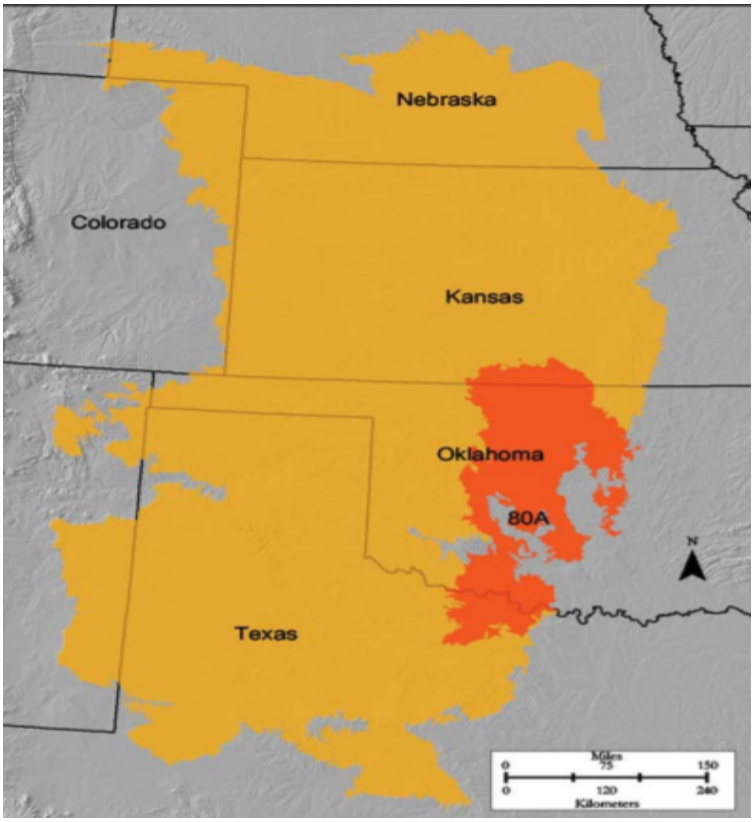
Oklahoma Case Study – Steve Pope, Pope Hilltop Farm-Loyal Oklahoma

Steve Pope is the manager and operator of a diverse farming and ranching operation in Kingfisher County, Oklahoma located in the Southern High Plains. His overall goals are to reduce risk, implement soil health management principles, and protect the soil resource for future agricultural production. This farm has the typical land uses for the geographic area where it is located and has been chosen as a case study of adaptive management due to the conservation land use ethic of the Pope family and their long-term planning initiatives.



Pope Hilltop Farms is located in Central Rolling Red Prairies of MLRA 80 A. It includes the cities of Enid, Stillwater, Oklahoma City, Chickasha, and Ft. Sill, Oklahoma; Wichita Falls, Texas; and Wellington, Kansas. Interstates 35, 40, and 44 cross this area.

Regional Information

Pope Hilltop Farms is located in the Southern High Plains MLRA 80A. This area is in Oklahoma (82 percent), Texas (11 percent), and Kansas (7 percent). It makes up about 19,925 square miles (51,635 square kilometers). It includes the towns or cities of Enid, Stillwater, Oklahoma City, Chickasha, and Ft. Sill, Oklahoma; Wichita Falls, Texas; and Wellington, Kansas. Interstates 35, 40, and 44 cross this area.

Farms and ranches make up nearly all of the private land in this area. Cropland and grassland (rangeland and pasture) make up nearly all of the land area. Most farms include both cropland and grassland and produce a combination of grain crops and beef cattle. Wheat is the principal crop, but soybeans, corn, grain sorghum, and cotton also are grown in the area. The grassland in the area is used for cow-calf and stocker cattle operations.

Climate Information

The average annual precipitation in the Southern Plains MLRA Region 80A is 25 to 38 inches. The annual amount of precipitation may fluctuate widely from year to year. Most of the rainfall occurs as high-intensity, convective thunderstorms during spring and fall. The average annual temperature is 57 to 64 degrees F (14 to 18 degrees C). The freeze-free period averages 235 days and ranges from 205 to 265 days.

According to the NOAA/NESDIS Technical Note 142-2, the area which encompasses Oklahoma and Texas, the average annual temperatures have increased. Hot periods are hotter and cold periods are warmer while the growing season is six days longer. Winters and springs are wetter; summers are drier. Drought and extreme precipitation events are more frequent. These trends are expected to continue based on model simulations. It is predicted that the number of days above 95° F and nights over 80° F will increase. Heavy rains, flooding, drought and severe storms will become more frequent and intense.

Natural Resource Concerns

The main resource concerns on cropland in this area include water erosion, surface compaction, conservation of soil moisture, and maintenance of the content of organic matter in the soils. The main resource concerns on grassland include plant health and vigor and control of noxious and invasive species. Conservation practices on cropland generally include high residue crops in the cropping system; systems of crop residue management such as no-till; conservation crop rotations; and nutrient and pest management. Conservation practices on grassland generally include brush management, prescribed burning, control of noxious weeds, pest management, development of watering facilities, and proper grazing use

Producer Observations

Mr. Pope stated that he has noticed subtle changes in rainfall patterns on his farm. Spring rains seem to come later in the season with fall moisture coming earlier in the months of September and August. These events have also appeared to have increased in intensity. This has led to challenges in controlling sheet, gully and rill erosion and maintaining and absorbing soil moisture. These rain patterns have also led to "crusting" on cultivated land leading to wind erosion events. Stopping these issues along with the desire to reduce fuel costs and improve fertilizer efficiency were the primary reasons the Pope's started implementing soil health practices on their land.

Picture of roller used to terminate cover crops used by the Popes in rotation with winter wheat and other 'cash' crops.

Soils in the Region

This region of Oklahoma has four general soil areas or distinctive kinds of landscape. These are the Flood Plains, Prairies, Blackjack Post Oak Savannas and Sandhills. Within each of these four kinds of landscape there are one or more easily recognized patterns of soils, called soil associations. The pattern of soils is fairly uniform in each association, but the soils in any one association may be much alike or greatly different.

Pope Hilltop Farms lies in the Prairies region of Kingfisher and Blaine Counties with the primary soil association being the Kingfisher-Renfrow soil association. The soils have good drainage, are deep reddish silt loams and clay loams.

Water

In the region where the Pope farm is located there is little irrigated agriculture. Most crop and forage production operate under dry land conditions. While the region receives roughly 34 inches of rain on average each year, timing and intensity of rainfall can have a major impact on crop production and pasture conditions. Dual purpose winter wheat (both harvested for grain and grazed in the winter months) is the primary cash crop in the region and depends upon rain in the fall for planting and germination and moisture during the winter months for growth. Changes in rainfall patterns creates challenges for winter wheat while potentially creating opportunities for forage cover crops and some spring crops.

Pope Hilltop Farms

Pope Hilltop farm is located 20 miles northwest of Kingfisher, Oklahoma near the town of Loyal. The Popes have farmed in this area for over 100 years and still raise cattle and crops on land settled by their family during the Oklahoma Land Run. The farming and ranching operation involves approximately 3,000 acres in Kingfisher and Blaine Counties with all acres being in dryland production. The Popes use no-till equipment and implement soil health management principles to eliminate soil erosion and increase soil organic matter as well as increase the soils water holding capacity. The Popes began no-tilling in the early 2000's with the assistance of the USDA Environmental Quality Incentives Program (EQIP) and the support of their local NRCS District Conservationist and their Local Conservation District. Starting with a straight dual-purpose winter wheat fallow rotation using no-till, the Popes converted to the use of cover crops and additional crop rotations starting in 2013. The Popes originally saw no-till as a way to help control soil erosion and reduce fuel costs but later saw the advantages of including cover crops and expanding rotations to increase organic matter as a way to increase the soils water holding capacity, reduce the loss of moisture to evaporation and improve fertilizer efficiency. The Popes also recognized the possibility of increased income from short term summer grazing of cover crops following winter wheat.

The Pope farming operation is primarily dependent upon small grains, primarily dual-purpose winter wheat and its stocker cattle operation and cow-calf herd. The Popes run both stocker calves and their cow-calf herd on winter wheat acres from late October/early November to March. The Popes follow their winter wheat acres with summer cover crops which are also grazed by cattle to consume some excess residue cover crops and add manures to promote soil health. Cover crops are planted as a diverse mix which may include up to twelve different species. Some of the warm season cover crop mixes they have tried include pearl and German millets, cow peas, mung beans, sunn hemp, okra, forage sorghum and sunflowers. Warm season grasses, legumes, and other cover crops do well in this region and fit in the rotation after small grain harvest. The Popes have also occasionally planted grain sorghum or forage sorghum in rotation on some crop acres and have planted a diverse mix of cool season cover crops after grain sorghum. The cool season cover crop mixes planted in the fall include winter peas, tillage radishes and triticale. The cover crops leave an excellent residue covering the soil and gives additional opportunities for grazing.

Improving the health of the soil has made a difference for them in increasing the amount of available moisture for crop emergence in the early fall months when winter wheat is planted creating additional days of winter grazing. This has helped the Popes better cope with periodic 'flash droughts,' a short time frame of rapidly intensifying water deficiency

accompanied by high temperatures, a phenomenon that is becoming more and more frequent with climate change. The improvement of soil health and the reduction in erosion has also helped the Pope farm when the region is impacted by increasingly intense rain events, also another issue exacerbated by climate change. Increased organic matter and improved soil structure has allowed more water to infiltrate when impacted by these rain events while reducing soil loss due to erosion. In addition, the constant mat of residue allows the microbes to slowly breakdown the carbon and provide the nutrients to be available for the next cash crop.

The Popes are also working to improve the efficiency of their pasture land utilizing soil health practices. The Popes participated in the Conservation Stewardship Program (CSP) and are exploring additional grazing practices such as intense rotational or 'mob' grazing. In the mid 1990's the Popes took several hundred acres of highly erodible land out of crop production and restored to permanent grass cover for livestock grazing. The Popes feel that these acres, while productive, could be improved with soil health practices such as improved grazing and potential over-seeding of winter cover crops on grass acers.

Animal integration is a key component on the Pope farm for diversifying the economics and improving soil health with animal manures. The Popes use a no-till drill to plant their crops.

Table 1 – Farm management goals and objectives for Pope Hilltop Farms

Management Unit	Management Goals	Management Objectives	Timeframes
Entire Property	Eliminate soil wind erosion and increase water holding capacity and water infiltration Increase microbial activity of soil	Increase residue levels and no till crops for agricultural productivity Consistently have a living root growing to feed soil microbes	Continuous
Dryland Acres (1,000 ac.)	Reduce risk and increase flexibility in the agricultural operation with dryland acres. Leave crop and cover crop residues to reduce wind erosion and build soil health.	Diverse crop rotation with cover crops used as forage for beef cattle. Use mixed species of cover crops after winter wheat for diversity.	Annual

The management goals in this table are recognizable for farmers in this region. It is commonplace to see wind erosion active as pictured below. Having a living root growing as much as possible is a way to hold the soil in place and supply soil microbes with food and shelter is important for Pope Hilltop Farms. By improving the health of the microbial community, the Popes hope to increase the water infiltration rate and water holding capacity of the soil while also increasing fertilizer efficiency.

WIND EROSION RESULTS PICTURED

Table 2 – Site specific climate change impacts and vulnerabilities for cropland and rangeland.

Regional Climate Impacts and Vulnerabilities Runkle and Sweet (2017)	**Climate Change Impacts and Vulnerabilities for the Farm**
Warmer temperatures – mean annual temperature has increased by approximately 1^0 F since the first half of the 20^{th} century. With higher emissions, warming is projected to increase along with extreme heat events in Oklahoma. Increased potential for drought – higher temperatures will increase soil moisture loss increasing the intensity of naturally occurring droughts. Oklahoma is consistently ranked in the top 10 states affected by extreme weather events.	Extreme heat events will cause animal stress. Wheat needs cooler nights to vernalize. Increased temperatures can increase the range for invasive pests such as the sugar cane aphid and various species of ticks. Extreme droughts and heavy rain events can impact yields on cash crops such as winter wheat and grain sorghum. Weather events can impact planting decisions potentially preventing planting. Later planting dates for winter wheat can result in the lose of grazing on dual purpose acres. Droughts can also decrease the ability to have successful cover crop stands. Cover crops are used to cover the soil surface, add diversity into the rotation, reduce wind erosion, and provide animal forage. Drought, extreme heat, and wildfires can all impact Pope Hilltop farms. Hail storms are also an extreme weather event that can destroy whole regions of crops.

Extreme heat events will cause animal stress which in turn can reduce productivity of livestock. Wheat can also be affected by changes in weather patterns due to its need for cooler nights to vernalize. Increased temperatures can also increase pressure from pests such as the sugar cane aphid and various species of ticks due to increases in insect range. Extreme droughts and heavy rain events can impact yields on cash crops such as winter wheat and grain sorghum and later planting dates for winter wheat can result in the loss of grazing on dual purpose acres. Droughts can also decrease the ability to have successful cover crop stands, effecting soil health and reducing grazing opportunities.

Worksheet 3 – Evaluate management objectives given projected impacts and vulnerabilities.

Management Unit	Management Objectives	Challenges to Meeting Management Objective with Climate Change	Opportunities for Meeting Management Objective with Climate Change	Feasibility of Objectives Under Current Management	Other Considerations
Entire	Increase microbial activity of soil	Effective weed and fertility, while still having reduced input of the synthetic nutrients and chemical treatments.	Reduced inputs and increased water holding capacity in the soil.	High	
Entire	Cover crops in rotation Example: Winter wheat harvested in June/July and the next week cover crops are planted. Management decision is made for timing of termination of cover crop and next crop or cover crop to be planted.	Rainfall for germination	Grazing opportunities	High	Impact of weather on cover crop planting decisions. Later planting reduces grazing opportunities.

For farmers in this region, the type of management objectives that the Pope Hilltop Farm has is visionary yet possible if there is a willingness to change the current culture of agriculture in this region. Summer cover crops after wheat and minimizing tillage are management changes that have challenges, but also opportunities for soil health.

Worksheet 4 – Identify adaption approaches and tactics for implementation.

What actions can enhance the ability of the ecosystem to adapt to anticipated changes and meet management goals?

Management Unit	Adaption Actions and Tactics	Benefits	Drawbacks and/or Barriers	Timeframes	Practical and/or Recommended
Entire Property	Tactic: Plant different varieties of commodity crops with diverse harvest dates to widen the window of opportunity to plant cover crops. Approach: Manage crops to cope with warmer and drier conditions.	Flexibility for planting cover crops within growing seasons.	Makes management harder with time and effort put into researching varieties and organizing harvest strategies.	Ongoing	Yes
	Tactic: Reduce inputs, increase yields for economic returns. Approach: Keep the soil covered to reduce weed pressure and increase microbial activity.	Increased income	Gaining experience to overcome the challenge of fewer inputs.	Ongoing	Yes
Entire Property	Tactic: Incorporate feeder cattle on cover crops to improve soil health before winter wheat is grown. Approach: Maintain and Improve Soil Health	Adding manures to cropland can improve soil health. Selling animals can diversify farming operations.	Cost of infrastructure and labor to meet animal needs. Strategies to make sure they have enough feed growing on fields.	Ongoing	Yes
Entire Property	Tactic: Always keep the soil covered with residues from main crop and cover crops. Use no-till to reduce soil disturbance. Approach: Reduce severity or extend of wind and water damage to soils and crops.	Maintain or increase soil carbon.	Time management of planting cover crops is critical. The earlier they are planted increases benefits with length of time grown, biomass accumulation, and soil protection.	Ongoing	Yes

By incorporating cover crops and keeping the soil covered, the Popes are accomplishing many goals-controlling erosion, improving soil health and increasing economic opportunities by grazing cover crops. By utilizing diverse cash crops such as grain sorghum (milo) or Sesame, the Popes are diversifying their crop income and utilizing crops with more diverse planting and harvest dates—winter wheat is planted in the fall and harvested in May/June while Grain Sorghum can be planted in this area in the April/May time frame with harvest around September or planted following wheat in June for harvest in October/November. Grain Sorghum stocks can also be grazed over the winter in some cow-calf systems. Sesame is planted in May/June with Harvest in October/November.

Worksheet 5 – Monitor and evaluate effectiveness of implemented actions.

Management Unit	Adaption Monitoring Variable	Criteria for Evaluation	Monitoring Implementation
Entire Property	Overall Economics	Economic Evaluations	Input and output costs
Dry land cropping area	Implement forages for animals	Are wheat yields and quality increasing?	Yield comparisons year to year

One of the key components for evaluating the effectiveness of any change to a farming/ranching operation is its overall economic impact. The producer has to make a profit if his operation is to be sustainable in any form. The Popes will monitor any changes to input costs to see of increases in fertilizer efficiency can be realized. Reductions in fuel use will also be monitored to determine savings. Reductions in harvesting costs on graze out acers and cover crops vs alternative cash crops will also be reviewed to determine if income realized from grazing and reduced harvesting costs outweigh income that would be realized from harvesting an alternative crop like grain sorghum. Year to year yield comparison on the primary cash crop of winter wheat will also be evaluated to determine if improved soil health is increasing yields. The Popes will also evaluate input costs to determine if changes in yields plus cost savings are increasing the operations overall economic health.