- Crop adaptation to a specific location
- Pest and disease problems
- Supporting infrastructure and facilities
- Laws and regulations (i.e. permits and license requirements)

Although these factors are not equally important for every new or alternative crop, producers must address all of them to make a well-informed choice. Once the alternatives are specified, producers must assess the product potential given the available resources and the identified risk factors. A more extensive guide for product evaluation is contained in the publication “A Market-Driven Enterprise Screening Guide” referenced in Module 5.

Is there a demand for the crop? What is the target market?

The first step in assessing demand for a particular crop is to consider the potential customer base. It is important that producers look beyond their immediate buyer and consider the whole supply chain, with the final consumer being the ultimate source of the sale. Producers should consider the final consumer as the buyer, even if they don't deal with them directly because it's the consumer's acceptance of the product that will determine its success. Evaluating the size of the market will help assess if there is a need for additional product or new products. Utilizing information available from the U. S. Department of Agriculture's Economic Research Service (USDA-ERS), producers can find the average annual U.S. consumption levels of several hundred foods (Tronstad, 2008), available online at <http://www.ers.usda.gov/Data/FoodConsumption/>.

Accessing the data and using onions as an example, USDA- ERS data shows that onion consumption was approximately 23 pounds per capita per year in 2007.



Once the average consumption per person per year has been determined, an equation can be applied to calculate the minimum number of customers needed at a given production level to supply all potential customers with one week's supply at average fresh consumption levels (Tronstad, 2008):

$$\frac{(\text{Acres in operation}) * (\text{Output per acre})}{(\text{Average consumption per person/year}) / (52 \text{ weeks/year})} = \text{Market size required}$$

Average output per acre for specific soils and areas can be calculated using WATER-ACIS for alternative crops in Nevada as will be presented in the next module. However this information is available on state and sometimes county levels through the National Agricultural Statistics Service (NASS) at http://www.nass.usda.gov/QuickStats/indexbysubject.jsp?Pass_group=Crops+%26+Plants.

According to NASS data, 760 hundred-weight was the average yield per acre for onions for the state of Nevada. If 10 acres were available for planting onions, altering the equation to reflect one month's supply at average consumption levels, the equation would be:

$$\frac{(10) * (76000)}{(23) / (12)}$$

Market size required = = 39,652 consumers


It seems highly unfeasible that this producer, if located in a rural area, could reach this number of consumers in one month by farm stand or local sales venues. A larger market is needed.

Consumer demographics are a crucial component in determining market size and composition. Producers planning to sell items directly should consider how large a radius, in terms of travel distance, the operation can expect to draw customers from (Tronstad, 2008). The USDA Forest Service's National Survey on Recreation and the Environment found the average distance U.S.

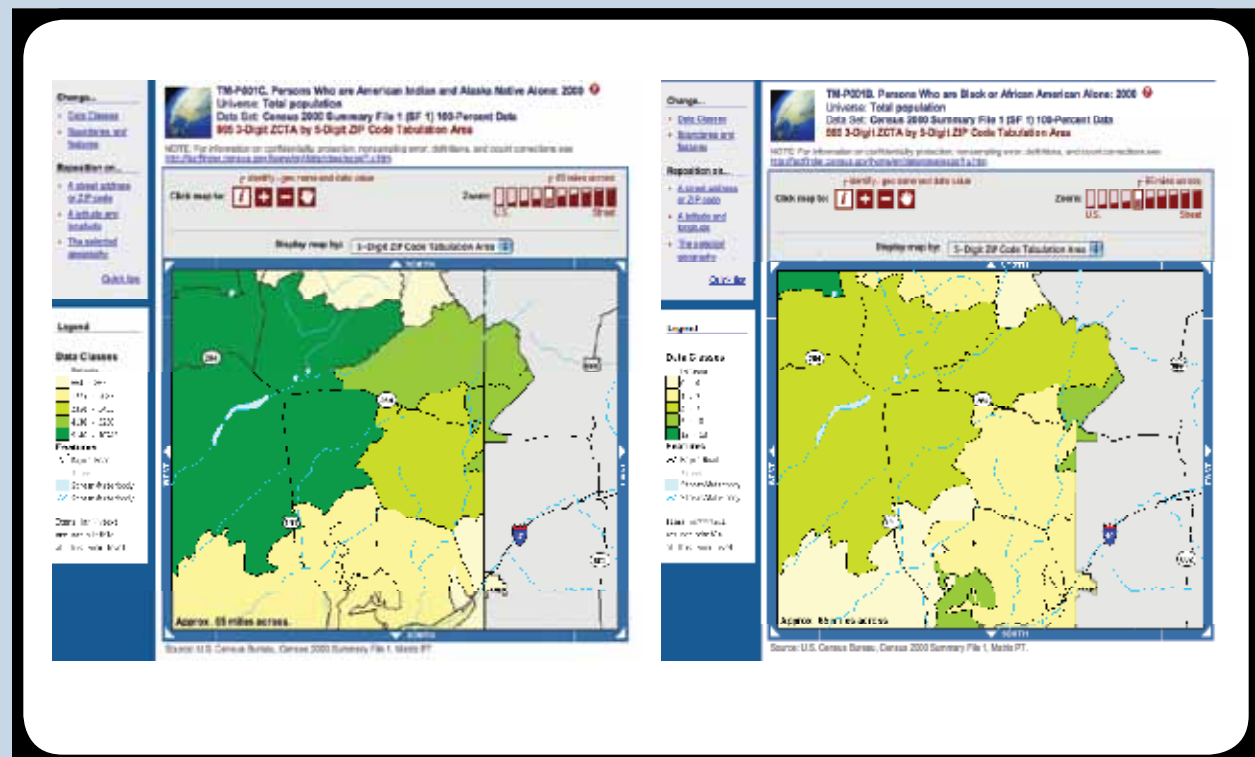


individuals drove to visit a farm in 2000 was 80 miles (USDA Forest Service, 2003). As this estimate also includes family members visiting their farms several hundred miles away, most consumers will be drawn within a 50-mile radius unless no other farm visit alternatives are available. However, in the West the majority of consumers travel over 75 miles to participate in agritourism events as closer alternatives do not exist in their metro area (Leones et al., 1994).

Knowing the demographic characteristics of the consumers in a potential target market is a key aspect in assessing the product attributes for the promotion, distribution and packaging needs of that market. For example, if a producer was operating a U-pick, he/she would likely wish to target families. In this case it would be helpful to know if there are enough families (total customers) in the area to ensure the financial feasibility of the U-pick operation. Demographics from the most recent U.S. Census can be searched online by state and by zip code. The information from a Census search provides an indication of the ages of people in the area, household and family size, income, ethnicity, and more, all of which can provide producers with additional information as to the characteristics of potential customers in the local and surrounding area.

FACT SHEET			
 United States 86505 Zip Code Tabulation Area 86505		city/ town, county, or zip 86505 state Arizona <input type="button" value="GO"/> search by address »	
Census 2000 Demographic Profile Highlights:		Reference Map	
General Characteristics - show more >>	Number	Percent	U.S.
Total population	9,508		map brief
Male	4,728	49.7	49.1% map brief
Female	4,780	50.3	50.9% map brief
Median age (years)	25.8	(X)	35.3 map brief
Under 5 years	871	9.2	6.8% map
18 years and over	5,731	60.3	74.3% map brief
65 years and over	794	8.4	12.4% map brief
One race	9,471	99.6	97.6%
White	284	3.0	75.1% map brief
Black or African American	4	0.0	12.3% map brief
American Indian and Alaska Native	9,146	96.2	0.9% map brief
Asian	4	0.0	3.6% map brief
Native Hawaiian and Other Pacific Islander	1	0.0	0.1% map brief
Some other race	32	0.3	5.5% map brief
Two or more races	37	0.4	2.4% map brief
Hispanic or Latino (of any race)	99	1.0	12.5% map brief
Household population	9,343	98.3	97.2% map brief
Group quarters population	165	1.7	2.8% map
Average household size	3.60	(X)	2.59 map brief
Average family size	4.30	(X)	3.14 map
Total housing units	4,162		map
Occupied housing units	2,598	62.4	91.0% map brief
Owner-occupied housing units	1,991	76.6	66.2% map brief
Renter-occupied housing units	607	23.4	33.8% map brief
Vacant housing units	1,564	37.6	9.0% map

The figure opposite shows an example using the “demographic profile” for zip code 86505 (Window Rock, Arizona). The total population is only 9,508, and 96.2% of the population is American Indian. Choosing the “map” link for race, yields a set of population density maps delineated by race and zip code, as shown in the figure below. Whether researching the market potential for an urban center or rural areas, these tools provide valuable baseline insights as to the market size and demographics of regional consumer bases. Census data can be found at <http://factfinder.census.gov/home/saff/main.html>.



How will the product reach the market?

For small scale producers located within driving distance of a metropolitan area, direct marketing/sales can be an optimal distribution method. For producers who are not located close to a large metropolitan area or for producers with larger production levels, direct sales alone are not a viable option for reaching the number of consumers required to break even or show a profit. For these producers it will be necessary to contract with a distributor and/or local grocery retailer.

Direct Marketing

Due to increasing consumer concerns regarding food safety, energy usage and costs, as well as environmental and rural land preservation, many consumers are now looking to buy locally. Consumer knowledge of the production location, and in some cases the actual producer of their food, provides an added benefit. Consumers are willing to pay more for locally produced foods and those foods grown using organic and natural methods. Hence, the benefit to the producer is the potential for increased revenues through enhanced pricing, as well as interaction and feedback from customers. Examples of direct marketing methods include:

- Farmers' markets
- Roadside stands/U-pick
- Community supported agriculture (CSA) programs
- Institutional, such as farm-to-school
- Restaurants



Although direct marketing has many potential advantages, there are several issues to consider. For example, selling at farmers' markets may entail travel expenses and time in route to markets in urban areas, delivery and booth equipment requirements, and interaction with the public. Participating in a CSA program may alleviate some of the disadvantages of farmers' markets, but they have their own

issues such as shareholder communication and administration requirements, lack of consumer knowledge regarding seasonality and weather impacts, as well as the need to provide a large variety of high quality products.

Traditional Markets

Traditional markets include using produce distributors, wholesalers, selling to local or national grocery retailers, and, finally, to breweries and wineries. The most efficient and cost-effective distribution methods depend largely on the crop under consideration and the quantity expected. For highly perishable crops, choosing a distributor/retailer based on proximity to the farm may be a more important consideration than choosing a distributor based on cost. The longer the product can be stored, the more flexibility there will be with regard to pricing and increased options with regard to distribution channels.

The immediate buyer will be determined in part by the quantities produced. Normally, when selling to distributors and/or grocery stores, a large quantity of the product is required. Hence, producers would need to focus on one or two crops. Producers would in many cases be required to deliver the product and would need to purchase delivery equipment. Other issues include maintaining a set delivery schedule and employing the labor/equipment to harvest, clean and package large quantities. For selling to large retailers there are specific steps and processes that a seller must follow, not the least of which is meeting the technological requirements such as labeling, scan packing and bar coding. The following is an example of the requirements:

- Farm business plan (product description, cost, availability, delivery schedule, etc.)
- Farm land use history and surrounding land use history
- Water and irrigation system description with water testing certificate
- Pesticide, fertilizer and herbicide application records
- Employee food safety training schedule
- Food safety plan such as HACCP or similar
- Harvest, packing, storage and transportation methods
- Record-keeping and safety incident management plan
- Certificate of insurance

If producers are interested in dealing directly with large retailers, information about systems and processes for suppliers can be found on their websites. For example, Whole Foods has a local produce buying program and farmer production loan program. This information is available at <http://www.wholefoodsmarket.com/>. An example of sales to Wal-Mart is given in the nationwide eXtension online database, under frequently asked questions (FAQ # 9759) available online at <http://www.extension.org/faq/9759>. eXtension is composed of groups of Extension personnel who collaborate on issues of importance to the public. In addition to providing fact sheets and other publications, the public can pose questions and have them answered by experts in a given field. Introducing producers to this database can potentially result in additional educational benefits and opportunities due to the diversity of topics covered.

A bureau service (technology middle-man) or third-party warehouse represent alternatives to dealing with large retailers directly. The advantage of an efficient third-party warehouse is they have the technology and experience to interface with retail systems. Loose stock could feasibly be delivered by the producer, with the third-party warehouse providing the labeling and distribution. For products such as wine grapes and malt barley, where a specific variety is desired by the prospective buyer, meetings should be held with the prospective buyers well in advance of a considered change, and a contract should be signed prior to planting. See Table 1 for example distribution channels for selected crops.

Crop/Product	Buyer	Potential Distribution
Onions	Consumers	Farmers' market
	Wholesale/Retail	Grocery outlet
Leaf Lettuce	Consumers	CSA program
	Wholesale/Retail	Warehouse
Teff	Miller	Delivery per contract terms
Malt Barley	Brewery	Delivery per contract terms
Great Basin Wildrye	USFS, BLM	Delivery per contract terms
Wine Grapes	Vinter/Winery	Delivery per contract terms

Table 1: Market and Distribution Examples by Crop

Does this crop have profit potential? How should the product price be determined?

To develop successful strategies, a producer needs to consider the options and examine potential profit. One type of profit analysis is break-even analysis, a quick analysis to determine if a strategy or idea has merit. The following overview was developed by Bailey and Ward (2008).

Break-Even Analysis

This section will present an explanation of how to perform a preliminary break-even analysis. This type of analysis answers the questions: “How much needs to be sold to break even?” and “What would the price need to be to break even?” If the quantity that would need to be sold to break even is a realistic amount, then the idea should be analyzed further. If the price that would need to be charged is unrealistic, then the idea is not feasible. These same questions can be answered using a set level of profit. An explanation of the math and formula is followed by an example to help illustrate the points. If an idea looks like it has merit after performing this initial analysis, a more detailed analysis should be undertaken (see the following section on scenario analysis).

It is important to understand how to use the formulas for break-even analysis, as well as the logic behind them. It is equally important to see the relationships in the formula and insights that can be gained from understanding the formula. Profit can be calculated simply as:

$$(1) \text{ Revenue} - \text{TVC} - \text{FC} = \text{Profit}$$

This formula shows that starting with the amount received for selling the product (revenue) and subtracting the cost of producing the product (variable and fixed costs) results in profit. Notice that there are two kinds of costs: variable and fixed. Variable costs (VC) are costs that come directly from producing each unit of the product, like seeds, and so will change depending on the quantity produced. Fixed costs (FC) are costs that will be incurred regardless of how many units are produced, like rent for land. These costs are also referred to as overhead.

Another way to write this equation is:

$$(2) \text{ (Price*Q)-(VC*Q)-FC=Profit}$$

This means the amount received for each unit sold (price), multiplied by the number of units sold (quantity, or Q), equals revenue. Variable cost is the costs per unit; multiplying VC by the number of units sold gives total variable cost (TVC). Profit is found by subtracting TVC and (FC) from revenue. Insight on ways to increase profit can be found just by looking at the equation. To increase profit, the options are to either increase revenue or decrease costs. Decreasing costs is pretty straightforward, but how can revenue be increased?

- Sell more to existing customers. This will increase quantity, and therefore increase profit.
- Find more customers to sell to. This will also increase the quantity sold.
- Find a sales outlet that will increase the per-unit price. For example, selling at a farmers' market may allow a producer to charge a higher price than the commercial or retail price.

Before working the numbers, assessing the possibility of any of the above options can often provide insight. The following example of tomato production shows how to perform a break-even analysis and other analyses using the formulas discussed above.

Tomato Example

Table 2 shows a sample production budget for a tomato operation, which will be used to show how equations (1) and (2) can be used. Table 3 builds on equations (1) and (2) to demonstrate how these formulas can be rearranged to perform a break-even analysis.

To calculate profit, take equation (2) and substitute numbers from Table 2, where price is \$0.24 per pound, variable costs are \$0.07 per pound and \$0.06 per pound, fixed costs are \$565, and the quantity sold was 20,000 pounds (this is found by dividing the revenue amount of \$4,800 by the per-unit price, \$0.24). Line 1 of Table 3 shows that pre-tax profit is found to be \$1,635 (taxes will be discussed later).

Break-Even Point

In most cases, it will be helpful to know how many units (such as pounds of tomatoes) need to be sold to “break even,” or cover costs. Start by setting equation 2 to zero, as one of the conditions of a break-even point is zero profit (this equation is shown on the Line 2 of Table 3). The price of the product less the variable cost is the profit margin per unit (profit margin per pound of tomatoes). In the example, tomatoes sell for \$0.24 per pound. There are \$0.13 cents in costs per pound (\$0.06 +\$0.07), which leaves \$0.11 per pound (\$0.24-\$0.13) as the profit margin. Since the break-even quantity needs to be calculated, the equation in the second line of Table 2 can be rearranged to solve for quantity, which is shown in the third line of Table 3. Solving for quantity shows that at a sale price of \$0.24 per pound, 5,136 pounds of tomatoes would need to be sold to cover costs.

Cost/Income	Total	Per unit (pound)
Revenue	\$ 4,800	\$ 0.24
Expenses		
Inputs	\$ 1,400	\$ 0.07
Labor	\$ 1,200	\$ 0.06
Overhead	\$ 565	\$ 0.03
Total Expenses	\$ 3,165	\$ 0.16
Net Income before taxes	\$ 1,635	\$ 0.08
Income taxes	\$ 605	\$ 0.03
Net Income	\$ 1,030	\$ 0.05

Table 2: Example Tomato Production Budget

Solving for Profit

If a certain profit level is desired, the same formula can be used with a slight modification. Just add any profit desired to the fixed costs. This is shown in Line 4 of Table 3. In order to reach the

Line	To solve for:	Need to know:	Equation
1	Profit	Quantity Price Variable costs Fixed costs	$(\text{Price} \times Q) - (\text{VC} \times Q) - \text{FC} = \text{Profit}$ $(\$0.24 \times 20,000) - (\$0.06 + \$0.07) \times 20,000 - \$565 = \$1,635$
2	Break-Even Point	Price Variable costs Fixed costs	$(\text{Price} - \text{VC}) \times Q - \text{FC} = 0$ $(\$0.24/\text{lb} - \$0.13/\text{lb}) \times Q - \$565 = 0$
3	Break-Even Quantity	Price Variable costs Fixed costs	$\frac{\text{FC}}{(\text{Price} - \text{VC})} = Q$ $\frac{\$565}{(\$0.24/\text{lb} - \$0.13/\text{lb})} = 5,136 \text{ lbs}$
4	Quantity that must be sold to earn a target profit	Price Variable costs Fixed costs Desired profit	$\frac{(\text{FC} + \text{Profit})}{(\text{Price} - \text{VC})} = Q$ $\frac{(\$565 + \$1635)}{(\$0.24/\text{lb} - \$0.13/\text{lb})} = 20,000 \text{ lbs}$
5	Quantity that must be sold to earn a target profit, including taxes	Price Variable costs Fixed costs Desired profit Tax amount	$\frac{(\text{FC} + \frac{\text{Profit}}{1 - \text{Tax rate}})}{(\text{Price} - \text{VC})} = Q$ $\frac{(\$565 + \frac{\$6500}{1 - 0.37})}{(\$0.24/\text{lb} - \$0.13/\text{lb})} = 98,931 \text{ lbs}$

Table 3: Equations for Break-Even Analysis

profit goal of \$1,635, a total of 20,000 pounds of tomatoes needs to be grown and sold at \$0.24 per pound. This formula provides an estimate of how large the enterprise will need to be. After examining this estimate, look at the market and production facilities and ask, “Is it possible to produce and sell this many units?” If the answer is “yes,” then investigate further. If the answer is “no,” then this may not be a good idea. A similar questions would be, “How many customers would need to purchase the product in order to sell this many units?”

Not only should the costs of producing the product be included in calculating the price, all the costs involved in the supply chain must also be incorporated. This includes the costs of transportation (including producer time); any cleaning, labeling or packaging and any third-party charges. The price point should cover all costs and allow for a given profit margin. Average national and state specific prices for numerous crops are available online through the National Agricultural Statistics Services database at http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/index.asp. These average prices can be used to determine whether the sales price is within a reasonable range of current pricing.



WORKSHEET #4

These five questions were developed by the Western Extension Marketing Committee and can help you define your alternatives (Lobo et al., 2008)

1. Describe the product (or closely linked group of products) you are considering producing, in as much detail as possible.
2. For the product in #1, describe your target
 - a. Consumer(s) and Market Outlet(s), and
 - b. Season(s)
3. What special requirements, problems, barriers, or risks do you anticipate in (a) producing and (b) marketing this product?

4. Who are/will be your competitors?

5. What are your *competitive advantages*, if any, in producing this new crop? Consider your competitors, location, regulations, seasonality, production costs, and other factors.

WORKSHEET #4

These five questions were developed by the Western Extension Marketing Committee and can help you define your alternatives (Lobo et al., 2008)

1. Describe the product (or closely linked group of products) you are considering producing, in as much detail as possible.

Option 1: Pole tomatoes

Option 2: Heirloom tomatoes grown in hoop houses

Option 3: Hand-harvested blueberries

2. For the product in #1, describe your target

a. Consumer(s) and Market Outlet(s), and

b. Season(s)

Pole tomatoes: Sold to wholesalers and at farmers' markets, depending on price and season. Generally avoid harvesting in summer months when prices are weakest.

Heirloom tomatoes: Sell directly to restaurants and in farmers' markets in the region. Year-round production, but will focus on harvesting outside of the summer months.

Blueberries: Sell directly to restaurants and in farmers' markets in the region. Will focus on being in the market in the early season (March-May) and late season (October-December).

3. What special requirements, problems, barriers, or risks do you anticipate in (a) producing and (b) marketing this product?

Pole tomatoes: Summer price drop, frost and diseases may be a problem in the winter.

Heirloom tomatoes: Frost and disease, packing requirements, learning curve including selecting the best varieties, cultural practices, summer glut, market access (breaking in).

Blueberries: Mastering production challenges including soil pH management, possibility of frost in the winter.

4. Who are/will be your competitors?

Pole tomatoes: Other local growers, imports from Mexico, greenhouse growers.

Heirloom tomatoes: Local producers, imports.

Blueberries: Imports from South America and Mexico are the primary competition during the targeted market windows; during the traditional blueberry market season, there will be greater competition from growers in other states and regions of California.

5. What are your *competitive advantages*, if any, in producing this new crop? Consider your competitors, location, regulations, seasonality, production costs, and other factors.

The Profitseekers consider the following as competitive advantages--something that gives them an “edge” over other competitors.

Pole tomatoes: Proximity to markets, higher quality, better flavor, freshness.

Heirloom tomatoes: Hoop houses reduce frost and disease problems; know tomatoes, access to farmers’ markets as a current vendor, also all of the pole tomato advantages listed above.

Blueberries: Locally grown, fresh, proximity to affluent market, seasonal availability/ market window, high demand as a function of health trends, access to location -specific research.

Module 4

SELECTING ALTERNATIVE CROPS



RATIONALE

There are many alternative crops to consider. Evaluating which alternative crop or crops will be the best fit for a producer can be a daunting task. This lesson breaks down the process to a step-by-step review of individual crops to gauge which crops may be the most successful for a given producer.



OBJECTIVES

This module will enable participants to:

1. Create an enterprise budget.
2. Examine the agronomic practices associated with their crop of interest.
3. Gain basic knowledge of variable and fixed costs.
4. Estimate costs and returns for their crop of interest.
5. Research existing enterprise budgets for potential optimal alternative crops.
6. Use WATER-ACIS to determine profit for seven alternative crops.



Is the crop economically feasible (profitable)?

The most comprehensive way to determine if an alternative crop is economically feasible is to complete an enterprise budget. The enterprise budget is a **projection** of the manager's estimates, and is a tool to estimate net profit by estimating revenues and subtracting operating and ownership costs associated with a particular crop. To create an enterprise budget, data must be compiled and entered into four spreadsheets: an investment summary, establishment costs (for perennial crops), costs and returns, and a monthly cash flow. By familiarizing constituents with these documents, personnel assist producers in gaining knowledge of tools that can be applied to other operations and can also be useful in obtaining loans or other assistance.



How is an enterprise budget created?

The first step in creating an enterprise budget is to determine what agronomic practices are associated with growing the crop in question. Some questions to answer include:

- What is the available acreage?
- What is the irrigation source?
- What land preparation is needed?
 - What machinery or other methods will be used to prepare the soil?
 - After completing soil testing, what amendments will need to be added?
- Is the crop an annual or a perennial?
- What is the optimal seeding rate?
- How much and what type of fertilizers are best for this crop?
- How much irrigation is required and at what intervals?
- What pest management issues are common with this crop?
 - What weeds are problematic and what will be used to control them?
 - Are there insects that are especially fond of this crop?
 - Do vertebrate pests pose a problem?
- When is the crop harvested?
- What machinery will be used for harvesting?
- How much labor is necessary to grow and harvest the crop?
 - How many operator hours will be required per acre?
 - Should additional help be hired (either full-time or seasonal)?
- What are the average yields that can be expected for this crop in my area?

What is the next step after determining agronomic practices?

Each of the previous agronomic practices has an economic cost associated with it. These costs fall into one of two categories, either operating or ownership costs as mentioned in the previous module.

What are ownership or fixed costs?

Ownership or fixed costs are expenses that occur and must be paid regardless of whether a crop is produced or not. These costs are categorized into cash and non-cash overhead costs. Some examples of both types of fixed costs are:

- Cash Overhead Costs
 - Land (if leased)
 - Investment insurance
 - Investment taxes
- Non Cash Overhead Costs (Capital Recovery)
 - Buildings, improvements and equipment (includes establishment costs)
 - Machinery and vehicles





What are the operating costs or variable costs?

These costs would be incurred only if the crop is produced. These expenses vary from year to year and are easily adjusted by changing practices. Included are costs associated with seeds, irrigation, fertilizers, insecticides and herbicides, and labor. In addition to these costs, some additional operating expenses are:

- Accounting and legal expenses
- Fuel, oil, lube
- Repairs/maintenance
- Utilities
- Interest on operating capital
- Miscellaneous

How are these costs entered in an enterprise budget?

As mentioned, there are four spreadsheets in an enterprise budget: an investment summary, establishment costs (for perennial crops), costs and returns and a monthly cash flow.

Annual Equipment Costs								
Description	Purchase Price	Useful Life (Yrs)	Salvage Value	Annual Capital Recovery	Annual Insurance	Annual Taxes	Annual Repairs	Annual Fuel & Lube
Buildings, Improvements, and Equipment								
Owner House	\$ 200,000.00	50.00	\$ 200,000.00	\$ -	\$ 1,332.00	\$ 2,000.00	\$ 4,000.00	
Land	\$ 3,703,000.00	150.00	\$ 3,703,000.00	\$ -	\$ -	\$ 37,030.00	\$ -	
Shop (30X40) & Tools	\$ 42,000.00	25.00	\$ 4,200.00	\$ 1,512.00	\$ 153.85	\$ 231.00	\$ 840.00	
Metal Shed	\$ 24,000.00	25.00	\$ 2,400.00	\$ 864.00	\$ 87.91	\$ 132.00	\$ 480.00	
Implements	\$ 84,450.00	15.00	\$ 8,445.00	\$ 5,067.00	\$ 309.34	\$ 464.48	\$ 1,689.00	
Center Pivot System (2)	\$ 390,000.00	25.00	\$ 39,000.00	\$ 14,040.00	\$ 1,428.57	\$ 2,145.00	\$ 7,800.00	
Sub Total	\$ 4,443,450.00	NA	\$ 3,957,045.00	\$ 21,483.00	\$ 3,311.67	\$ 42,002.48	\$ 14,809.00	
Machinery and Vehicles								
150 HP Tractor	\$ 123,965.00	15.00	\$ 12,396.50	\$ 7,437.90	\$ 454.08	\$ 681.81	\$ 8,677.55	\$ 9,917.20
Combine	\$ 181,455.00	15.00	\$ 18,145.50	\$ 10,887.30	\$ 664.67	\$ 998.00	\$ 12,701.85	\$ 14,516.40
Polaris Sportman ATV	\$ 10,000.00	5.00	\$ 1,000.00	\$ 1,800.00	\$ 36.63	\$ 55.00	\$ 700.00	\$ 800.00
1 Ton Pickup	\$ 50,000.00	8.00	\$ 5,000.00	\$ 5,625.00	\$ 183.15	\$ 275.00	\$ 3,500.00	\$ 4,000.00
Sub Total	\$ 365,420.00	NA	\$ 36,542.00	\$ 25,750.20	\$ 1,338.53	\$ 2,009.81	\$ 25,579.40	\$ 29,233.60
Total	\$ 4,808,870.00	NA	\$ 3,993,587.00	\$ 47,233.20	\$ 4,650.20	\$ 44,012.29	\$ 40,388.40	\$ 29,233.60

Which spreadsheet should be completed first?

The investment summary should be the first spreadsheet completed.

The investment summary is a summary of all property used in the enterprise. This consists of all buildings, improvements and equipment including the house, land, shops and any outbuildings, tools and implements and perennial establishment costs. Also included on the investment summary spreadsheet are machinery and vehicles such as tractors and other self-propelled or PTO equipment, pickups and ATVs. The values entered are used to calculate annual capital recovery (i.e. depreciation), annual insurance, annual taxes, annual repairs and annual fuel and lube expenses as a percentage of either the purchase price or the average asset value. The totals are carried to the establishment costs spreadsheet (if applicable) and the costs and returns spreadsheet. The following page contains an example of an investment summary for the production of 240 acres of two-row malt barley using center pivot irrigation.

What spreadsheet should be completed next?

The establishment costs spreadsheet should be completed next if the crop under consideration is a perennial. Because perennial crops can take several years to establish and at first yield little or no production, first-year costs are usually much higher and returns are

much lower than in subsequent years, resulting in net losses. The net returns for the first year as determined by the establishment costs spreadsheet allows for capitalization of any losses over the duration of the crop life on the investment summary. The following example is from a 400-acre alfalfa farm.

Operating Establishment Costs						
	Total Units	Unit	Price/Cost Per Unit	Total Cost/Value	Total Cost/Value Per Acre	Your Farm
OPERATING COSTS						
Rodent Control	400.00	Acre	\$ 1.50	\$ 600.00	\$ 1.50	
Insecticide	400.00	Acre	\$ -	\$ -	\$ -	
Herbicide	400.00	Acre	\$ 55.00	\$ 22,000.00	\$ 55.00	
Fertilizer	400.00	Acre	\$ 52.00	\$ 20,800.00	\$ 52.00	
Irrigation	400.00	Acre	\$ 102.50	\$ 41,000.00	\$ 102.50	
Alfalfa Seed	20.00	Lbs/Acre	\$ 2.60	\$ 20,800.00	\$ 52.00	
Roundup	2.00	Quarts/Acre	\$ 14.50	\$ 11,600.00	\$ 29.00	
Operator Labor	1.00	Annual	\$ 30,000.00	\$ 30,000.00	\$ 75.00	
Accounting & Legal	1.00	Annual	\$ 2,000.00	\$ 2,000.00	\$ 5.00	
Fuel & Lube	1.25	Annual	\$ 28,359.85	\$ 35,449.81	\$ 88.62	
Maintenance	1.00	Annual	\$ 12,998.45	\$ 12,998.45	\$ 32.50	
Utilities	1.00	Annual	\$ 7,000.00	\$ 7,000.00	\$ 17.50	
Miscellaneous	400.00	Acre	\$ 5.00	\$ 2,000.00	\$ 5.00	
Interest Operating Capital	\$ 164,998.61	\$	\$ 0.065	\$ 5,362.45	\$ 13.41	
TOTAL OPERATING COSTS				\$ 211,610.72	\$ 529.03	
OWNERSHIP COSTS						
CASH OVERHEAD COSTS						
Liability Insurance				\$ 1,749.00	\$ 4.37	
Office & Travel				\$ 3,000.00	\$ 7.50	
Annual Investment Insurance				\$ 4,328.48	\$ 10.82	
Annual Investment Taxes				\$ 52,729.23	\$ 131.82	
TOTAL CASH OVERHEAD COSTS				\$ 61,806.71	\$ 154.52	
NONCASH OVERHEAD COSTS (Capital Recovery)						
Buildings, Improvements, & Equipment				\$ 7,985.94	\$ 19.96	
Machinery & Vehicles				\$ 53,333.79	\$ 133.33	
TOTAL NONCASH OVERHEAD COSTS				\$ 61,319.73	\$ 153.30	
TOTAL OWNERSHIP COSTS				\$ 123,126.44	\$ 307.82	
TOTAL COSTS				\$ 334,737.16	\$ 836.84	
YEAR ONE INCOME						
Alfalfa Hay	0.00	Tons	\$ 134.00	\$ -	\$ -	
TOTAL GROSS INCOME				\$ -	\$ -	
TOTAL ESTABLISHMENT INVESTMENT				\$ 334,737.16	\$ 836.84	

What returns can be expected?

Returns can vary by region. Average prices for the crop of interest for any region can be established by consultation with Extension personnel. As mentioned in Module 3, average national prices for numerous crops and statewide prices for some crops are available online through the National Agricultural Statistics Services database at http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/index.asp.

These average prices can be used to consider if the desired sales price is within a reasonable range of current pricing. The figure below is an example for onions in Nevada.

Source	Year	State	Data Item	Value
SURVEY	2009	NEVADA	ONIONS, DRY, SUMMER, NON-STORAGE - PRICE RECEIVED, MEASURED IN \$ / CWT	35
SURVEY	2008	NEVADA	ONIONS, DRY, SUMMER, NON-STORAGE - PRICE RECEIVED, MEASURED IN \$ / CWT	24
SURVEY	2007	NEVADA	ONIONS, DRY, SUMMER, NON-STORAGE - PRICE RECEIVED, MEASURED IN \$ / CWT	19
SURVEY	2006	NEVADA	ONIONS, DRY, SUMMER, NON-STORAGE - PRICE RECEIVED, MEASURED IN \$ / CWT	30

What if I am growing an annual crop and don't have establishment costs?

If the crop the producer is considering is an annual or if they have completed an establishment costs spreadsheet for a perennial crop, the next spreadsheet to complete is costs and returns. This spreadsheet is a summation of all returns, variable costs and fixed costs. An example costs and returns spreadsheet for two-row malt barley follows.

The following figure is an example of the monthly cash flow spreadsheet.

Monthly Summary of Returns and Expenses												
Description	January	February	March	April	May	June	July	August	September	October	November	December
Production:												
Two o Row Malt Barley	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 302,400.00	\$ -	\$ -	\$ -	\$ -
	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total Income	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 302,400.00	\$ -	\$ -	\$ -	\$ -
Operating Inputs:												
Insecticide	\$ -	\$ -	\$ -	\$ 1,969.80	\$ 1,969.80	\$ 1,969.80	\$ 1,969.80	\$ -	\$ -	\$ -	\$ -	\$ -
Herbicide	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Fertilizer	\$ -	\$ -	\$ 10,718.40	\$ -	\$ 17,172.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Seed	\$ -	\$ -	\$ -	\$ 4,320.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Irrigation	\$ -	\$ -	\$ -	\$ 8,592.60	\$ 8,592.60	\$ 8,592.60	\$ 8,592.60	\$ -	\$ -	\$ -	\$ -	\$ -
Operator Labor	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00
Accounting & Legal	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67	\$ 166.67
Fuel & Lube	\$ 846.24	\$ 846.24	\$ 1,692.47	\$ 1,692.47	\$ 1,692.47	\$ 1,692.47	\$ 1,692.47	\$ 1,692.47	\$ 1,692.47	\$ 846.24	\$ 846.24	\$ 846.24
Maintenance	\$ 509.19	\$ 509.19	\$ 1,018.38	\$ 1,018.38	\$ 1,018.38	\$ 1,018.38	\$ 1,018.38	\$ 1,018.38	\$ 1,018.38	\$ 509.19	\$ 509.19	\$ 509.19
Utilities	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00	\$ 490.00
Miscellaneous	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00	\$ 100.00
Interest OC	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20	\$ 201.20
Total Operating Costs	\$ 4,813.29	\$ 4,813.29	\$ 16,887.12	\$ 21,051.12	\$ 33,903.12	\$ 16,731.12	\$ 16,731.12	\$ 6,168.72	\$ 6,168.72	\$ 4,813.29	\$ 4,813.29	\$ 4,813.29
Net Returns	\$ (4,813.29)	\$ (4,813.29)	\$ (16,887.12)	\$ (21,051.12)	\$ (33,903.12)	\$ (16,731.12)	\$ (16,731.12)	\$ 296,231.28	\$ (6,168.72)	\$ (4,813.29)	\$ (4,813.29)	\$ (4,813.29)

What is the purpose of the monthly cash flow spreadsheet?

The monthly cash flow spreadsheet enables producers to take a comprehensive look at their projected cash flow from month to month throughout the year. This will help producers anticipate which months of the year it will be necessary to use savings or obtain operating loans to be able to meet expenses and in which months revenue will exceed expenses. It is a valuable document and will be requested by any banker in order to determine the need for an enterprise's operating capital. This spreadsheet is only necessary if the 'bottom line' or net profit from the cost and returns spreadsheet is sufficient to warrant further inquiry.



How much should net profit be to consider an alternative crop?

The net profit per acre of a proposed alternative crop should be compared with the net profit per acre of current enterprises as well as possible other alternative crops. Enterprise budgets for numerous crops are available online through state Extension. It is perhaps easier to modify an existing budget than to create a budget from scratch. Malt barley, wine grapes, Great Basin wildrye, onions, lettuce, switchgrass and teff are some alternative crops that were evaluated for their potential in Nevada. The enterprise budgets for these crops and others are online and are accessible at <http://www.unce.unr.edu/publications/search/details.asp?searchby=keywordsearch&searchtext=costs>.

After finding a potential alternative crop, if net profits are close to but below a desirable range, they can possibly be increased. There are ways to increase the 'bottom line' of most costs and returns spreadsheets.

How can the bottom line (net profit) be increased?

Net profit can be increased by increasing yields, increasing prices or by reducing costs.

How can yields be increased?

Yields are determined by soils, climate and irrigation practices. After amending the soil and choosing the optimal time to plant for the prevailing climate, the largest determining factor is when and how much to irrigate. Producers in northwestern Nevada can utilize the WATERACIS tool, an adaptation of IRRIG-AID, to estimate yields for alfalfa and seven alternative crops. After inputting the percentage of sand in your soil and your closest weather station, WATERACIS allows you to alter irrigation levels by month to create an irrigation strategy that will optimize yields.



EXAMPLE FOR ACTIVITY #1

Using WATERACIS to optimize yields

What is the percent of sand in the top profile of my soil?

_____ % in the top _____ inches

Irrigation Strategy Worksheet for Northwestern Nevada Irrigators

- 1) Fill in **ONLY** the blue boxes to create your irrigation strategy outcomes.
- 2) Click the Yellow Report Tab and Choose 'Print' or 'Print Preview' from the File Menu to print and/or view your Worksheet Summary Report.

Producer Name:	DATE:
XYZ FARMS	9/3/2008
(Optional)	

Counties (for Selection of Soil):	
SELECT County:	
Churchill	Lyon
Lyon	
Mineral	

Soil Type (%sand):	
SELECT Soil Type :	
Percent Sand in topsoil (%)	40.00 % sand *
* See "VIEW SOILS" SHEET to view %sand soil values	

Weather Stations (Rainfall, Temperature, Elevation):	
SELECT Weather Station:	
Fallon	Yerington
Hawthorne	
Smith	
Yerington	

Irrigation Strategies:									
Enter total crop acreage for each crop									
Irrigated Crop Alternatives:									
SELECT irrigation amount for one or more month(s) of the growing season for two or more competing crops (inches):	Irrigation Applications During the Growing Season								
	March	April			May	June	July	August	September
	(inches/ac)	(inches/ac)	(inches/ac)	(inches/ac)	(inches/ac)	(inches/ac)	(inches/ac)	(inches/ac)	
	Alfalfa Irrigations	4.00	6.00	8.00	8.00	8.00	8.00	6.00	
	Onion Irrigations		8.00	8.00	8.00	4.00			
	Leaf Lettuce Irrigations		5.00	4.00	3.00				
	Teff Irrigations				12.00	12.00	12.00		
	Malt Barley Irrigations		6.00	6.00	6.00	6.00			
	Switchgrass Forage Irrigations			6.00	8.00	10.00	10.00	2.00	
	Wildrye Irrigations		1.50	2.50	2.50	3.00	2.50		
	Wine Grape Irrigations			0.20	2.00	1.40	1.00		
	Monthly water required, ac. in.	200	1325	1735	2475	2220	1675	400	

Yield Estimates:							
	Predicted Yields						
	Alfalfa tons/ac	Onions lbs/ac	Leaf Lettuce tons/ac	Teff lbs/ac	Malt Barley bu/ac	Switchgrass Forage tons/ac	Wildrye lbs/ac
	6.2	87,932	9.9	2,258	152.2	6.4	400.3

What costs can be reduced?

In most situations, there is usually a way to reduce variable costs. These expenses vary from year to year and are easily adjusted by changing practices. Irrigation costs, both amounts of water and utilities costs, are examples.

How can water costs change by changing practices?

Changing from a flood or furrow irrigation system to a center pivot system or drip system greatly increases the efficiency with which water is delivered and reduces the amount of water used. One of the advantages of either center pivot or drip irrigation is the system's ability to uniformly distribute the water. The importance of distribution to yield has been shown by studies of sprinkler irrigation, where yields increased with increased uniformity of distribution (Li, 1998). This highlights one of the disadvantages of flood irrigation: the necessity of intense land preparation prior to planting, such as planing and laser leveling, to ensure a more even distribution. Center pivot systems with Low Energy Precision Application (LEPA) have emitters 12 to 18 inches above the ground, or have drag socks or hoses that release water on the ground. By using this technology, it has been found that 95 percent to 98 percent of the irrigation water pumped is delivered to the crop (New and Fipps, 2000). These systems have lower energy consumption and consequently lower pumping costs. Additionally, chemicals and fertilizers can also be applied through the system, which has the effect of lowering labor costs (Robinson, 2007). Drip irrigation systems have been proven performers in increasing yields and both net and total water productivity while decreasing net water applied (O'Neill et al., 2008). Subsoil drip irrigation has been found to be especially water-saving and new innovations are being developed to increase the longevity and efficiency of these systems (Barth, 1999). While it may seem obvious that drip irrigation systems are more efficient than other systems, they can also be costly and are not appropriate for all crops, such as those that utilize machine harvesting prior to the removal of the drip system. Changing irrigation systems may result in both increased yields and decreased costs, helping to increase net profits.

How can utilities costs be reduced by changing practices?

If groundwater is the irrigation source, it may be beneficial to investigate whether changing the source of power for the pump, upgrading to a newer pump with an increased efficiency, reducing the pressure needed to run the irrigation system or reducing the pump horsepower will result in reduced utility costs. WATERACIS will help make that determination. It utilizes a spreadsheet that allows for input of numerous variables and compares the cost per acre-inch of water between electric, natural gas, propane and diesel sources of power.

Electricity Irrigation Costs	
Gallons per Minute:	400.0
Pumping Lift (in Feet):	200.0
Discharge Pressure (PSI):	10.0
Pump Efficiency (Percent):	60.0
Motor Efficiency (Percent):	88.0
Vertical Hollow Shaft Motor (88%)	
Submersible Motor (80%)	
Electricity Cost per Kilowatt Hour:	\$0.08
Pump Horsepower Requirement:	37.5589
Kilowatt Load:	31.8397
Hourly Power Use	2.5472
Cost per Acre Inch of Water:	\$2.87

EXAMPLE FOR ACTIVITY #2

Using WATERACIS energy estimator to determine energy costs of pumping water using different energy sources

Electricity Irrigation Costs		Default	Natural Gas Irrigation Costs		Default
Gallons per Minute:	400.0	165.0	Gallons per Minute:	890.0	890.0
Pumping Lift (in Feet):	200.0	152.0	Pumping Lift (in Feet):	365.0	365.0
Discharge Pressure (PSI):	10.0	3.0	Discharge Pressure (PSI):	8.0	8.0
Pump Efficiency (Percent):	60.0	60.0	Pump Efficiency (Percent):	60.0	60.0
Motor Efficiency (Percent):	88.0	88.0	Gear Head Efficiency (Percent):	95.0	95.0
Vertical Hollow Shaft Motor (88%)			Engine Efficiency (Percent):	22.0	22.0
Submersible Motor (80%)					
Electricity Cost per Kilowatt Hour:	\$0.08	\$0.15	Natural Gas Costs per MCF:	\$10.00	\$10.00
Pump Horsepower Requirement:	37.5589	11.0368	Pump Horsepower Requirement:	151.2038	151.2038
Kilowatt Load:	31.8397	9.3562	Hourly Fuel Use (Million Cubic Feet)	1.7492	1.7492
Hourly Power Use	2.5472	0.7017	Hourly Fuel Cost (\$/MCF):	17.4915	5.2475
Cost per Acre Inch of Water:	\$2.87		Cost per Acre Inch of Water:	\$8.84	

L.P. Irrigation Costs		Default	Diesel Irrigation Costs		Default
Gallons per Minute:	550.0	550.0	Gallons per Minute:	190.0	190.0
Pumping Lift (in Feet):	150.0	150.0	Pumping Lift (in Feet):	315.0	315.0
Discharge Pressure (PSI):	4.0	4.0	Discharge Pressure (PSI):	20.0	20.0
Pump Efficiency (Percent):	60.0	60.0	Pump Efficiency (Percent):	60.0	60.0
Gear Head Efficiency (Percent):	95.0	95.0	Gear Head Efficiency (Percent):	95.0	95.0
Engine Efficiency (Percent):	22.0	22.0	Engine Efficiency (Percent):	32.0	32.0
L.P. Cost per Gallon:	\$2.00	\$2.00	Diesel Cost per Gallon:	\$2.25	\$2.25
Pump Horsepower Requirement:	36.8611	36.8611	Pump Horsepower Requirement:	28.8838	28.8838
Engine Shaft Horsepower:	38.8012	38.8012	Engine Shaft Horsepower:	30.4040	30.4040
Hourly Fuel Use (Gallons per Hour)	4.9873	4.9873	Hourly Fuel Use (Gallons per Hour)	1.7912	1.7912
Hourly Fuel Cost	\$9.97	\$2.49	Hourly Fuel Cost	\$4.03	\$1.16
Cost per Acre Inch of Water:	\$8.16		Cost per Acre Inch of Water:	\$9.55	

Provided by Drs. Stan Bevers, Prof. and Extension Economist, Vernon, Texas, and Leon New, Prof. and Irrigation Engineer, Ar

What crop or crops will give the best economic returns based on available water?

After an enterprise budget has been completed, returns and expenses are known. Once the returns and expenses associated with a given crop have been determined, this information can be inputted to the profit sheet of WATER-ACIS.

Are there risks specific to the chosen alternative crop?

When considering an alternative crop that is unfamiliar to the producer, there are additional questions that need to be answered with regard to risk, including:

- How have/will prices vary from year to year?
- How does price vary when there are variations in quality?
- Is a contract needed with the buyer prior to planting?
- Can existing equipment be modified to meet the needs of the new crop?
- Are there added operating costs that are particular to this crop?

Risk occurs in several categories including general, production, market, financial, legal and human risk. Assessment tools and further education for all categories can be accessed at the Western Risk Management Library online at <http://agecon.uwyo.edu/RiskMgt/>.



EXAMPLE FOR ACTIVITY #3

Using WATER-ACIS to determine the crop with the best economic returns

PROFIT ANALYSIS							
Fill in ONLY the blue boxes to calculate your Profit Analysis							
Gross Income	Alfalfa \$/ton	Onions ^{1/} \$/lb	Leaf Lettuce \$/ton	Teff \$/lb	Malt Barley \$/bu	Switchgrass Forage \$/ton	
Selling price, \$/unit	\$ 144.00	\$ 0.16	\$ 700.00	\$ 0.38	\$ 9.00	\$ 66.00	
Income, \$/acre	\$ 890.53	\$ 13,733.93	\$ 6,858.25	\$ 849.31	\$ 1,356.54	\$ 420.93	
1/ Onion price default is based on red and white onions, but not yellow. If a mixed price is desired, estimate the average price.							
Expenses:	Alfalfa	Onions	Leaf Lettuce	Teff	Malt Barley	Switchgrass Forage	
Surface water - Enter YOUR Cost (\$/inch)	\$ 2.50	\$ 2.50	\$ 2.50	\$ 2.50	\$ 2.50	\$ 2.50	
Allocation of Use for EACH Crop	100%	100%	100%	100%	0%	100%	
Ground water - Enter YOUR Cost OR SELECT in cell A14: \$ -							
Ground water using Electricity \$ 2.87	\$ 2.87	\$ 2.87	\$ 2.87	\$ 2.87	\$ 2.87	\$ 2.87	
Allocation of Use for EACH Crop	0%	0%	0%	0%	100%	0%	
Irrigation Sources MUST total 100% for EACH Crop →	100%	100%	100%	100%	100%	100%	
	Alfalfa	Onions	Leaf Lettuce	Teff	Malt Barley	Switchgrass Forage	
Weighted Average Irrigation Cost \$/acre	\$ 120.00	\$ 70.00	\$ 30.00	\$ 90.00	\$ 68.77	\$ 90.00	
Fertilizer (N costs only) Unit Cost/lb \$ 0.75	\$ -	\$ 37.50	\$ 52.50	\$ 30.00	\$ 75.00	\$ 75.00	
Mixed Fertilizer (Other excluding N & P) Total Cost/ac	\$ 42.00	\$ 716.50	\$ 209.50	\$ 6.00	\$ 41.21	\$ -	
Cost of P ₂ O ₅ Fertilizer Unit Cost/lb \$ 0.40	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Enter Total Establishment Costs	\$ 105.00					\$ 394.56	
Enter Years of Rotation 6.0						10.0	
Annualized Establishment Cost	\$ 17.50					\$ 39.46	
Additional other costs ^{2/}	\$ 346.88	\$ 7,588.31	\$ 5,521.01	\$ 426.70	\$ 409.92	\$ 266.70	
Subtotal before Interest	\$ 526.38	\$ 8,412.31	\$ 5,813.01	\$ 552.70	\$ 594.90	\$ 471.16	
Annual Interest Rate (6 months interest expense) 7.00%	\$ 18.42	\$ 294.43	\$ 203.46	\$ 19.34	\$ 20.82	\$ 16.49	
Total	\$ 544.80	\$ 8,706.74	\$ 6,016.47	\$ 572.04	\$ 615.73	\$ 487.65	
2/ Excludes fertilizer, irrigation, interest, utilities, accounting fees and all fixed costs including machinery depreciation, taxes, insurance, and land cost.							
Net Income:	Alfalfa	Onions	Leaf Lettuce	Teff	Malt Barley	Switchgrass Forage	
Net Income (\$/ac)	\$ 345.73	\$ 5,027.19	\$ 841.79	\$ 277.27	\$ 740.82	\$ (66.72)	
Total Crop Acreage (acres) 50		50	50	50	50	50	
TOTAL Net Income (\$) ^{3/}	\$ 17,286.48	\$ 251,359.62	\$ 42,089.35	\$ 13,863.34	\$ 37,040.87	\$ (3,335.90)	
Operator Labor Charge \$ -							
Total Farm Net Income ^{3/}							
3/ Net returns to land and capital (does not include capital start-up costs, depreciation, and land payments)							
2008 Nevada Crop Budget Estimates of Additional Costs	\$ 346.88	\$ 7,588.31	\$ 5,521.01	\$ 426.70	\$ 409.92	\$ 266.70	

Module 5

ASSISTANCE IN IMPLEMENTING ALTERNATIVE CROPS



RATIONALE

Success, especially with new ventures, can be largely dependent on the amount of support received. This lesson outlines institutions and agencies that can provide support for those producers willing to undertake production of alternative crops.



OBJECTIVES

This module will enable participants to:

1. Increase awareness of the variety of support programs offered by Federal agencies.
2. Gain a better knowledge of the extent of services provided by Cooperative Extension at the local and national levels.
3. Develop the confidence to undertake a new venture, knowing there are support systems in place.



Who can help with information, decision making, or capital outlay?

Federal Government

The United States Department of Agriculture (USDA) supports American farmers through a variety of credit, commodity and conservation programs that are designed to benefit the quality of life of residents and enhance the rural landscape. There are a number of Farm Bill programs offered every year by a variety of agencies. Farmers, ranchers and other conservation-minded individuals have access to Natural Resources Conservation Service (NRCS) and Farm Service of America (FSA) programs that provide additional resources in protecting agriculture and natural resources. NRCS is



best known for its conservation cost-share programs while FSA is best known for its lending programs. In each instance, these agencies play an integral role in agriculture sustainability.

USDA Conservation Programs

There are several conservation programs implemented by NRCS and FSA. The goal of the programs is to assist private landowners in conserving their soil, water and other natural resources. Conservation planning is an integral part of the process. Producers are assisted by USDA personnel in developing and implementing a conservation plan that protect, conserve and enhance natural resources including soil, water, air, plants and animals.

Producers who were surveyed by the U.S. Government Accountability Office about the top six conservation programs used in the United States frequently identified the financial benefits of the programs as being the primary incentive for participating in the conservation programs (GAO, 2006). Specific financial benefits reported were easement and rental payments that compensate landowners for specific land uses on the property, and cost-share payments that assist land owners (by a percentage of cost) to implement specific conservation practices. For those not participating, a 2006 report on the six conservation programs stated that limited participation was a result of fears about federal government regulations, paperwork requirements, participation and eligibility requirements and the potential for participation to hinder agriculture production (GAO, 2006).

Each conservation program offered has a specific set of rules and regulations based on a conservation plan. There are also incentives to beginning farmers or socially disadvantaged farmers. The key is to design a comprehensive conservation plan in the beginning based on overall goals of the agriculture operation. Specific programs highlighted below were chosen due to their potential applicability in the Great Basin.



Grassland Reserve Program (GRP)

Established in 2002, GRP assists landowners and agriculture operators in restoring and protecting grassland, rangeland, pastureland, shrub land and certain other lands, while maintaining the areas as grazing land. The program emphasizes support for working grazing operations on enhancement of plant and animal biodiversity and on protection of grassland and land containing shrubs and forbs under threat of conversion to cropping, urban development and other activities that threaten grassland resources. The program offers different enrollment options including permanent easement, 30-year easement, both permanent and 30-year, rental agreement or restoration agreement. Each option has criteria on how payments will be made to the landowner or operator (NRCS-b, 2009).

Conservation Reserve Program (CRP)

Established in 1985, CRP is designed to safeguard highly erodible or other highly sensitive qualified lands. This program provides participants with rental payments and cost-share assistance for planting long-term, resource-conserving vegetation to improve the quality of water, control soil erosion and enhance wildlife habitat (FSA-CRP, 2008). This can include land taken out of agriculture production to establish a vegetative cover to conserve soil (GAO, 2006).

Environmental Quality Incentives Program (EQIP)

Established in 1996, EQIP promotes agriculture production and environmental quality. The program offers financial and technical assistance to private landowners, tribes and qualifying groups to implement structural and management practices on eligible agriculture land. EQIP contracts have a minimum term of one year after the implementation of the last scheduled practice and a maximum term of 10 years. The program has a cost share for certain conservation practices up to 75 percent, unless participants qualify as limited resource producers or beginning farmers. The limited resource or beginning farmer cost share can be up to 90 percent (NRCS- a, 2008).

Wildlife Habitat Incentives Program (WHIP)

Established in 1996, WHIP encourages creation of high quality wildlife habitats that support wildlife populations of national, state, tribal and local significance. Technical and financial assistance to landowners and others is available to develop upland, wetland, riparian and aquatic habitat areas on private property. These contracts last from five to 10 years, offering cost-share assistance for practices. There are limits on the number of acres that can be enrolled and payments that can be made (NRCS- c, 2004).



Agriculture Management Assistance (AMA)

Established in 2002, AMA addresses issues involving water management, water quality and erosion control by incorporating conservation practices in farming operations. Producers, under this program have the ability to “construct or improve water management structures or irrigation structures; plant trees for windbreaks or to improve water quality and mitigate risk through production diversification or conservation practices, which can include soil erosion control; integrated pest management; or transition to organic farming” (NRCS-AMA, 2007).

New 2008 Farm Bill Programs

H.R. 6124, the Food Conservation and Energy Act of 2008, better known as the new Farm Bill, became Public Law No. 110-234 on May 22, 2008. The law will be in effect until 2012. The rules and regulations for the law can be easily accessed online through the National Agricultural Library at: http://riley.nal.usda.gov/nal_display/index.php?info_center=8&tax_level=2&tax_subject=567&level3_id=0&level4_id=0&level5_id=0&topic_id=2249&placement_default=0. The farm bill has a variety of measures including retaining some of the existing programs and eliminating others, as well as new programs. The programs highlighted in this chapter have not gone away, but will likely have new regulations and criteria. It is important to pose questions to USDA providers on what new programs may be available to farmers and ranchers to meet their goals in their operations. Look for opportunities to fit the appropriate program to the farm and ranch environment and producer goals. It is also important to note that work has already begun to prepare for the next farm bill.

State Extension Personnel and Publications

One of the most accessible resources is also one that should be most familiar with a particular area for any given situation: the local Extension Educator and/or Extension office. Extension is the



link between the public and the latest university research. While Extension may not have all the answers, Extension agents will typically know where to find additional information or resources to address the public's questions. There is a wealth of information on Extension websites as evidenced by the following examples:

1. Managing saline soils from Colorado State University Extension at <http://www.ext.colostate.edu/PUBS/CROPS/00503.html>
2. Managing alkaline soils from Utah State University Extension at <http://extension.usu.edu/files/publications/soils2n.pdf>
3. Soil testing from Utah State University Extension at <http://extension.usu.edu/files/publications/publication/HG-513>.
4. A Market-Driven Enterprise Screening Guide at <http://ag.arizona.edu/arec/wemc/nichemarkets/03marketdrivenenterprise.pdf>

Regionally, the Western Farm Management Extension Committee is an organization of Extension economists from the 13 western states, Guam and other Pacific Islands supported by Cooperative Extension directors in the western region. They have assembled a database of online courses, publications and other useful tools to assist agricultural producers and agribusiness professionals with recordkeeping, risk management, estate and tax planning, marketing and numerous other topics related to agricultural economics. Included in the publications database is an online decision tool that assists with the economics of adopting new strategies, the Feasibility of Alternative Rural Enterprises, available at <http://agecon.uwyo.edu/WFMEC/>.

In addition to local and regional Extension personnel, there is a national Cooperative Extension database that provides information on numerous topics, available at <http://www.extension.org/>. This website also has a unique feature: it allowing users to ask a question that will be answered by extension personnel from that area of specialization, putting an expert at their fingertips.

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