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Interim Report: 2015 Drought and Agriculture

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Interim Report: 2015 Drought and Agriculture

By

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Summary

The 2015 crop season in Washington State was one of the driest on record. The water year, which began on October 1, 2014 and ended on September 30, 2015, had above average temperatures throughout the state, severely impacting snowpack and reducing streamflows throughout the state. At the height of this year's drought (during the last week of August, 2015), 85 percent of Washington was in "extreme drought" status.

Washington State has a vibrant agricultural economy that contributes more than 160,000 jobs and averages 13% of the state's total economic profile. With more than 300 crops produced throughout the state, extremely accessible foreign markets, and deepwater ports, Washington is a key player in producing high quality fresh and processed food products (WSDA, 2015b).

During water-limited years like 2015, many regions of the state have reduced irrigation water available; this can reduce yields, quality, and marketability of produce.

In October 2015, the Washington State Department of Ecology (Ecology), the state lead on drought, requested a proposal from the Washington State Department of Agriculture's Natural Resources Assessment Section (NRAS) for an analysis of the economic impact of the 2015 drought on agriculture throughout the state. A final agreement was signed in mid-November, with deliverables of a largely qualitative interim report (due December 31, 2015), and a final report, to include all available quantitative data on the 2015 harvest and drought impacts (due to Ecology on December 31, 2016).

This interim report includes the results of three different data collection efforts: targeted mapping, meetings with commodity groups, and an online survey.

Introduction

The final statewide drought declaration by Governor Jay Inslee on May 15, 2015 and subsequent completion of the state budget gave Ecology funds to conduct drought mitigation activities and provide grants to government organizations focused on reducing the impact of this year's drought. At Ecology's request, the Washington State Department of Agriculture (WSDA) wrote a proposal for an assessment of the 2015 drought and its impact on Washington agriculture. The purpose of the study is to improve future drought relief efforts.

While drought impacts are difficult to isolate and even more difficult to quantify, this interim report is intended to lay the groundwork for further evaluation of drought impacts in 2016, using data from USDA's National Agricultural Statistics Service (NASS). This analysis includes harvested acreage and yield information for the 2015 harvest (where available) from NASS. All yield losses and crop impacts are reported either as a percentage or in dollars. The value of production represents the gross revenue of agricultural commodities; total units produced multiplied by the market value of each unit in 2015. It does not include cash and non-cash expenses, or other sources of farm income (insurance payments, sales of goods and services, etc.). This report is not intended to include analysis of net farm income, nor is it intended to completely quantify the economic losses from the 2015 drought.

For this report, we limited our analysis to four major commodity groupings (fruit, field crops, animal feed crops, dryland) and divided the state into four major regions (Western, Central, Columbia Basin, and Eastern) (Figure 1). Data from the 2015 season are not yet available for animal products (livestock and dairy) or nursery products: those sectors are not included in this report. Where available, data will be provided specifically for water-limited areas.

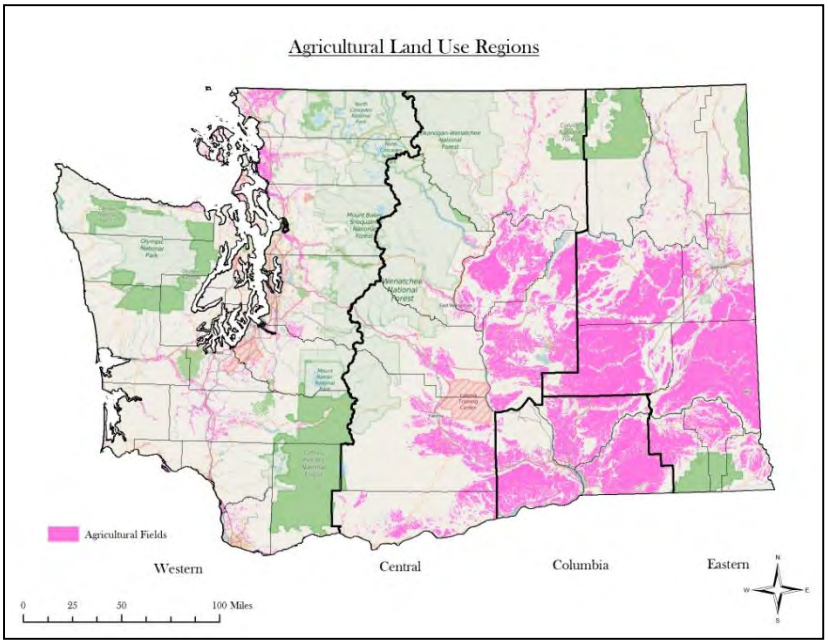

Figure 1. Map of agricultural lands broken into reporting regions

Agriculture in Washington

Washington State is home to rich volcanic soils, a diverse climate, and some of the largest irrigation systems in North America. Its location makes it ideal for overseas exports, with deep water ports and easy year-round accessibility to Asia. It is not surprising that Washington uses these advantages to grow more than 300 crops annually, placing the state second behind California in total agricultural exports (WSDA, 2015a). Washington State is divided into two distinct regions divided by the Cascade Mountain Range. Western Washington is highly urbanized, and farms tend to be smaller in scale. Dairy products, poultry, hay, and berries are the dominant products. Eastern Washington tends to be more rural and the farms are larger, producing the majority of Washington's tree fruit, wheat, barley, pulse crops (dry peas and lentils), wine and juice grapes, and potatoes.

The 2013 crop production value in Washington exceeded $10 billion, and food processing brought another $15 billion in revenue (this is the most recent crop value information available from NASS). The agricultural industry supports over 160,000 jobs throughout the state and agriculture makes up 13-15 percent of the state's economy each year (NASS, 2015b).

Apples continue to dominate the economic output of farming in Washington, with a 2013 crop value of $2.19 billion (22 percent of the state's total crop value). This was followed by milk

($1.298 billion), wheat ($1.014 billion), potatoes ($792 million), and cattle and calves ($706 million). In the context of U.S. production, Washington is the top producer of a wide variety of crops, which include (NASS, 2015c):

- hops (78.7 percent)
- spearmint oil (69.6 percent)
- wrinkled seed peas (77.7 percent)
- peppermint oil (26.4 percent)
- apples (63.9 percent)
- Concord grapes (51.5 percent)
- sweet cherries (65.1 percent)
- pears (50 percent)
- processing green peas (32.6 percent).

Agriculture is a constantly developing industry, with changes in cropping systems and commodities grown driven by external pressures like increasing temperatures, water uncertainty, market prices, new technology, and available growing space. This changing landscape also makes it more difficult to quantify the impacts of drought. An analysis of acreage in different crop groups since 2007 shows slight increases in fruit, grain, and vegetable production although the total number of crop acres has remained relatively stable (Figure 2). For instance, Washington has seen a significant increase in wine grape production, with more than 50,000 acres in production in 2015. One example of change due to market pressure is the recent significant increase in wine grape production, with more than 50,000 acres in production in 2015. Much of this acreage was already in crop production, likely in Concord juice grapes. Juice grapes are grown in locations that may be favorable for wine grapes, but with less sophisticated irrigation systems; the higher market price that wine grapes command drives the conversion of acreage. Technology development and adoption can also be stimulated by external pressures like water uncertainty. Washington growers have become more efficient irrigators as cropping systems have evolved. The central Washington orchards full of large trees have been replaced by orchards using a trellis system that allows increased fruit production on the same acreage.

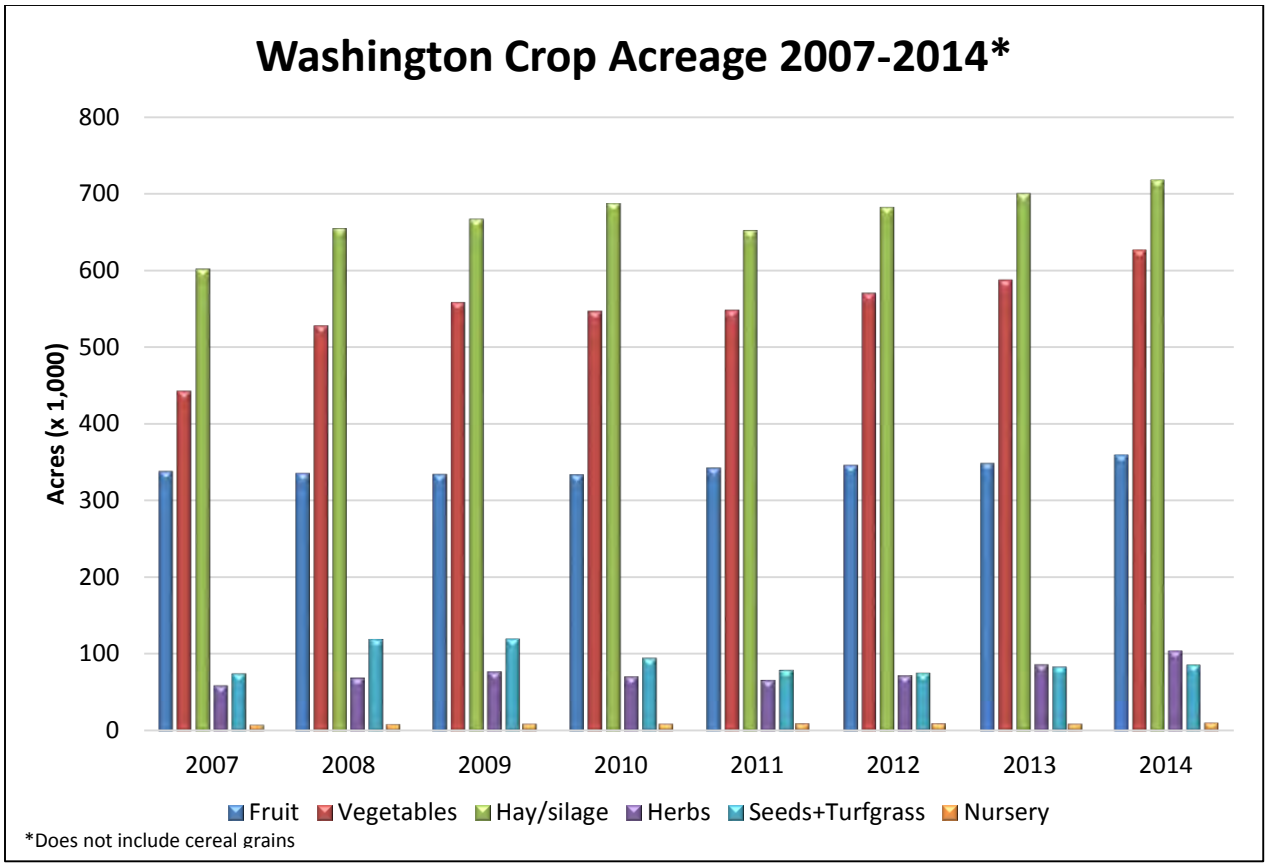

Figure 2. Washington crop acreage 2007-2014 (excludes cereal grains)

2015 External Pressures

There were an unusually large number of external pressures affecting the market value of Washington State's 2015 crops. A mid-winter port slowdown along the West Coast dramatically slowed shipping times, often meaning crops sat waiting to be loaded onto or off of ships. Depending on the crop type, this affects storability, marketability, and final values for 2014 crops. It also affected marketing of early-harvested 2015 crops (spring wheat and timothy hay).

2015 was a year of temperature extremes across most of Washington State. By early May, temperatures were already 2-4°F above normal across central and eastern Washington; the rest of the state was trending approximately 2°F above normal. Temperatures during the first week of July ranged 9-15°F above normal throughout most of Washington State. This heat exacerbated the impacts of little to no snowpack accumulated during the winter and extremely low stream flows throughout the state (OWSC, 2015).

Wildfires impacted a large portion of central Washington during the summer of 2015 (for some of this region, it was the second straight year of fire damage). Affected facilities include fruit packing houses, rangeland, pasture, and orchard edges; outcomes were either complete loss or damage during the fires. These historic wildfires burned over 1 million acres and cost the state $178 million to fight.

Analyzing the impact of drought is extremely difficult. Of the three pressures listed above, extreme heat is one that would be very difficult to isolate from standard drought conditions; WSDA has chosen to evaluate the impact of the low water year and extreme heat in combination. This report does not cover losses from the port slow down or the wildfires.

Washington Water Supplies

Approximately 80 percent of Washington water withdrawals are for agricultural purposes (WSU, 2015). Water for Washington agriculture comes from two main sources: surface water and groundwater. Surface water is the largest source, accounting for approximately 75 percent of agricultural water needs on average (WSU, 2015). Some farmers and ranchers have surface water rights administered by the Washington State Department of Ecology (Ecology), others have contracts with entities like the United States Bureau of Reclamation (USBR) in the Yakima Valley.

In some parts of Washington, demand for water greatly exceeds availability. In the Yakima Basin, for example, some irrigation districts are “prorated” by USBR in low water availability years, and receive only a portion of their water right. These proratable districts are junior water right holders, with water rights granted post-1905. Senior water right holders (pre-1905) receive their full water right. Due to western water law’s prior appropriation doctrine (first in time, first in right), junior water rights holders are often curtailed in drought years. Since 1992, there have been 6 low water availability years (1992,1993,1994,2001,2005,2015) where proratable irrigation districts in the Yakima Basin received far less than their full allocation of water (Roza Irrigation District, 2015).

Groundwater withdrawals account for approximately 25 percent of irrigation water use in Washington (WSU, 2015). In drought years, emergency drought well permits are issued and groundwater may be more heavily used. A water user with an emergency drought well permit

may use their well during a drought declaration as long as their use is mitigated (Ecology, 2015). Ecology requires mitigation water to offset the use of the wells, in an effort to prevent groundwater levels from dropping. The most recent USGS Water Use Trends in Washington report (1985-2005) reported an average increase of 16 percent in crop-irrigation withdrawals during that 20-year period (Lane, 2009). During this time, surface water withdrawals for crop irrigation increased by 22 percent while groundwater withdrawals for crop irrigation increased 10 percent (Lane, 2009).

2015 Drought

During the winter of 2014-2015, much of the precipitation in the mountains fell as rain rather than snow due to above average temperatures. The snowpack is considered to be a "third reservoir", and is an important water source for rivers as lowland precipitation tapers off in the late spring/early summer. This resulted in low snowpack which was the initial driver of the 2015 drought. On March 13, 2015, Governor Jay Inslee declared a drought in 3 regions in Washington state; the Olympic Peninsula, the east side of the central Cascade mountains (including Yakima and Wenatchee), and the Walla Walla region. This declaration included a total of 11 watersheds (6 west and 5 east of the Cascades). Water supply dropped quickly, leading to a second drought declaration by the governor on April 17, 2015. After this declaration, nearly half of the state (44%) was declared a drought emergency area. This state declaration included 24 of 62 total river basins (16 basins in western Washington and 8 basins in eastern Washington). Snowpack in April was much lower than normal with a statewide average snow water equivalent of 25% of normal. Conditions throughout the state continued to decline, leading to a final statewide drought declaration on May 15, 2015. By the May declaration, about one-fifth of the state's rivers and streams were at record lows. The peak of the drought occurred during the last week in August, when 85 percent of the state was categorized as "extreme drought" (shown in red below) (Figure 3).

Week of August 25, 2015

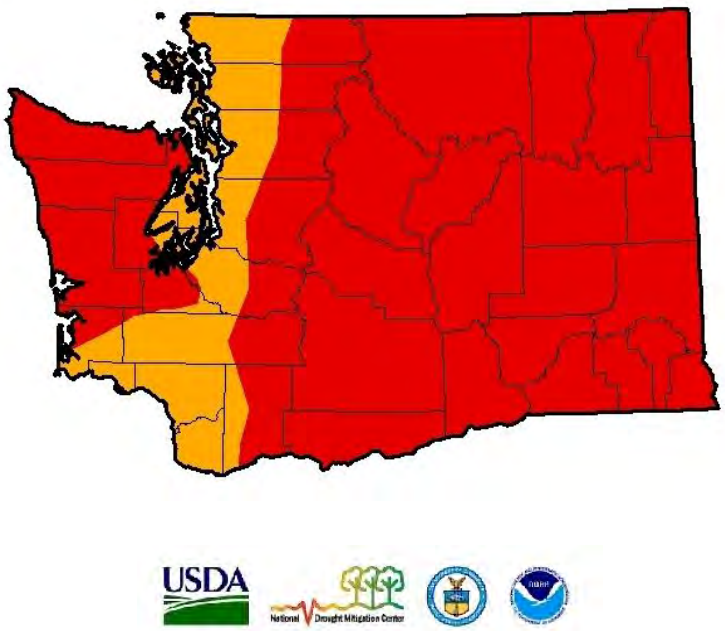

Figure 3. USDA Drought Monitor Map August 25, 2015

Methodology

All data collection was completed by WSDA staff through email conversations, online surveys, windshield field-based surveys, phone conversations, and in-person meetings.

Meetings (phone, email, in person)

WSDA NRAS staff conducted a number of meetings with commodity groups to gather yield and quality information throughout the state. To date, data has been gathered on tree fruit (apples, cherries, and pears), wheat, blueberries, red raspberries, timothy hay, irrigated pastures, and field cropping patterns (specific to Yakima valley). All of these meetings were conducted between November 10, 2015 and December 15, 2015 and contain quantitative information (when available) and some qualitative reporting of impacts for specific commodities or heavily-affected areas.

Targeted Mapping Effort – Kittitas Reclamation District

WSDA originally expected impacts from this drought would be most severe in the areas served by prorated irrigation districts in the Kittitas and Yakima valleys. To assess field level impacts, NRAS staff completed new windshield surveys of all fields within the boundaries of the Roza Irrigation District and Kittitas Reclamation District. Qualitative data was also collected on crop losses in both districts. At the time this report was published, qualitative assessment and mapping in the Kittitas Reclamation District were complete; this data is included in the results section. Qualitative assessment and mapping in the Roza Irrigation District is ongoing.

The Kittitas Reclamation District (KRD) is a proratable irrigation district in the Kittitas Valley in central Washington. KRD receives less than its full entitlement of water in drought years. In September 2015, WSDA staff surveyed KRD to analyze crops for impacts from drought. KRD staff participated in the data collection process. Staff specifically looked for dry or unharvestable crops and other signs, such as land left fallow due to drought. Site specific data was recorded for all crops impacted. Other impacts of the drought, such as yield reductions or changes in crop rotation were not documented. The survey of the area highlighted the fact that most of the damage is concentrated in the northern, western, and eastern portions of the valley. The dominant crops affected by drought within the KRD boundaries are timothy, alfalfa, and pasture.

The survey included meetings with growers to discuss specific water shortage issues. These discussions confirmed that in the KRD timothy hay usually has two cuttings and alfalfa has three or four cuttings. In 2015, most of the KRD had only one cutting of timothy and two or three cuttings of alfalfa. Additionally, the yield of the first cutting of timothy was reduced by up to 25 percent due to growers reducing water use in an attempt to stretch their water supply as late in the season as possible. Alfalfa fared better than timothy because it is an earlier crop and is more drought tolerant. The majority of the pastures in the district were dry, greatly reducing the carrying capacity for cattle. One grower stated that cattle were taken off the pastures and put into the timothy fields after the first cutting. Many growers were concerned about drought impacts continuing into next year, forecasting yield reductions of 25 percent in 2016 as a result of the 2015 drought. The results include values for crop losses and assumes pasture grazing reductions occurred in most of the district.

Online Survey

WSDA produced a short online survey for growers targeting information on the impacts of the 2015 drought. Questions were grouped by commodity type and region and included questions about impacts to yields, quality, marketability and storage. The survey also asked questions about infrastructure improvements, increased pest pressure, anticipated impacts to the 2016 crop, costs associated with drought wells, and estimations of total economic impact on the farm. Results collected through December 21st are included in this report. The survey will remain open and collect information for another two months, and that data will be used in the final report released in December 2016.

Results

Meetings (phone, email, in person)

Wheat

Wheat is a major crop in Washington State, grown in each of the four regions delineated in this report and covering a total of 2,294,279 acres in 2014 (WSDA, 2015a). The 2013 crop value for wheat was just over $1 billion and Washington ranked 4th in the nation for wheat production with 5.4 percent of the total national production (NASS, 2015a). This year's drought was a continuation of 2014 drought conditions in dryland wheat growing areas. Final 2015 wheat harvest concluded in early fall, allowing WSDA to quantify estimated drought losses for this crop (with help from the Washington Association of Wheat Growers).

The final harvest (from NASS) for all wheat crops in Washington in 2015 was 111,540,000 bushels. This number was 22% below the reported five-year average of 142,237,000 bushels. The low soil moisture, coupled with drier than normal spring and hotter than normal summer conditions led to reduced yield, heat shriveled kernels, and elevated protein levels (which affects marketability the crop) (WAWG, 2015; NASS, 2015d).

Known loss: Using the NASS five-year price average of $6.92/bushel, the estimated known loss at this time in wheat is approximately **$212.4 million.**

Apples

As mentioned above, apples are the number one crop in total value in Washington State, with 180,000 acres in production (WSDA, 2015a) and a 2013 crop value of $2.19 billion (NASS, 2015b). NASS conducts analysis of expected apple yields prior to the start of each harvest season. This estimate combines an analysis of typical average yield per acre, total acres in production, and attempts to take into account any expected external stressors on the crop. Harvest estimates in the early summer were around 125 million boxes. In contrast, late summer harvest totals dropped to 118 million boxes. Early harvest varieties were most affected by low water availability and high temperaturesin the Yakima basin – tree fruit growing regions to the north (in Chelan, Okanogan, and Douglas Counties) were less impacted by the drought. Based on

conversations with industry representatives, the 7 million box loss presented here is all attributed to either drought or extreme heat.

Known loss: 7 million boxes, 40lbs each. = 280 million lbs. With a 2014 marketing year average price of $0.309/lb (NASS, 2015a), approximately **$86.52 million.**

Blueberries

Washington is third in the nation in blueberry production. The majority of production (about 65%) occurs in northwest Washington (Whatcom and Skagit Counties). In recent years, significant certified organic blueberry operations have been established in eastern Washington (primarily Benton County). The 2014 crop value of Washington's blueberry harvest was $112 million (NASS, 2015a).

Western Washington growers reported impacts on yield, size, and quality. Prior to harvest, growers estimated that in a normal year, production would have been approximately 112 million pounds. The final harvest totals were only 104 million pounds, a loss of 8 million pounds. Meetings with producers attributed all of that loss to high temperatures immediately before and during harvest.

Known loss: 8 million pound loss (based on data received from commodity commission on lost yield) and $1.32/lb price based on NASS 5-year price average (NASS, 2015a), approximately **$10.56 million.**

Red Raspberries

Washington State is the second largest grower of red raspberries in the nation. In 2014, Washington State recorded 12,596 acres planted in red raspberries or other caneberries (WSDA, 2015a). Of this acreage, 84 is in northwest Washington (Skagit and Whatcom Counties). Red raspberry growers in this region reported both size and quality impacts from this year's drought and extreme heat.

Known loss: 26% crop loss (based on 2014 yield of 72.6 million pounds) at an average price of $0.735/lb – (5-year price average, NASS 2015a), approximately **$13.9 million.**

Cherries

The cherry harvest started almost three weeks early in 2015, mostly due to high temperatures in prime fruit growing regions of the state (central Washington and the Columbia Basin). The crop itself sustained little damage from the low water and high temperatures in 2015; due to food safety requirements and targeted export markets, cherries are picked immediately when ripe and cooled to prevent spoilage. Size was smaller than normal, which did impact some Asian export markets (they desire large, brightly colored cherries).

Pears

Pear harvest also began 10-14 days early this year, but growers did not report crop yield impacts. Due to long storage needs, pears are often harvested prior to being fully ripe, which eliminates some of the quality and storage issues seen in fruit harvested during this same time period.

Yakima Valley Information

Growers reported reduced yields and quality, additional fallowing, and impacts on crop rotation. Growers without emergency drought wells in place reported a hesitancy to planting "permanent" crops (i.e. apples, cherries, pears, hops) due to future water uncertainty. Permanent crops cannot be fallowed during low water years due to upfront capital costs, required infrastructure, subsequent fixed costs, and replanting cost. Although impacts were more severe on acreage within the Roza Irrigation District, all of the valley crops suffered in some way due to the drought and extreme heat.

Targeted Mapping – Kittitas Reclamation District

The results of the survey identified 447 impacted fields (13,051.39 acres) and 685 impacted pastures (20,201.90 acres) within the boundaries of the KRD (Table 1). Site specific information was documented to describe each field. The identified fields were paired with NASS value per harvested acre estimates (NASS, 2015a) to determine the total impact for that crop (Table 1).

Alfalfa and alfalfa/grass hay values are based on half of the normal cuttings (50% of documented 2014 crop value/acre). USDA does not have a specific value per acre for timothy hay. The economic value per acre for timothy used in this report is based on grower interviews in conjunction with USDA statistics for non-alfalfa hay. Results used were $400/ton (based on information from growers) and a five-year average yield for all other hay of 3 tons per acre (NASS, 2015c). This value per acre is a mid-range value based on one cutting only with an additional reduction of up to 25 percent due to water rationing. The value for fallowed land was set to $0/acre because actual cost cannot be calculated (the crop type that would have been grown is unknown). The value of pasture losses was determined through grower interviews. During a nomal year growers would expect $200/acre of pasture for the grazing season of 4 months. During 2015 this value was reduced by half, resulting in $25 per month per acre for the duration of four months for a final total value of $100/acre. Site specific and local agricultural detail was contributed by Kittitas Reclamation District staff and board in this report.

Figure 4 shows the boundary of the Kittitas Reclamation District, as well as drought affected pastures and crops within the KRD.

Table 1. 2015 acreage and cost impacts for KRD

Impacted Crop	Impacted Acres	Value/acre ($)	Correction factor	Impact ($)
Alfalfa Hay	771.28	1,001.00	0.50	386,025.64
Alfalfa/Grass Hay	132.73	627.20	0.50	41,624.13
Apple	13.11	12,163.00		159,470.10
Fallow	565.64	0.00		0.00
Grass Hay	632.25	627.20		396,547.59
Oat	38.65	178.50		6,898.40
Pear	24.73	10,959.00		270,966.39
Sudangrass	56.61	627.20		35,505.19
Timothy	10,743.10	1,200.00	0.625	8,057,325.00
Triticale Hay	73.29	627.00		45,955.11
Pasture	20,201.90	100.00		2,020,190.00
Total	**33,253.29**			**$11,420,507.55**

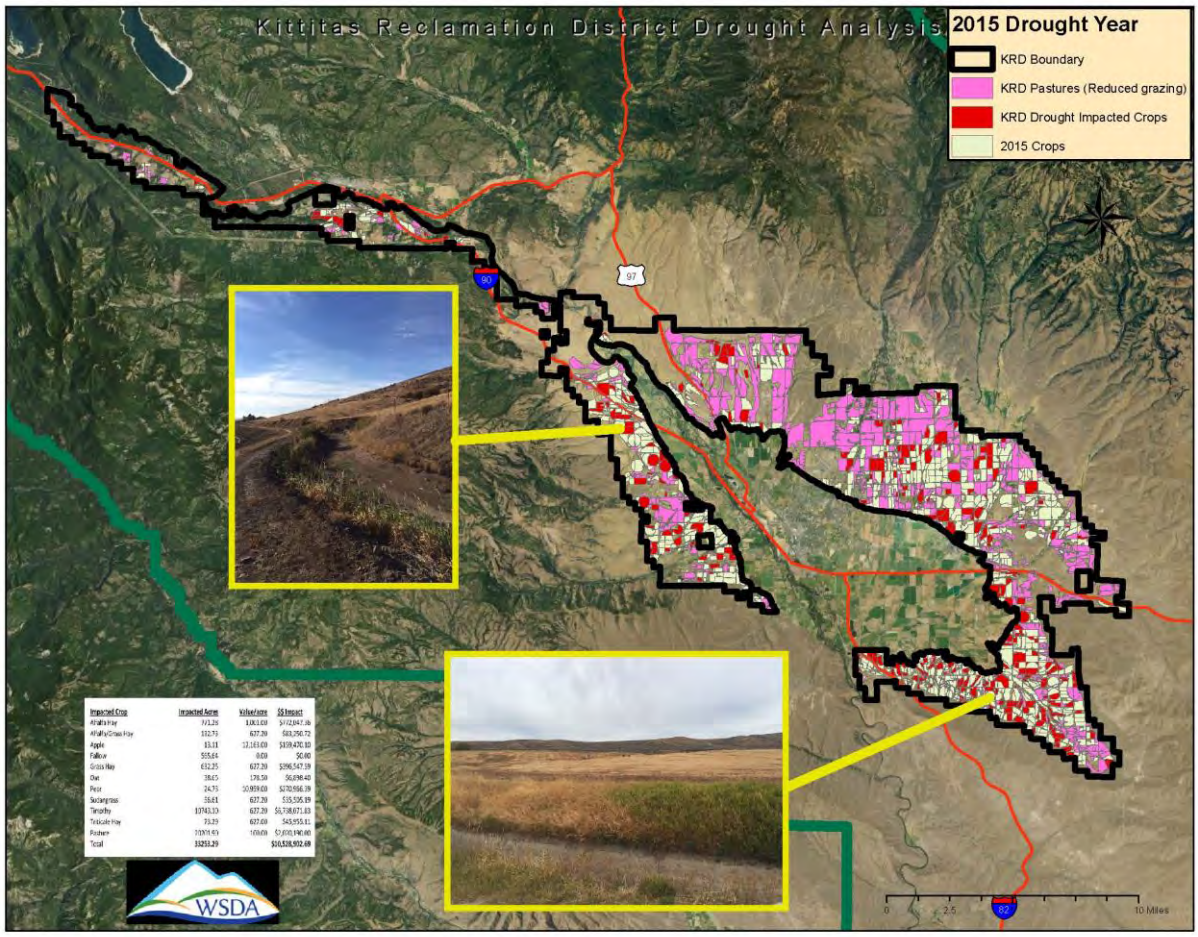

Figure 4. Targeted Mapping Results for Kittitas Reclamation District

Online Survey

Question #1: Crop Type Information

Respondents could provide information about four main crop groups (shown in Figure 5), with a variety of sub-categories in each main group. Respondents could submit more than one survey to provide information about more than one crop. The fruit grouping includes tree fruit, berries, wine grapes, and juice grapes. The field crop grouping includes vegetables, seed crops, nursery and greenhouse crops, hops, mint, bulbs, and market crops. The animal feed category covers pasture, corn, hay, and rangeland. The final grouping is dryland crops, which covers wheat, barley, peas, and lentils. There were 452 survey respondents (107 fruit, 96 field crops, 122 animal feed, and 127 dryland crops). There were 12 survey responses that were not included in this chart (cattle, eggs, honey, pork, timber, shellfish).

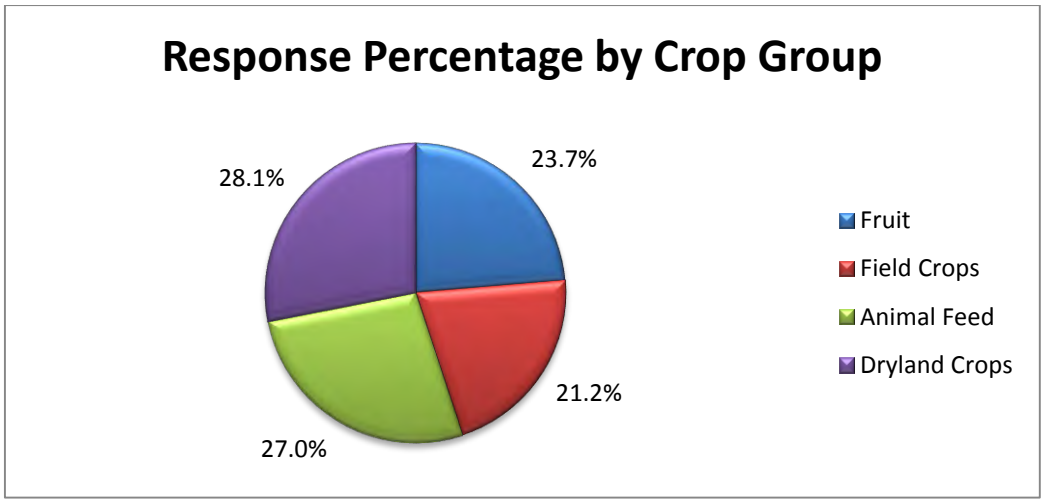

Figure 5. Crop Grouping Percentages

Question #2: Region of Operation

WSDA asked all respondents to share information about the location of their farming operation. The state was broken into four regions (Western, Central, Columbia Basin, and Eastern). The least represented region was the Columbia Basin at 13 percent of the total response area; this was expected, since these three counties are heavily irrigated by the Columbia Basin Project, which operated with a full water allotment in 2015.

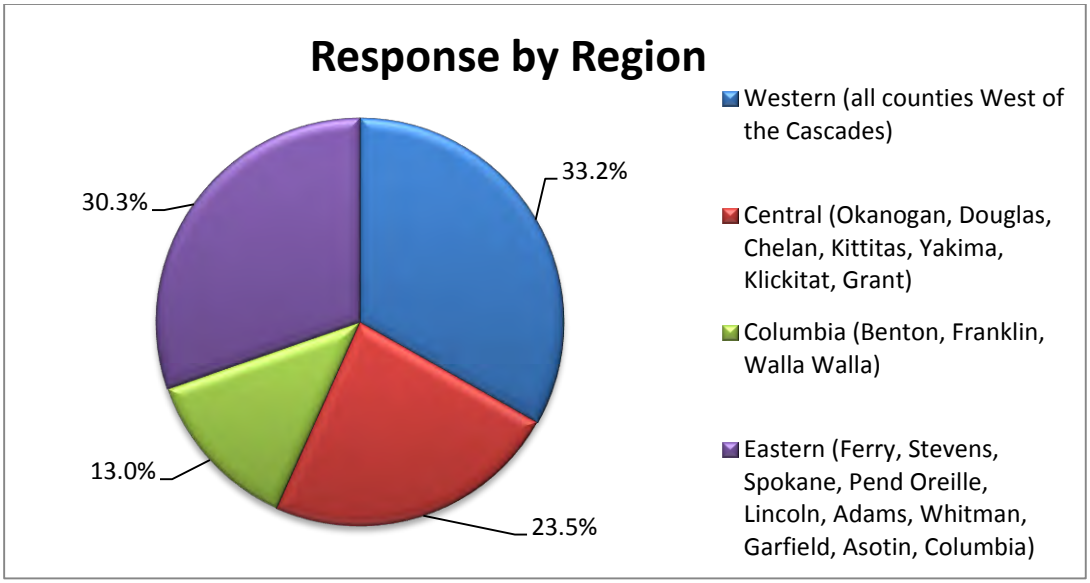

Figure 6. Region of Respondent Operations

Question #3:Yield Reduction Due to Drought

Respondents were asked to choose from a range of options for yield losses caused by the 2015 drought. The choices for yield loss were 0 percent, 1-10 percent, 11-25 percent, 26-50 percent, and greater than 50 percent. Figure 7 shows the number of respondents within each grouping by loss. Of note, animal feed and dryland crops showed the greatest losses, with 67.5 percent and 76.8 percent, respectively, reporting greater than a 26 percent reduction in yield due to drought and extreme heat. For fruit and field crops, the majority of respondents reported losses of 11-50 percent, with 61.2 percent for fruit and 56.3 percent for field crops.

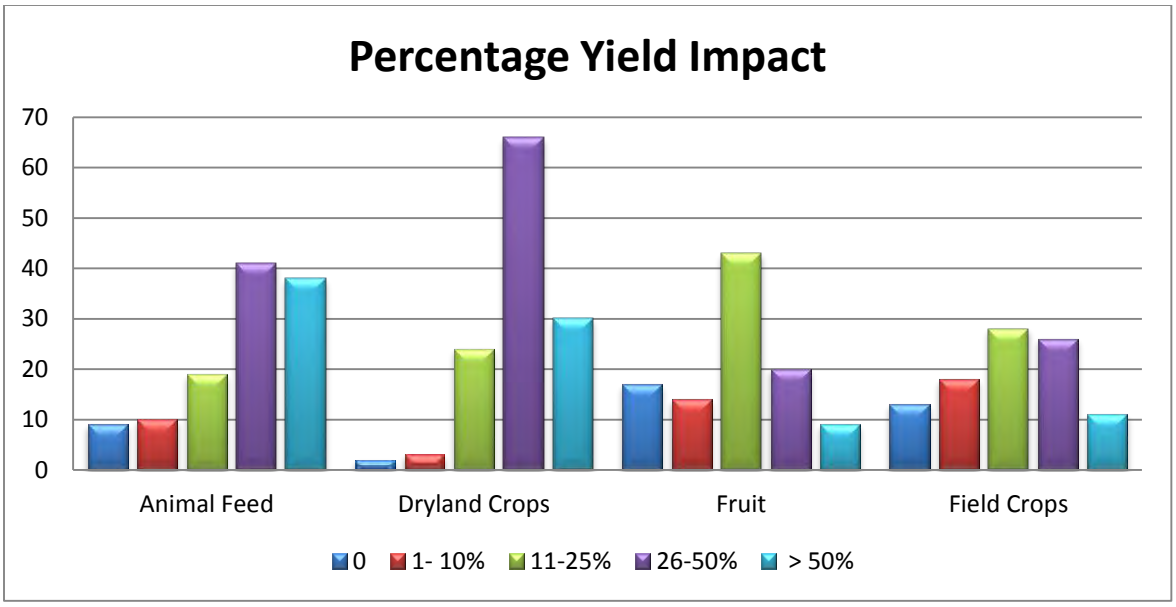

Figure 7. Yield Impact by Crop Group

Question #4: Impacts on quality and marketability

When respondents were questioned about whether the drought or high temperatures impacted either the quality or the marketability of their crop, 460 responded, with 298 (64.8 percent) stating yes and 162 (35.2 percent) responding no. This corresponds well with reports received when meeting with growers and commodity representatives.

Question #5: Drought impacts on storage

WSDA had received anecdotal information that some crops (especially tree fruit) harvested in the height of 2015's summer heat wave did not store as well as in normal weather years. To try and obtain more information, the respondents were asked whether or not they saw reduced storability caused by the 2015 drought and extreme heat. 146 (31.7 percent) of respondents replied that storability of their most recent crop was reduced by the drought and heat.

Questions #6 & 7: Drought-related infrastructure needs

In questions 6 and 7, WSDA attempted to determine whether or not the drought or extreme heat caused respondents to spend additional money on infrastructure improvements. Approximately one-third of respondents (31.8 percent) stated that infrastructure improvements were completed in 2015 due to drought. Of those that responded with cost per acre information, 73 percent

reported the cost of such improvements ranging from $25-$1000 per acre. Infrastructure improvements might include shade cloth, micro sprinklers, or more efficient irrigation equipment.

Question #8: 2016 Impacts

WSDA asked all respondents whether the drought conditions in 2015 would affect the 2016 harvest. These impacts could include plant damage, yield reduction, reduced size, crop rotation changes (potentially to a lower value crop), or reduced marketability. Most respondents (434) answered this question, and almost two-thirds (61.5 percent) reported that they expect the 2015 drought to have negative impacts on their farming operation and 2016 crop.

Question #9: Economic Impacts

The online survey included a question about the total economic impact of this year's drought on farming operations. This data is meant to capture reported impacts throughout the state and is not specific to any region or crop group. Figure 8 shows the responses from agricultural operations of different sizes, cropping patterns, locations, and scale. These responses may come from operations as diverse as 6-acre direct marketing farm in western Washington and a 4,000 acre wheat farm in the Palouse.

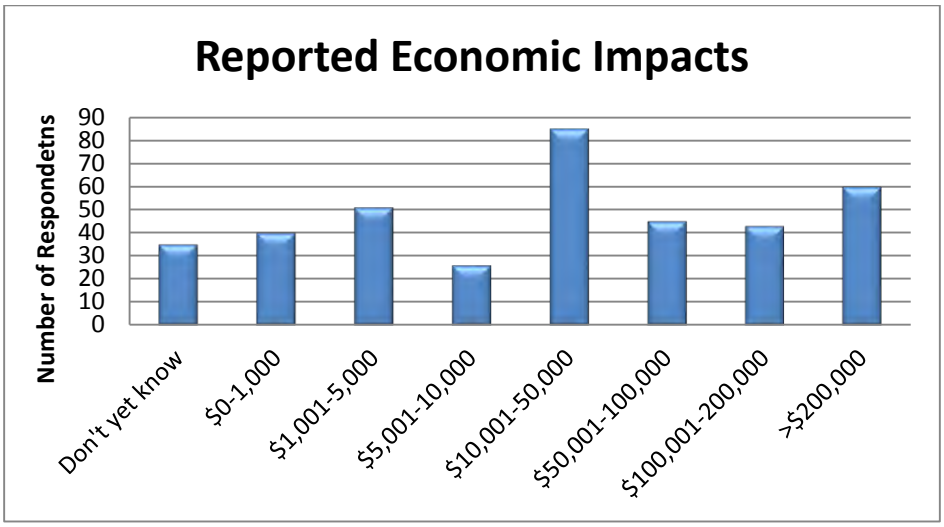

Figure 8. Reported Economic Impact Categories

Question #10: Pest Pressure Changes

WSDA staff has received anecdotal information that pest pressures were higher during this growing season due to unprecedented prolonged periods of hot dry weather. To further understand whether this was a regional effect, specific to a certain crop type, or a statement that can't be substantiated, the online survey included a question regarding the believed impact of this year's drought and hot temperatures on pest pressure. Was it increased or similar to a normal year? A total of 437 respondents answered the question, and the results were split; 52.2 percent (228 respondents) stated that there were no changes in pest pressure this season and 47.8 percent (209 respondents) stated that pest pressure increases were influenced by the drought and extreme heat. There was no indication in this initial data that these answers vary by region or crop type.

Preliminary Conclusions

As stated earlier, data collection for this interim report began in early November and ended a six weeks later on December 21, 2015. This report is not intended to provide an estimate of the total economic impact of the 2015 drought on agriculture; there is not yet enough data to make any final statements and all losses reported are estimates.

The response collecting and providing this impact information has been very good. Most growers and commodity groups appreciate the effort by WSDA to put numbers and impacts into a concise document that can be used by regulators and the legislature to direct economic relief in future drought years.

The impact of this year's drought were not limited to certain crops, or certain regions, or even certain times of the year. Every farmer in the state felt some type of impact in 2015, whether it was yield or quality reduction, crop rotation related, a shortened harvest period (due to fast ripening during extreme heat), or some other effect. Many of these impacts will not be quantifiable even with more data collection in 2016. As of the 2012 USDA Agricultural Census, Washington State had 37,249 farms. It would be impossible to contact each of them individually.

The main conclusion from this interim report is that impacts were widespread and will be ongoing. In the agricultural industry, a drought is not a single point of impact, simply because crop growing periods, seeding, drought damaged plants, and other issues take time to resolve. We will not truly know the impact of this drought for two to four years, and that is only if another drought does not occur during this time. Farming operations will struggle to stay solvent, despite their technological innovation and adapting practices, if climate and weather changes like those seen in 2015 become more regular.

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Appendix A: Ecology Grant Scope of Work

Economic Impact Assessment: 2015 Drought and Agriculture

Introduction

The water year that began in October 2014 was one of the driest years on record for Washington State. The winter of 2014 was quite dry, with little to no snowpack in the Cascade Mountains. That snowpack feeds rivers, streams, lakes, reservoirs, and irrigation systems throughout eastern and western Washington during the dry summer months.

Ecology approached the Washington State Department of Agriculture to request an analysis of the 2014 water year and subsequent 2015 drought declaration on Washington agriculture. This study, when complete, will provide both qualitative and quantitative data on the impact of the 2015 drought on Washington agriculture. This information will then be available to agencies and the legislature when conducting future drought planning and identifying key impact areas throughout the state.

Applicable Documents

A significant amount of the data needed to complete a true economic assessment of the impacts of the 2015 drought on agriculture will not be available for quantification until late 2016. The ripple effect of the drought on 2016 crops is also yet to be determined. Due to data availability, this project will be broken into multiple deliverables to allow for incorporation of data as it becomes available.

Requirements and Tasks

Task 1: Project Management
Due Date: December 31, 2016

WSDA will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of payment vouchers, fiscal forms, and progress reports; compliance with applicable procurement, contracting, and interlocal agreement requirements; application for, receipt of, and compliance with all required permits, licenses, easements, or property rights necessary for the project; and submittal of required performance items.

WSDA must manage the project. Efforts will include conducting, coordinating, and scheduling project activities and assuring quality control. Every effort will be made to maintain effective communication with the WSDA designees; Ecology; all affected local, state, or federal jurisdictions; and any interested individuals or groups. The WSDA must carry out this project in accordance with any completion dates outlined in this agreement.

WSDA must ensure this project is completed according to the details of this agreement. WSDA may elect to use its own forces or it may contract for professional services necessary to perform and complete projectrelated work. Required Performance:

1. Effective administration and management of this grant project.
2. Maintenance of all project records.
3. Timely submittal of all required performance items including reports and vouchers.

Task 2: Agricultural Land Use Mapping of Most Affected Areas
Due Date: December 31, 2015

WSDA agricultural land use mapping staff will complete a field survey of all farms being served by water in the Roza Irrigation district. Data collected will include information about crop being produced, irrigation type, field boundaries, and any qualitative information easily discerned via field surveys (i.e. tree health status - good, stressed, dead and requiring replacement). Acres impacted directly by drought will be quantified and included in a report on other drought impacts, and all fields in the affected areas will be placed in a geodatabase and sent to Ecology staff for their records.

Task 3: Initial Qualitative and Quantitative Drought Impacts Data Collection
Due Date: December 31, 2015

WSDA's senior natural resource scientist and hydrogeologist will work with stakeholders in agricultural communities throughout the state to quantify known impacts of the 2015 drought. This includes talking to major commodity producers and grouping data into regions (western, central, Columbia Basin, eastern) and commodity buckets (fruit, field crops, dryland). Prorated irrigation districts that were anticipated to have greater impacts will be detailed separately within the report. Data will include (when available) quantifiable impacts on yields. When available, WSDA staff will also collect information on secondary drought impacts (changed planting/harvest schedules, additional costs for running pumps on drought wells and mitigation payments, labor impacts, etc.)

Task 4: Final Qualitative and Quantitative Drought Impacts Data Collection
Due Date: December 31, 2016

WSDA will use all available quantifiable data as well as interviews with commodity representatives to complete data collection for the 2015 drought impacts on agriculture. This will include phone calls, in person meetings, and emails to representatives throughout the state. USDA NASS data will be used when it is available. The final product will encompass all data analysis and methods of both collecting and analyzing the data.

Task 5: Interim and Final Report
Due Dates: December 31, 2015 (interim) and December 31, 2016 (final)

Ecology will receive an interim report with all data available through December 10, 2015 and a final report with all data available through October 15, 2016. WSDA staff will also prepare a fact sheet for this report. All documents prepared for the project will be made available via WSDA's website.

Task 6: Subcontract draft final report for review and analysis by Washington State Academy of Sciences
Due Date: December 31, 2015

WSDA will deliver a draft report to WSAS for review and comments prior to finalizing and submitting the report to Ecology.

Project Budget

TASK	TASKS	BUDGET
1	Project Management	$5,500.00
2	Agricultural Land Use Mapping of Most Affected Areas	$3,000.00
3	Initial Qualitative and Quantitative Drought Impacts Data Collection	$8,000.00
4	Final Qualitative and Quantitative Drought Impacts Data Collection	$12,500.00
5	Interim and Final Report	$10,000.00
6	Subcontract draft final report for review and analysis by Washington State Academy of Sciences	$6,000.00
	TOTAL PROJECT BUDGET	**$45,000.00**

Appendix B: Online Survey Questions

Introduction: The Washington State Department of Agriculture (WSDA) is compiling information about how 2015 drought conditions have affected our state's agricultural operations. The data we collect will be used to prepare an economic assessment of this year's drought and better target future drought funding and support.

Please answer the questions for your operation or farm. Your feedback is important. The survey results will be grouped by region and crop groupings, allowing individual grower operations to remain anonymous. This survey contains 13 questions and should take no more than 5 minutes to complete.

1. For this survey, I am providing information about the following: (Pick one category)
    a. Tree Fruit (apples, pears, cherries, peaches, nectarines, apricots)
    b. Small Fruit (raspberries, strawberries, wine grapes, blueberries, juice grapes)
    c. Vegetables (potatoes, carrots, sweet corn, green peas, asparagus, onions)
    d. Pulse crops (peas, lentils, chickpeas)
    e. Grain crops (wheat, barley)
    f. Herbs, etc. (spearmint, peppermint, hops, bulbs)
    g. Animal Feed crops (corn, hay, pasture, rangeland)
    h. Other (please specify)

2. I operate in the following region:
    a. Western (all counties west of the Cascades)
    b. Central (Okanogan, Douglas, Chelan, Kittitas, Yakima, Klickitat, Grant)
    c. Columbia (Benton, Franklin, Walla Walla)
    d. Eastern (Ferry, Stevens, Spokane, Pend Oreille, Lincoln, Adams, Whitman, Garfield, Asotin, Columbia)

3. The 2015 drought affected my harvest yields by this percentage range:
    a. 0%
    b. 1-10%
    c. 11-25%
    d. 26-50%
    e. Over 50%

4. The drought affected the quality or marketability of my crop or product.
    a. No
    b. Yes (If yes, what percent?)

        Fill in box

5. The drought or high temperatures affected how long I stored my crop or product.
    a. No

b. Yes

6. The drought caused me to make infrastructure improvements (i.e., shading fabric, irrigation equipment upgrades, etc.) **(Do not include drought well operation).**
   a. Yes (if yes, cost per acre and number of acres impacted)
      Cost: Fill in Box Acres: Fill in Box
   b. No

7. I expect the 2015 drought will affect my 2016 crop.
   a. Yes
   b. No

8. The 2015 drought caused a total economic impact on your farm of: (in dollars)
   Fill in Box

9. The drought and high temperatures increased pest issues on my farm operation.

   Yes/No

Drought Well Questions

10. I operated an emergency drought well in 2015.
    a. Yes
    b. No

11. My well required maintenance.
    a. Yes
    b. No

12. The approximate cost of running the well was: (In dollars or gpm)?
    Fill in Box

13. I ran my well for the following number of hours a day.
    Fill in Box