LONG TERM TRENDS AND THE FUTURE OF THE ALFALFA & FORAGE INDUSTRY

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ABSTRACT

Alfalfa is a key economic crop in all 11 Western states. In this paper we examine historical factors and key recent 'megatrends' which will likely impact alfalfa in the future. Acreage, yield, and production has mostly been static over the past 20 years, but the importance of alfalfa and other forages is thought to be increasing, given high world demand and increases in Western dairy herds. Key trends include a rise in emphasis on forage quality and testing, the advent of genetically engineered alfalfa, emerging pests such as aphid infestations and stem nematode. The economic and environmental health of the Western dairy sector is certainly of concern. Water restrictions, cost of production, availability, and quality are undoubtedly the most important limiting factor for alfalfa for the future, as well as a need to increase yields and improve consistency of forage quality testing. Researchable issues include development of salt resistance and drought tolerance, irrigation management approaches, improved IPM techniques, and forage quality evaluation. The lack of grower and USDA support for research is noted as a key limiting factor for the future of forage crops.

Key Words: Economics, irrigation, water issues, yield, quality, genetics, genetic engineering, alfalfa, forage, hay, acreage, yield, production, exports, genetic improvement, costs, water, animal diet.

INTRODUCTION

Alfalfa has been an important crop in all eleven Western states since the development of Western agriculture in the 1850s, and remains a critical component of irrigated cropping systems today. It is either #1 acreage crop, or one of the most important economic crops in all Western states, and tens of thousands of farms depend upon it. The historical forces which created the high demand for alfalfa and forage crops remain operative, or have intensified today, especially since Western states now produce nearly 50% of the US milk supply, and forage acreage and supplies have been limited. Alfalfa is inextricably linked with dairy production systems, which have been under tremendous economic and environmental pressure in recent years. However, there are a number of factors, such as the increased importance of exports, severe water limitations, competition with other high-value crops, replacement of alfalfa in dairy rations, genetic advances, and world demand for milk and forages which may determine the role alfalfa plays in the future. In this paper, we examine some of the historical trends and the forces at work which may determine the future of this crop.

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ACREAGE

The acreage of forage crops in the Western U.S. has increased steadily since 1919, the earliest records are available from the National Agricultural Statistics Service (NASS, 2013).

- ***Alfalfa hay*** acres have increased from 4 to 7 million acres between 1919 and 2013 (Fig. 1). The state with the highest increase in alfalfa acres is Montana with a 4-5 fold increase. The increase in alfalfa acres in all other Western states ranges from 1-2 fold. However, since the late 1990's, alfalfa acreage has remained steady or decreased slightly.
- ***Hay*** acres excluding alfalfa have decreased over time from 5- 6 million in the early 1920's to a little over 4 million acres in the past few years (Fig. 2). Acreage of hay other than alfalfa is about half of what it was in 1919 for California, Idaho, and Washington.
- ***Corn silage*** acres have increased over 8 fold in the Western US since 1919 (Fig 3). The largest increases have been in California, New Mexico, and Utah. Corn silage acreage has doubled since 1992.

Although acreage has increased in historically, we have seen acreage as constant or declining in most of the western states during the past 20 years. Nationally, alfalfa acreage is at the lowest point since the 1960s.

YIELD

The yield of forage crops in the Western U.S. have increased, since the early part of the 20th century similar to most other crop types (NASS, 2013). However, yields have reached a plateau in the case of hay.

- ***Alfalfa hay*** yield has nearly doubled since 1919 in the Western US from about 2.5 to 4.6 tons/acre (Fig. 4). The largest yield increases have come from Arizona, California, New Mexico, and Utah. The highest state average alfalfa yields currently are obtained in Arizona and California. However, it should be noted that yields have not really increased much at all since the 1980s in most Western states.
- ***Hay*** yield excluding alfalfa have increased from about 1.1 tons/acre in 1919 to 2.4 tons/acre in 2012 (Fig 5). The greatest yield increases have come from Arizona and California. However, similar to alfalfa, yields have not increased substantially since the latter part of the 20th century.
- ***Corn silage*** yield since 1919 has quadrupled from 5.8 to 24.4 tons/acre (Fig. 6). This yield increase has been fairly consistent since about 1940. This increase in yield over time has been fairly similar across all Western states.

An important factor for the 'yield plateau' in the past 30 years is the emphasis on forage quality, which frequently requires harvesting at shorter cutting schedules, thereby lowering yields.

PRODUCTION

Forage crop production has increased in the Western US since 1919, but has remained constant since the 1990s (NASS, 2013).

- ***Alfalfa hay*** production in the Western US increased steadily from the mid-1930's to the mid-1990's (Fig. 7). California, Idaho, and Montana account for the largest increase in

hay production since 1919. Since about 1995, alfalfa production has not changed appreciably until the years after a peak in 2009 where production has declined.

- ***Hay*** production excluding alfalfa has increased from 6.6 to 7.9 million tons in the Western U.S., an increase of over a third, from 1919 to 2012 (Fig 8). California had the largest share of this increase in absolute terms, but New Mexico had the largest percentage increase. Hay production has been increasing fairly steadily since about 1951, and was vacillated near 6 million tons for 3 decades prior.
- ***Corn silage*** production has increased in the Western US from 0.8 million tons in 1919 to about 29 million tons in 2012 (Fig. 9). About 60% of this increase is due to production in California and Idaho. Corn silage production was steady at a bit less than 1 million tons from 1919 to 1937, increased to 15 million ton in 1972, was stable at 15 million tons until 1994, increased to 30 million tons in 2008, and had decreased slightly the last few years.

There is little doubt that alfalfa hay production in the western states has not kept pace with the rapid expansion of dairy production in western states – the difference being made up mostly by corn and small grain silage, and by grain and other concentrate feeds.

NATIONAL TRENDS IN FORAGE PRODUCTION

In non-Western states of the US, forage production has been similar to Western states in some cases but not others.

- ***Alfalfa hay*** production in non-Western states has declined since 1980 when tons produced were roughly similar to Western states to the present time where Western states produce almost twice as much alfalfa hay as non-Western states. The decline in alfalfa hay production in non-Western states is due to declining acreage and not yield.
- ***Hay*** production excluding alfalfa in non-Western states has increased in a fashion similar to Western states. However, it should be noted that non-Western states produce about 10 times as much non-alfalfa hay as Western states, so the increases in absolute terms are much greater.
- ***Corn silage*** production in non-Western states has not increased significantly since about 1997, due to relatively stable acreage and yields. This is in contrast to Western states where corn silage production has increased dramatically since the mid-1990's.

DAIRY DEMAND

A key 'megatrend' for Western forage producers is the rapid expansion of Western dairy herds during the 1970 through 2008 period, and even continuing today (Fig. 10). This has been nothing short of phenomenal, since both herd numbers and production per cow have increased substantially over that period in Western states. The largest percentage increases have been in New Mexico and Idaho, but California has logged the largest quantitative increase in both cow numbers and production, now producing more than 20% of the US milk supply. While Western states provided 17% of the US milk supply in 1970, today this amount is nearly 50%. This follows a trend of increased Western population, but it is primarily driven by other factors, such as high productivity, historically low feed prices, and generally low cost of production per liter through management. One factor, low feed prices, has changed substantially during the past 5-7 year period.

However, it is not clear that this rate of expansion will continue, at least in terms of cow numbers. There have been severe restrictions on expansion due to poor profitability and by environmental pressures. The reality of an 'expanding universe' of domestic demand for alfalfa by dairies has been tempered by changes in rations (more concentrates, more corn silage and by-products), and an economic crisis on the dairy side precipitated by the rapid expansion of milk production and low milk prices and high costs of production. This expansion has occurred at the same time that alfalfa production has been essentially flat. While few expect continued expansion of dairies at the same rate as the 1970-2008 period, domestic dairies remain the key economic driver for forages, and will likely remain so in the future.

EXPORTS

The phenomenal increase in hay exports must be listed as a key 'megatrend' which has impacted hay producers over the past 5-10 years. Hay exports (including alfalfa and other hay) exports from the Western U.S. have doubled from 1998 to 2012 from about 2 to over 4 million metric tons (Putnam et al., 2013, this proceedings), and increased >60% since 2007. About half of this hay goes to Japan, and the remainder goes to various countries including Taiwan, China, Korea, and the United Arab Emirates. Exports to Japan, the number one buyer, have been fairly stable around 2 million tons, and the increases since 1998 have come primarily from China, Korea, and UAE. The type of hay shipped overseas is alfalfa, timothy, sudangrass, and kleingrass. In the seven Western states, about 12% of the alfalfa and 30% of grassy hays are exported. In California, it has been estimated of the 21% of the hay was exported in 2013 (see Fig. 11, Hoyt, 2013a, this proceedings) in contrast to a previous estimate of about 1-1.5% percent in 2003 (Hoyt, 2004). If current trends continue, intensification of exports is likely to occur over the next 3-5 years, a 'megatrend' which will likely significantly influence price, availability, and markets for hay.

COST OF PRODUCTION

The cost of producing alfalfa hay has increased over the years. In Maricopa County, Arizona, for example, the cost of alfalfa hay production has increased by about 50% from $822/acre in 1998 (Teergerstrom, 2000) to $1215/acre in 2013 (Teegerstrom, 2013) (Table 1). Both operating and capital costs have increased. Some of the biggest changes in cost have been in establishment and harvest costs. Establishment costs have increased due to increases in costs of seed, fertilizer, chemicals, and fuel. Harvest costs have increased due to increased costs associated with equipment and fuel. Growing costs have not changed as much as other costs in this case because the cost of irrigation water has been relatively stable in this area, which accounts for about half of the growing costs. In other regions, water or pumping costs have increased substantially. Capital costs have not increased as much as operating costs. Fortunately, alfalfa hay price has increased in the 15 year period between 1998 and 2013, to offset the cost increase. Hay yields have increased only slightly. The net effect is that the return in 2013 is greater than 1998, where alfalfa hay was actually grown at a loss. The breakeven price for alfalfa hay has increased from $103 to $146/ton during this time period in Maricopa County, an annual increase of 2.39%.

WATER REALITIES AND CONFLICTS

As a key 'megatrend', water availability and price is without question the most important limiting factor for viability of alfalfa and forage crop production currently and into the future. Water availability and price will likely be the key determinant of alfalfa's future in Western regions. 2012 saw one of the most severe droughts on record.

It is difficult to generalize about water restrictions, since they vary so much between regions – but each state has stories about the forces at work which restrict water availability, whether it is urban demand, water transfers, environmental restrictions, endangered species restrictions, restrictions on pumping due to groundwater subsidence, or the gradual replacement of agronomic crops with permanent plantings of orchards and vineyards, particularly in California.

In short, the alfalfa industry MUST envision ever-more water-efficient production systems for the future in order to remain viable. Key strategies for addressing these water issues have been provided in more detail elsewhere (Putnam, 2012, Schwankl et al, 2013, Sanden et al., 2011). More than anything, our response to water restrictions and water management may be as important as the restrictions themselves, which are predictable enough, and have been challenging for many years. Although alfalfa is a relatively water-use efficient crop, there are undoubtedly innovative approaches to tackle a future of highly limited water supplies. Here are a few:

- Deficit irrigation strategies to produce partial seasonal crops.
- Genetic innovations and other methods to improving yields, rooting depth, stand persistence and to address the yield-quality tradeoff, thereby water use efficiency (WUE)
- Developing salt and drought tolerant varieties to utilize more marginal water
- Improving distribution uniformity with improved delivery systems such as drip and sprinklers, and better surface systems
- Traffic-controlled and GPS-monitored systems to improve WUE
- Alternative forage crops which provide advantages in water use and flexibility
- Better water scheduling and moisture monitoring systems to improve the match of ET with water applications.

Without addressing the water-use questions in alfalfa with more intensive research and private-sector innovation, the ability of this crop to survive a water-challenged future will be greatly compromised. We should remember that this is a world-wide issue, not just a Western issue, as illustrated by the decline of alfalfa production in the UAE and Saudi Arabia due to water restrictions.

RELATIVE USE OF ALFALFA HAY AND CORN SILAGE

The ration of a dairy cow has been changing over the past to include less alfalfa hay and more corn silage (Higginbotham and Karlin, 2008). Robinson (2008) reported that in California alfalfa hay, as a percentage of the feed on dairy farms in California, has decreased from 27 to 13% while corn silage has increased from 5 to 17%. The amount of alfalfa and small grain silage fed also increased during this time period. Milk production in the Western US has been increasing at the same rate as corn silage production since 1990, whereas alfalfa hay production

has not been increasing during this time period and has decreased since 2009 (Fig. 12). These statistics do not provide information on the changes in the use of alfalfa hay and corn silage as a percent of the dairy diet per se, but provide an indication of the declining use of alfalfa hay and the reliance on corn silage for milk production.

ALFALFA'S VALUE TO THE ENVIRONMENT

As the world food picture takes greater shape in the public's mind (projection of 9 billion with higher demand for high quality foods such as milk, meat, fruits, vegetables, specialty crops), we also must recognize the role that crops play in either protecting or degrading soil resources, air quality, in mitigating climate change or wildlife habitat, or in lessening the impacts on non-renewable fossil fuels. Alfalfa principally (but other forages as well) have a tremendous role to play in making a contribution to environmental improvements in the future, something that should be considered beyond their ability to produce food products. This subject has been addressed in detail elsewhere (Putnam, 2010) – but should not be forgotten when considering the future of this crop.

WHAT ABOUT THE FUTURE? - SURVEY RESULTS

We conducted a survey of Western alfalfa specialists, and of some industry members. This was a non-scientific survey, so is limited to those who cared to respond. The results of this survey are provided in Tables 1-5. This describes key issues for the region, and people's view of the critical issues and the future of the industry. Here are a few of the key points:

- Water is unquestionably the most important issue currently and in the future for the alfalfa industry.
- Alfalfa and forages dominate many Western cropping systems. Although acreage is the same or declining in many areas, the importance of alfalfa and forage crops is thought to be either the same or increasing.
- Alfalfa and forages are competing for acreage and water with more profitable crops.
- The market does not always pay for forage quality reducing the incentive for the grower to sacrifice yield for quality.
- There are endemic and emerging pest issues that are important – including blue alfalfa aphid, stem nematodes, leafhoppers as well as long-term pests such as alfalfa weevil and lepidopthora pests.
- There will be innovations in genetics, including genetic engineering. GMO issues, coexistence of GM and non-GM crops are important, given that the future will likely entail further genetic engineering trait advances.
- Standardization of forage quality remains a very important issue.
- Public education about forages and environmental education remains important.

CONCLUSIONS

Alfalfa and forage crops have a long history in Western states, and are likely to be critical to the future given the Western expansion of dairies, strong horse demand, and a phenomenal increase in export demand from the Western US. However, the industry must act to address vital issues

of water management, pest management and forage quality testing to meet the needs of the future.

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Table 1. Annual growing costs and returns for alfalfa hay in Maricopa County, Arizona in 1998 (Teegerstrom, 2000) and 2013 (Teegerstrom, 2013). The establishment costs are amortized over 3 years.

Category	Sub-category	Units	1998	2013	Change
Operating	Establishment over 3 years	$/acre	67	165	245%
	Growing	$/acre	210	230	110%
	Harvest	$/acre	158	345	218%
	SUM	$/acre	435	740	170%
Capital	Establishment over 3 years	$/acre	43	52	119%
	Growing and Harvest	$/acre	343	424	124%
	SUM	$/acre	386	476	123%
Operating and Capital	SUM	$/acre	822	1215	148%
	Hay price	$/ton	97	225	232%
	Hay yield	tons/acre	8.0	8.3	104%
	Revenue	$/acre	776	1868	241%
	Return	$/acre	-46	652	
	Breakeven price	$/ton	103	146	143%

Table 2. Status of alfalfa & forages, results of a survey of forage Specialists from Western States (2013).

State	Percent Irrigated	Importance of Alfalfa	Importance of Other Forages	Cuts per Year	Fall Dormancy Range	Forage Quality is a Major Economic Factor for our state	Standardization of Forage Quality is a Major Issue	Comments on Forage Quality
Arizona	95	Increasing	Increasing	6 to 10	8 to 10	Yes	Yes	It is difficult to impossible to produce high quality hay for milking cows during the summer
California	100	Same or increasing	Increasing	3 to 12	3 to 11	Yes	Yes	The relative importance of FQ varies considerably across the state and even across the different production regions. Some areas have a strong horse, export and beef
Colorado	87	No change	No Change	1 to 5	2 to 5	Yes	Yes	Quality is still very important for the dairy industry but we also have a high percentage of alfalfa that goes to the beef industry (feedlot and cow/calf) which is concerned less about quality and more about yield
Idaho	93	Increasing	Increasing	2 to 6	2 to 6	Yes	Yes	Sellers market currently, not much spread in price, thus little incentive for premium hay
Nevada	100	Increasing	Increasing	2 to 7	3 to 7	Yes	Yes	Much of our alfalfa is exported and quality is critical to receive adequate compensation for the high production costs and relative low yields.
New Mexico	95	No change	Increasing	3 to 8	2 to 9	Yes	Yes	Both yield and quality are important considerations; yield more important in recent drought years. NM experiences a broad range of quality even within a small regional area. Consistency of product is a big challenge.
Oregon	89	No change	No Change	2 to 5	2 to 6	Yes	Yes	Lab analysis quality is important for alfalfa, Not as important for grass and cereal hay, but importance gaining for horse hay.
Utah	70	No change	Increasing	2 to 5	2 to 5	No, Emphasize mostly yields		Today's high price environment seems to place very little premium on quality. We have growers baling strait weeds and getting a decent price. When prices are low and inventories are high, that's when it seems that quality becomes a big issue.
Washington	59	Decreasing	Increasing	2 to 5	2 to 6	Yes	Yes	Export and dairy markets are important require quality hay

Table 3. Key Pest issues and most important limiting factors for alfalfa in western states (results of a survey of Alfalfa Specialists, 2013).

State	Insects	diseases	weeds	vertebrates	What are the most important Limiting Factors for alfalfa?
Arizona	Aphids, alfalfa caterpillar, leafhopper, alfalfa weevil	stem nematode, anthracnose, texas root rot, rhizoctonia	nutsedge, bermudagrass, summer annual grasses	pocket gophers	Heat stress, Water availability, Insect problems, Intense cutting schedules
California	Alfalfa weevil, aphid complex, armyworms, alfalfa caterpillar	Phytophthora, stem nematode, sclerotinia, anthracnose	Common groundsel, mustard sp,, Setaria spp., nutsedge	Pocket gophers, meadow voles, ground squirrels, deer	Irrigation management is by far the most yield limiting factor, soil fertility management is next followed by harvest management, weed and pest control.
Colorado	Alfalfa weevil (#1), army cutworms, aphid complex, and grasshoppers	Alfalfa stem nematode (#1), crown and root rot complex	Canada thistle, field bindweed, annual mustards (most common problem), and	Pocket gophers (#1), minor ground squirrel damage in some areas, occasional deer grazing	Water, water, and water are the 3 big issues. Irrigation wells have been curtailed in eastern Colorado. Research is needed on methods to deficit irrigate alfalfa and still maintain stands
Idaho	Clover Root Curculio, Alfalfa Weevil, Aphid Complex	Stem nematode, phytophera, crown rot, common leaf spot	field bindweed, canada thistle, ventenata, annual bluegrass	pocket gophers, voles, ground squirrels, elk	Shortage of irrigation water; yield needs to increase to be competitive with corn;
Nevada	Alfalfa weevil, aphid complex, thrips, army/cutworms	Phytophora root rot, crown rot complex, fusarium wilt, spring black stem	annual mustards, annual grasses, red stem fillaree, perennial broad leaved weeds.	Pocket gophers, ground squirrels, voles, rabbits	Irrigation water availability, Irrigation efficiency, increasing costs related to production.
New Mexico	Alfalfa weevil, aphids, armyworms, cutworm (recent)	Phytophthora, Anthracnose, Fusarium wilt, Bacterial wilt	Various mustards, Bindweed, Morningglory, Annual Grasses (e.g., foxtails, Bromes, field sandbur)	Gophers, prairie dogs, deer/elk, feral hogs (increasing)	WATER! Need drought tolerant and WUE varieties for semiarid conditions. Research on watering schedules and a systems approach to evaluating economics of alternatives to alfalfa during low water times.
Oregon	alfalfa weevil, aphid complex, cutworm	Root lesion, Stem nematode, Northern Root Knot nematode	bluegrass, quackgrass, mustards, dandelions	ground Squirrels, pocket gophers, Voles, ungalates	Funding! K fertilizer research, varieties (companies are less willing to pay trial fees). Irrigation management; Nematodes (we don't really know); did I mention funding....
Utah	alfalfa weevil, pea aphid, blue aphid, spotted aphid	bacterial wilt, Verticillium wilt, Phytophthora root rot, and stem nematode	quackgrass, dandelion, common mallow, downy brome	gophers, voles, deer, elk	
Washington	Aphid complex, alfalfa weevils, clover root curculio, blister beetles	Verticillum wilt, stem nematodes, crown and root complex, leaf spots	Downey Brome in timothy, lambsquarter, mustards, ALS resistant broadleaves (ie. prickly lettuce)	Pocket gophers, voles, ground squirrels	Higher quality forages. Better stem nematode resistance, Better conventional herbicides with less crop damage

Table 4. What are the key issues in Western States? (response from CE Specialists Survey, 2013)

State	Wh do you see as the future of alfalfa and forages?	Further Comments
Arizona	I see the demand for forages continuing to increase in the future, but acreage increases will be limited by water availability and opportunities in other crops.	Alfalfa and forage trading is expanding to regional and international markets.
California	Acreage will stay static, but demand for higher quality hay will increase. Foreign demand for alfalfa will intensifiy. There will be a gradual decline in alfalfa acreage in CA as growers who can plant other more profitable crops, especially tree and vine crops, but this will also depend upon water and other agronomic crops like cotton, wheat and corn. Water supplies will continue to tighten and there will be increased competition over water for environmental and urban water uses. Alfalfa production will be relegated more and more to outlying areas and marginal soils and water supplies.	Almonds will likely surpass alfalfa as the #1 CA crop in acreage in the next 6 years. Alfalfa will remain an important crop in the CA landscape and will never go away due to the importance of the dairy industry. We need to find ways to maximize the water use efficiency of alfalfa. Increasing demand for alfalfa by foreign markets will increase the value of alfalfa hay for our local markets.
Colorado	Alfalfa gets the bad rap for its high water use and it is being looked at as a crop to replace to reduce irrigation water demands. However, it holds promise as a crop that can be deficit or partial season irrigated and still provide an economically viable yield, especially if there is some compensation for saved water. Demand for forages of all types (maybe not as much alfalfa) will remain high with the well established beef feedlot industry and the growing dairy industry (new cheese factory being constructed). The horse and small farm use and demand for forages also remains strong and growing.	Lack of financial support from the industry (alfalfa, dairy, beef, and horse industries, etc.) hinders dollars available for research. Seems strange for a crop that ranks 2nd or 3rd in the state as far as economic worth.
Idaho	Strong future for alfalfa and other forages to support the dairy industry, but yields and water use efficiency must improve; low lignin and less bloat risk alfalfa would also be important	Future for forage education, research, and extension is at a critical point and may drop below a critical mass, which will allow a decline in future production
Nevada	As the dairy industry continues to expand in Nevada, the trend should be for increased alfalfa and corn/corn silage production. However, water is still the big issue here. There is little chance for growth of acreage due to the limited amounts of water available for irrigation.	Alfalfa and other hays will continue to be the dominate crops due to climatic limitations. In the long term I'm afraid that the acreage will slowly decrease as water is moved from agriculture to urban uses.
New Mexico	The forage industry as a whole will have to become more water-use efficient. Producers will have to be more educated on conservation practices and maximization of inputs while keeping costs down. If the drought weakens and water storage returns to normal, acreage will remain similar or increase because the demand and infrastructure is present.	If drought persists and/or water becomes less available then what are the alternatives? Diverse approaches will have to be considered and accepted.
Oregon	I see the forage industry as status quo - very important to the state. I believe it will be important to move the dairies to the east of Oregon. We truck the hay to the west side and other states and overseas. All of these nutrients are being exported from producers fields, and we need to replace nutrients.	Greater organizational participation (politics and $) from the forage industry will be needed in the future to advance forage production.Lack of forage industry $ support will affect research and Extension hiring in the future based on present model.
Utah	In terms of the future of alfalfa in Utah: I believe that alfalfa and other forages will continue to be the cornerstone of cropping systems on irrigated land in Utah well into the future. Water will continue to be a big issue, as will the long-term health of the dairy industry and the attractiveness of production opportunities in other crops.	Advances in genetics, technology, and management will be important in ensuring the viability of alfalfa in cropping systems of the future.
Washington	In the long term the need for forages will be there, the question will be on the economics of production vs. market ability to pay. Nutrient removal from soils with forages will be more and more expensive in the futrue. Finding economical ways to replenish these soils will be critical.	For Washington maintaining export market is critical, maintaining higher prices. This involves maintaining a nonGMO market for alfalfa. Washington export ports must be competitive with other competitive ports for freight rates.

Table 5: Result of an industry survey on the most limiting factors and key issues that should be addressed via research/outreach by grower groups or by universities.

LIMITING FACTORS: What are the most important limiting factors for alfalfa production in your area? (ranked in order of importance)	
1	Water Availability/regulation/cost
2	Cost of Production/Profitability
3	Pest Management Issues
4	Problems with Quality/Measurement
5	Yields are too low
Other limitations: climate limitations, fertilizer costs, growing alfalfa in marginal soils including saline soils, land prices, competition with other crops, alfalfa is not keeping up in yields with other crops, viability of dairy industry, need water management technology and varieties to deal with low water, stand persistence, equipment, shipping charges.	
KEY ISSUES: What are the most important things that a grower-representative group or Universiteis should be working on? (ranked in order of importance)	
1	Irrigation Management/Water Issues
2	Pesticide Work/Approval of new tools
3	GMO Issues/Adaptation/Coexistence
4	Standardize Forage Quality Testing
5	Environmental Issues/Regulatory
6	Public Education on Forages
7	Farm Bill/federal Regulatory
8	Securing Money for Research and Education
9	Trucking/Regulatory Issues
Other Key Issues (comments by different respondents): The above question asking about public education, I assumed was concerning the general public. I would've ranked it higher if it referred to grower education. I think what you are doing with your grower symposium is vital to the industry. Too many regulations, packaging hay for certain markets, dairy profitability, research, research, research!, contamination of non-GMO seed production with GMO seed, better nematode control, longer stand life, control of pocket gophers and voles, being able to produce for 5-6 years without loss of stand. Benefits of alfalfa to IPM, research to see if GMO is tying up micronutrients in soil, need weather proof harvest system, disemination of information in a timely manner.	

Table 6. Industry views of the future of alfalfa and forage crops. Results of a survey of industry members, Fall, 2013.

What best describes your view of the future of alfalfa and forage crops?	
64%	It will remain about the same in the future, no change
31%	I'm very posititive about the future of alfalfa-I see it as becoming a more important crop
6%	I'm pessimistic about alfalfa-it will likely become less important.
Other comments about the future (comments by respondents): As our market changes we will have to change - not sure if better or worse. Diaries are using less and less alfalfa, and there are fewer dairies. Exports are increasingly driving the market. The large increase in cow numbers in China is very positive for alfalfa; other areas such as US and Argentina probably will continue their downward trend. Aside from exports, I am very concerned with the future of the dairy industry in Calif. A strong export program could counter the challenges met in the dairy industry with state & fed regulations. The era of cheap feed in the west is over. Too many factors limit any increase in forage acres. Users of forage must produce an end product that can be fed expensive feed. Alfalfa is still an important forage, high source of protein. Export market in addition to needs locally. More acres going into corn and wheat. From an environmental standpoint, it is the best crop we have. From an economic standpoint, it is one of the most stable income producers. Alfalfa is losing some of its grip on the forage market because of the equine market and their interest in grasses, especially Timothy for livestock feed. As long as dollar remains weak exports should be strong. The export market is currently good. The domestic dairy market is struggling and as grain prices fall alfalfa supply will likely increase moving prices lower. I am cautiously optimistic. There are many dairy farms going out of business in this northern Utah area. The export market has been able to pick almost everything up. They have paid a high price which is great for me but hard on the dairies. With dairy disappearance may be the prices will tail off too. As long there are cows to feed, alfalfa will be important.	
Do you think it's important to have a grower-representative group, either local, state, or national?	
50%	Yes
28%	Maybe, depends on how it's done
12%	No
Is the State Land-Grant Research and Extension System important to you and your business? (this includes county-based Cooperative Extension and campus-based research/extension	
91%	Yes
9%	No
Additonal Comments by respondents: Need fewer administrators, Claims for feed value higher than realistic. Public opinion of ag in general is that we use too much water and spray lots of pesticides. Many don't care as long as they have what they need for life (food) but there are many outspoken groups and individuals that believe we have no right to use water for alfalfa when they are being rationed for water. We need to improve productivity and $ return per acre at farm level to compete effectively with other crops. This means we need more technology for alfalfa including GMO but not limited to this one area. As new and interesting forage crops come into the market place alfalfa should be used as the standard in all educational materials. For example, timothy is similar to alfalfa in that it ..... and other crops such as Teff hay is similar to alfalfa hay in that ....Never thought we would see 200 $ hay but I sold 1st and 2nd for $225. Dairies will always need good testing hay but we have other places and options for the rest.	

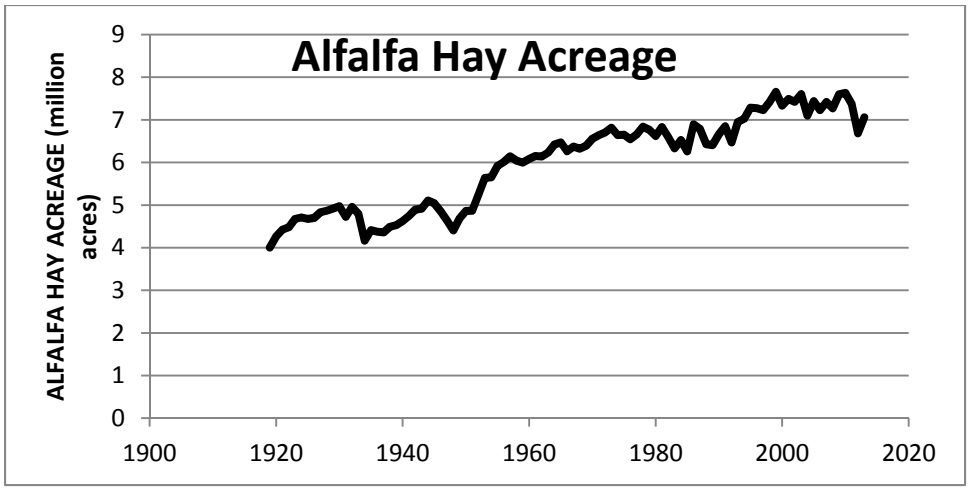

Fig 1. Alfalfa hay acreage for the Western US (NASS, 2013).

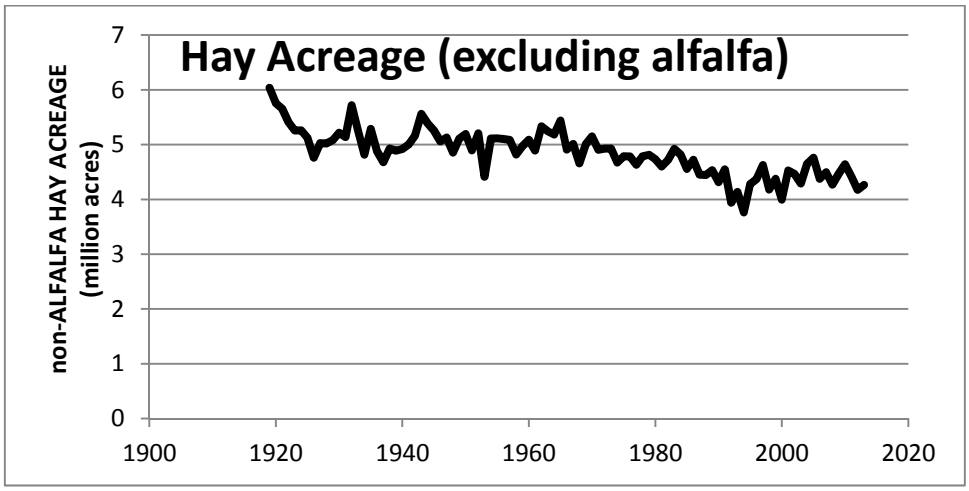

Fig 2. Hay acreage (excluding alfalfa) for the Western US (NASS, 2013).

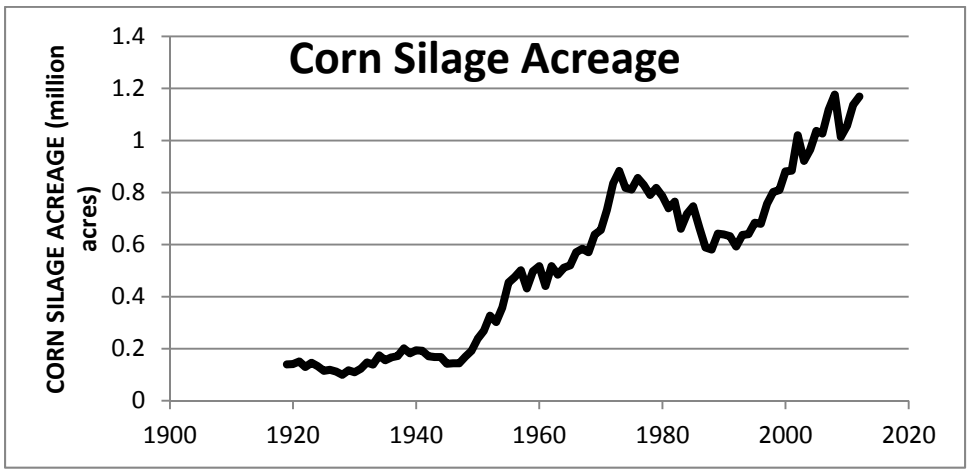

Fig 3. Corn silage acreage for the Western US (NASS, 2013).

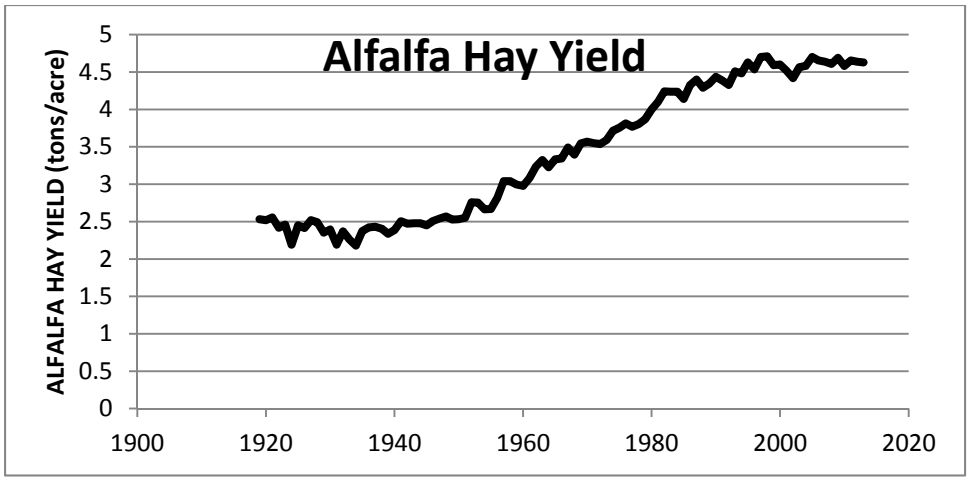

Fig 4. Alfalfa hay yield for the Western US (NASS, 2013).

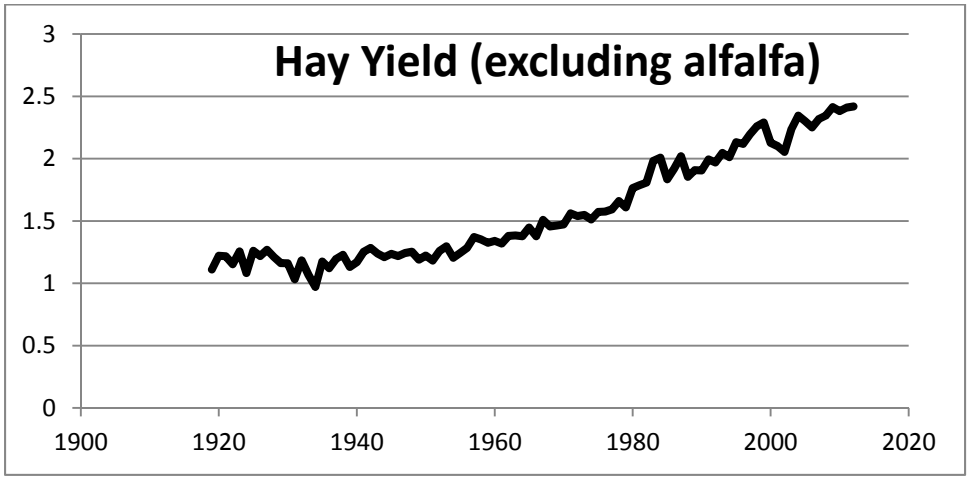

Fig 5. Hay yield (excluding alfalfa) for the Western US (NASS, 2013).

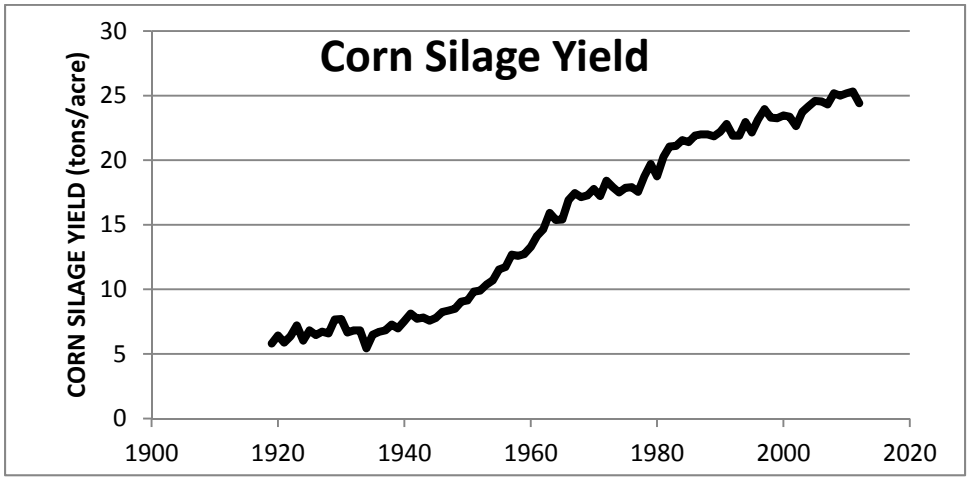

Fig 6. Corn silage yield for the Western US (NASS, 2013).

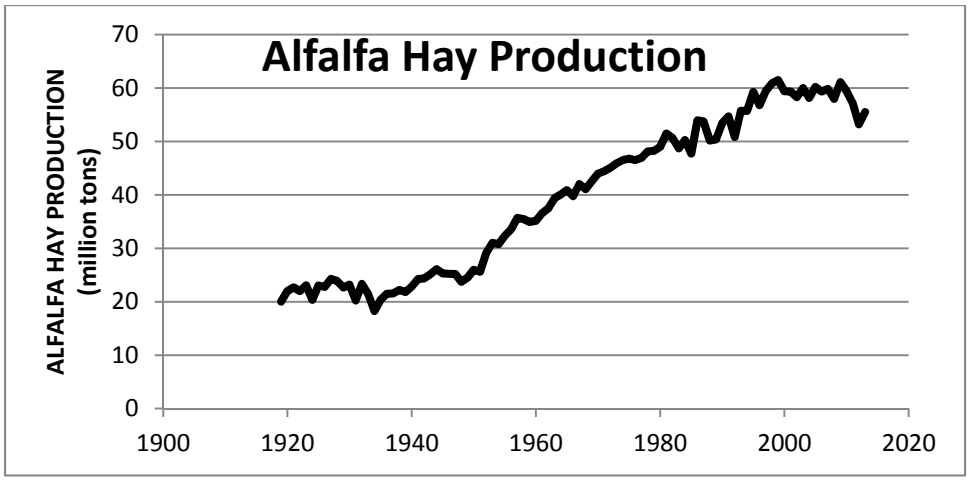

Fig 7. Alfalfa hay production for the Western US (NASS, 2013).

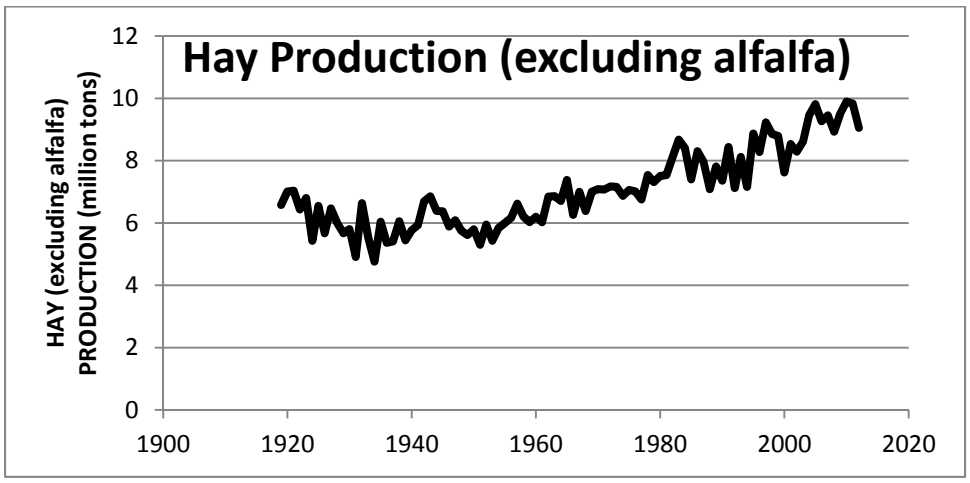

Fig 8. Hay production (excluding alfalfa) for the Western US (NASS, 2013).

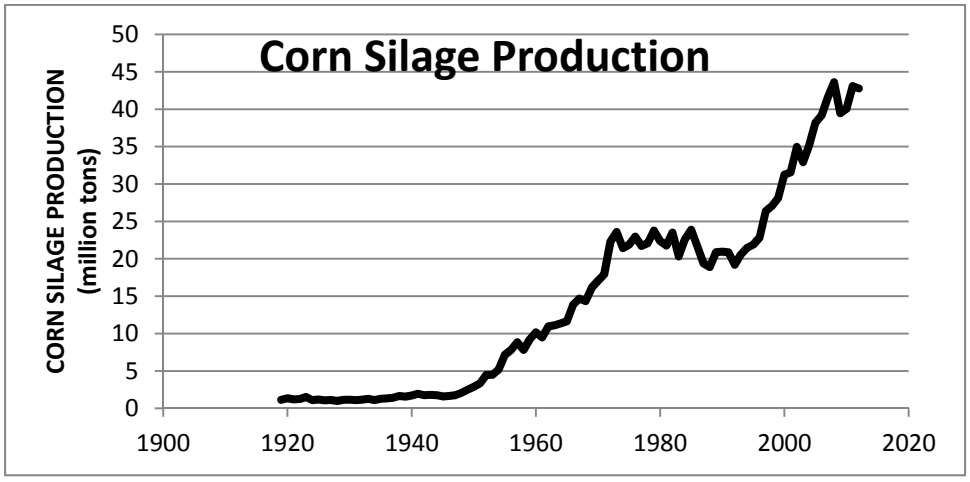

Fig 9. Corn silage production for the Western US (NASS, 2013).

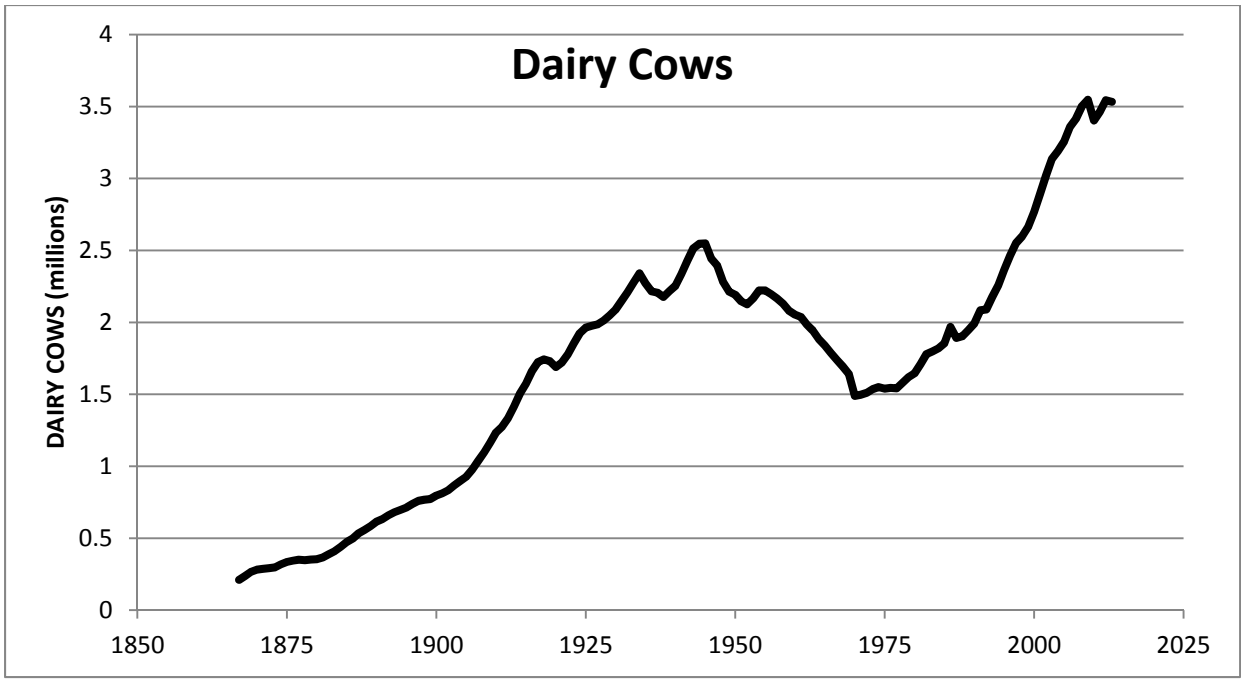

Fig 10. Dairy cow numbers for the Western US (NASS, 2013).

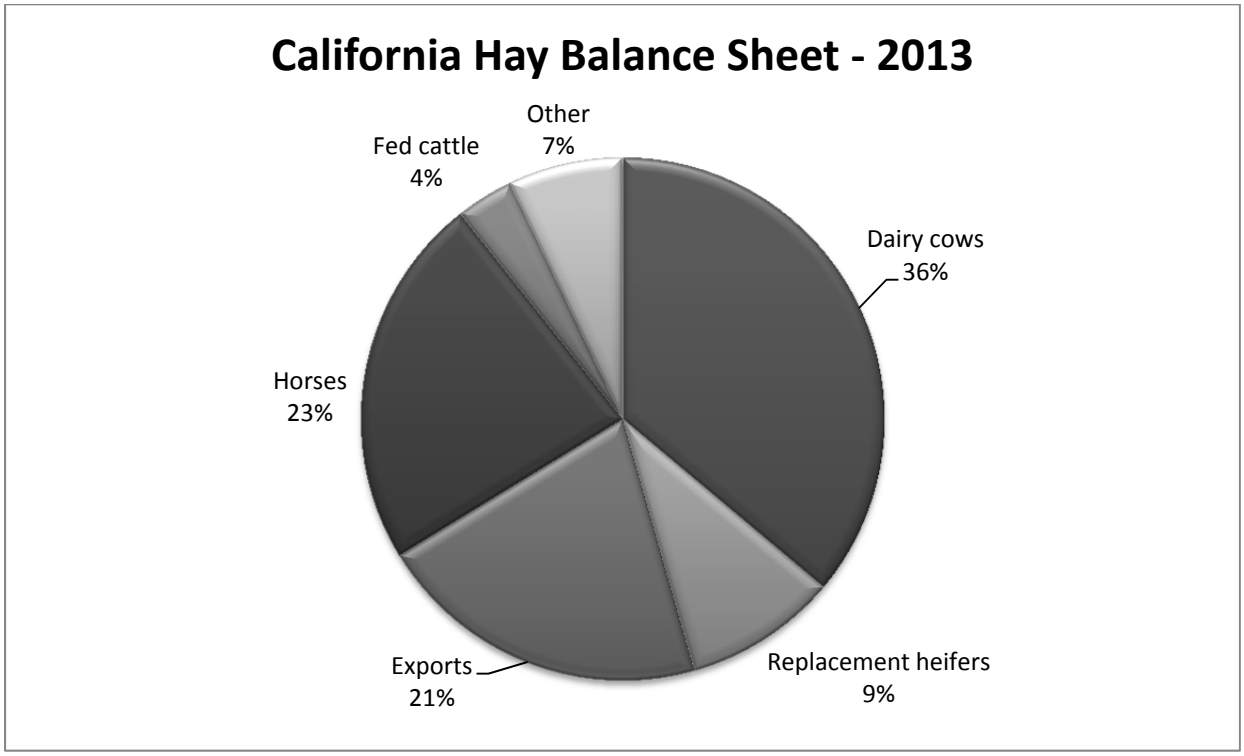

Fig. 11. Estimation of California all hay disappearance for 2013 showing hay usage by various markets. (Adapted from Hoyt, 2013b). This estimate may differ from alfalfa hay disappearance, which is more heavily tilted towards the dairy markets.

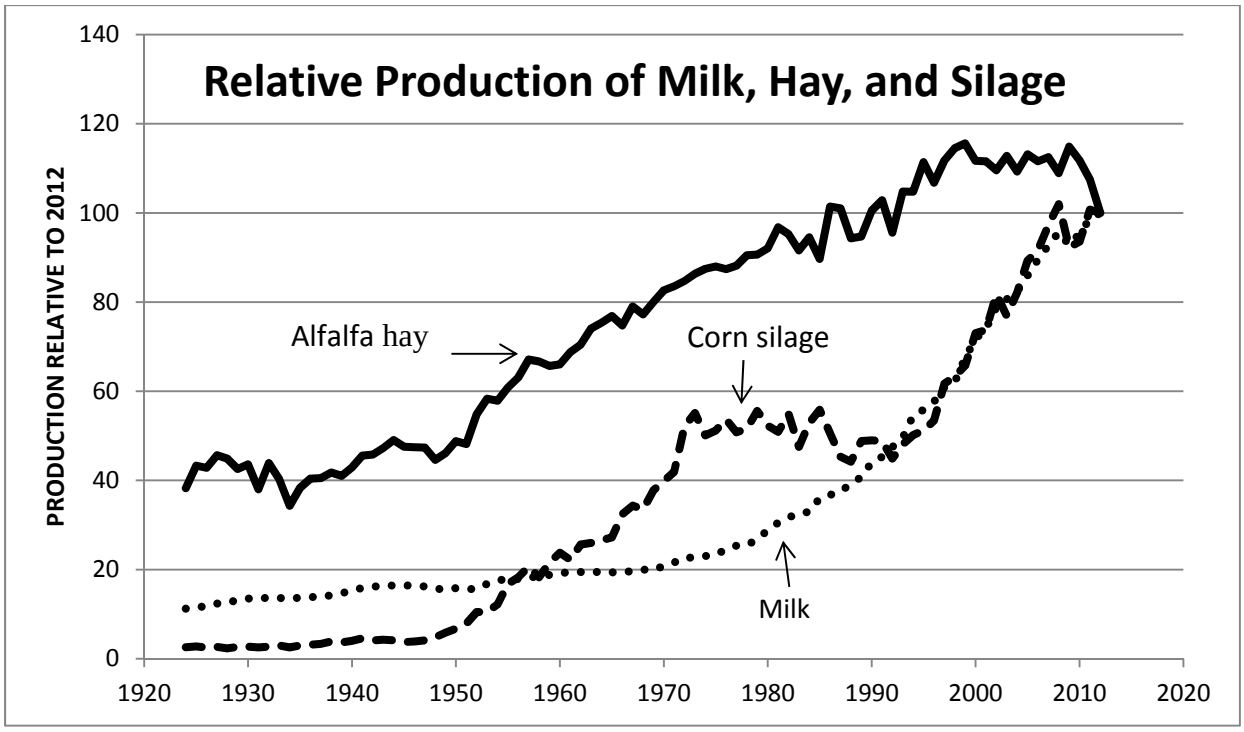

Fig. 12. Production of milk, alfalfa hay, and corn silage in the Western US relative to 2012 (NASS, 2013).