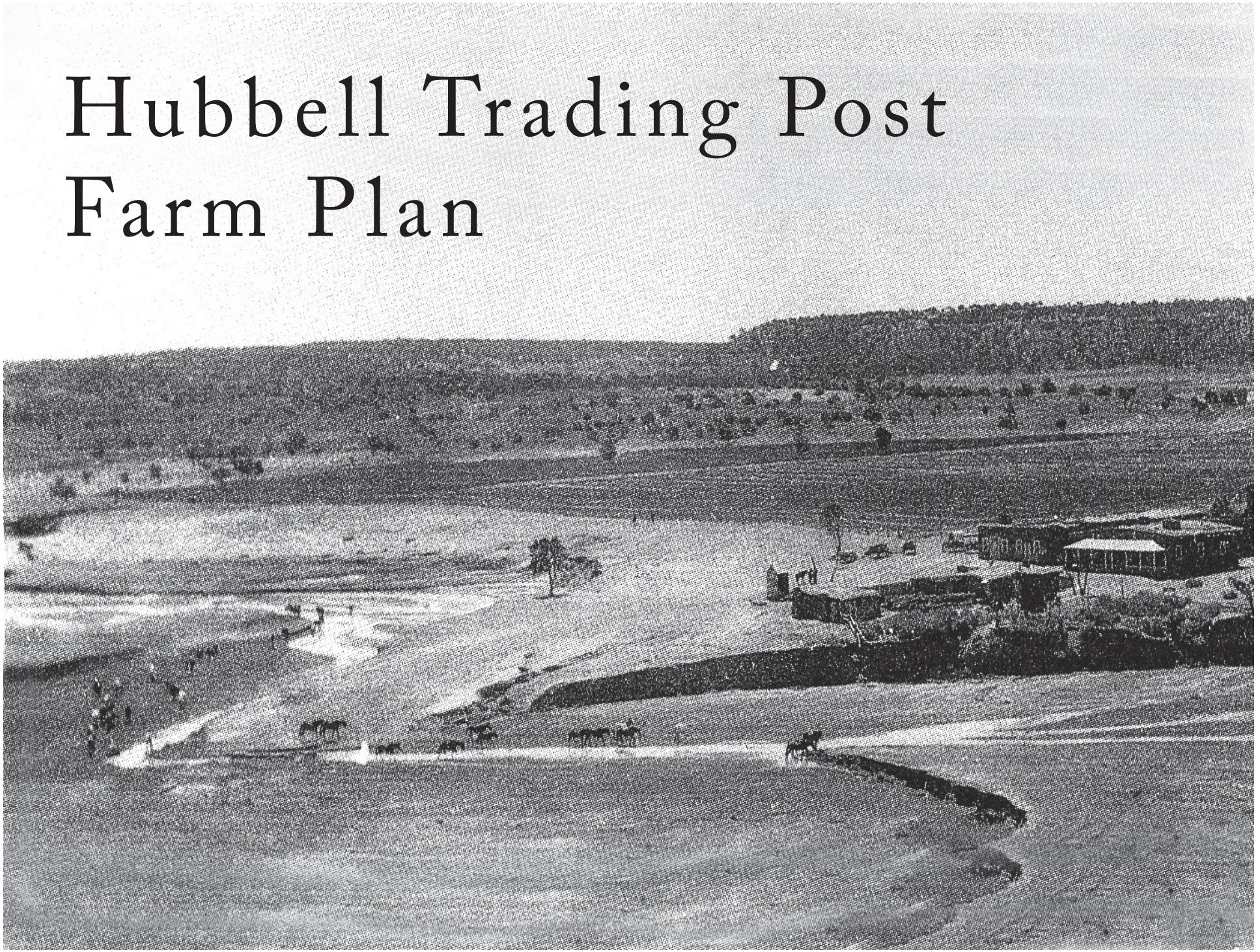
Hubbell Trading Post Farm Plan



prepared for

The National Park Service
Hubbell Trading Post National Historic Site

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prepared by

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Acknowledgements

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What the land said to us:

The people and I are one.
We are not separate.
What is good for me
is good for the people.
What is bad for me
is bad for the people.
In the dry lands of the Diné
I am a green abundant place.
But my ability to support living things
is fragile and easily thrown
out of balance.
If I am changed too radically,
if the rains are disrupted,
if the trees are cut down
the waters dammed,
then the harmonious relationship
of all things is disrupted
and my life force is drained away.
We must learn again
to live together
all children of the same mother
animals, plants, people,
streams, soils, and rocks.

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An Introduction to This Place

I receive the abundance
of rain and nutrients, flowing
down from the Defiance Plateau.
When people knew how
to live in harmony with me
they matched their cycles
to my cycles, surviving
periods of rain or drought.
But sometimes people
would forget who I was.
They would think I was
the abundant side of my cycle
and forget
I was the drought times too.
They moved out of balance
trying to grow too much food
too many people, too many animals
too much money.
When they did that
the people suffered
and so did I

Here, where the Pueblo Colorado Wash breaks out from the constricting hills at the base of the Defiance Plateau, a green ribbon winds through the high red desert—the concentrated richness of the uplands spilling across the plain. Cottonwoods and other riparian trees and plants line the banks, nourished by the abundant water, soil, and fertility. Red mesas and rounded hills bound the valley, cut by arroyos running down to the Pueblo Colorado.

"We found a pretty creek running between steep earth banks ten or twelve feet high. The water is good though warm…The crest of a plateau a few miles from the creek overlooked an extensive and lovely valley, a brilliant sheet of verdure dotted with clumps of cedars, and extending far to the north and south… This is one of the favorite grazing grounds of the Navajos, the green plain below us as far as the eye could reach was dotted with their herds and flocks,"

-Ives 1861 (expedition of 1859)

The ancient rise of the Defiance Plateau and Chuska Mountains form a verdant island in the midst of the Colorado plateau deserts. They receive 80% of the rain that falls on the Navajo Nation portion of the Colorado Plateau. The uplands catch the precious moisture and funnel it to the fertile lowland valleys, where people have settled for millennia.

In geologic time, most of the lowlands saw repeated inundation by oceans of saltwater and sand. However, the Defiance Plateau and its lower edges rose above these floods. Rich soils developed in the high elevations, nourished by mountain rains and snows. In time these soils washed down into the valleys. Though most of the Colorado Plateau was once a grassland, this valley stood out, distinguished by its abundant plant and animal life and its rich soils among the poor clays and sands of the dry plateau. The herds of the plains and their predators came to drink and eat. Bears, cats, and other mountain dwellers moved up and down the river corridor.

People came too, first to drink and to hunt the herds of antelope, desert bighorn, elk, and deer; then to farm and settle in small villages. From the time of pit-houses in 1 AD through the Chacoan great houses of Pueblo Colorado and Wide Reed, the land in and around this portion of the wash was farmed. As in other long-settled regions of the Colorado Plateau, overpopulation The bare land shed the rain that fell rather than absorbing it. The soil's store of water was not replenished, soils eroded, and the watercourses downcut, lowering the water table. Under these conditions the puebloans could not survive the droughts of the 1300's, as they had numerous more severe droughts. They migrated away from the Colorado Plateau for better watered lands to the east and the Hopi mesas to the west.

Later, as the valley recovered, the Diné moved here attracted by returning animals. As their culture mixed with that of the puebloans, they too began to farm along the washes and to build fortified stone settlements. Like Chinle Wash, its sister drainage to the north, Pueblo Colorado Wash again became a center known for its cornfields. It became important (or desirable) enough to be chosen as the headquarters for Kit Carson's campaign against the Diné that led to the long walk and imprisonment.

Although outside of official reservation lands, three years after the end of imprisonment (1868) there were enough Navajo in the area to attract traders. Five years later John Lorenzo Hubbell was trading in the area. The concentration of people and resources here attracted the traders, who encouraged their clients to settle by encouraging agriculture and herding and use of store specific tokens. Hubbell soon made this the center of his far-flung trading empire, establishing an irrigation system and farm suitable to his sense of farming, land ownership, and water rights. He encouraged his customers to produce corn, wool, and rugs—first for sale to the army and later for the tourist trade. He greatly influenced farming in the region through the introduction of new crops, techniques and technologies. He also influenced weaving and grazing through developing markets and marketing, as well as standardized rug patterns.

The Federal take over of the Hubbell irrigation system in 1913 was a part of a program of water development throughout the reservation that had far reaching impacts on people and landscape. The development of wells, springs, and tanks increased grazeable lands on the Navajo Nation by four to five times. While livestock numbers had previously been controlled by rainfall, water development allowed herds to increase to satisfy increasing demand for wool and rugs, as well as Navajo desire for manufactured goods. In addition, they led to concentrating and settling previously nomadic herders. The result

As floodwater agriculture was supplanted by irrigation systems, water could be delivered to more centralized, predictable locations. This too led to more concentrated settlement. Agriculture became ditch irrigated and land became owned by government assignment, often by "outsiders."

Maintenance of the Ganado irrigation system was problematic. It was often washed out where it crossed side drainages and contributed to the erosion and down cutting of both these side drainages and the main watercourse. It became too costly to maintain and was finally abandoned in the 1960's.

The 1960s marked a shift in ownership of the land at Hubbell Trading Post. After the death of John Lorenzo and the partial paralysis of his son, Roman, the farm became too much for Dorothy Hubbell to manage on her own. With an interest in preserving the integrity of the landscape and maintaining trading operations, Dorothy Hubbell sold the land and Trading Post to the National Park Service and, in 1965, the Hubbell Trading Post was recognized as a National Historic Site. From 1965 forward the NPS has maintained the landscape and operations of the trading post. Now nearly four decades later, the NPS is reintroducing agriculture to the land at Hubbell Trading Post.

Respecting the Pattern of Place

The pattern we can see in this story is one of oscillation between abundant periods and scarce periods. The land has evolved to survive and even prosper through these oscillations, by creating storage and resilience. When people were aware of this and lived in balance with these cycles, the land was able to sustain them. But when they forgot, overextended, grew too much and diminished the landscape, it could no longer support them in times of drought. A truly sustainable culture in this place must remember to harvest only surplus and not extract the richness that is the source of the land's resilience.

Given this pattern, there are several critical areas requiring careful attention in designing and working the Hubbell farm. Three are listed here.

Areas for Attention

- **Wind erosion**—the strong winds of the plateau country can increase evaporation and water needs in plants by several fold. They can also strip away the soil that provides the productive capacity of the land. That this is a severe threat can be seen from the nebkas (windblown mounds of soil) built up around the shrubs in the farm fields during the years of disuse. Protection from the wind will be of central importance to limiting the water use on the farm and protecting and building soil.

- **Soil salting**—irrigation in drylands always presents the hazard of salting the fields that are being watered. The dissolved minerals in the irrigation water concentrate on the soil surface when evaporation occurs. It is important reduce the need for irrigation water and to limit evaporation as much as possible through the use of mulches, plant cover, windbreaks, and dense plantings.

- **Soil fertility/Soil structure/Permeability/Water storage capacity**—these smetitic clay soils have a high cation exchange capacity. This means that they can hold large amounts of water and nutrients. It also means that they are very susceptible to salting and erosion or collapse. These clays crack deeply when they dry out. Water will then run through the cracks and cause sink holes. Once dried and cracked, the clays are difficult to rehydrate. It is important to keep these soils moist by eliminating evaporation and increasing soil permeability. These soils are dense. Their small particles leave little room for water to enter into the soil. They need to be opened up, have their structure built and their organic matter content increased. This will enable them to absorb and hold more water. **Plant roots are the best tool for providing all of these needs.** The roots open tunnels in the soil. When animals graze the plants their roots die back leaving organic material to rot into soil—increasing permeability, fertility, soil structure, organic content, and the soil's ability to absorb and store water.

About this Approach

A number of premises helped to shape the thinking behind this farm plan. Understanding these premises should help clarify the approach that was taken in planning this particular farm.

Premises

1. The first goal of sustainable agriculture is to preserve and develop the productive capacity of the land.

2. Limiting water-use through a systemic approach is central to designing and operating the farm.

3. Integrating the Hubbell farm into larger systems (the watershed, the community, the park service, etc.) is key to making it ecologically and economically viable.

4. A management body for the Hubbell farm reflecting the community relationships will help realize the potential to contribute value to a wide variety of constituencies (park visitors, local farmers, community, health agencies, educational groups, etc.)

5. Agriculture practice, to be sustainable, must be tailored to the distinctive nature of a given place.

1. **Preserving and developing the productive capacity of the land.** All communities are enriched when nutrients and other resources cycle repeatedly through a complex local web of exchange. All communities are impoverished when large volumes of resources are exported and outside resources (fertilizer, etc.) are imported. Any community that depends on large amounts of external resources is ecologically and economically unsustainable. The Hubbell farm needs to focus on growing its internal productive capacity (e.g. the health of the soil), rather than mining that capacity. Products taken off the farm should be small in volume but concentrated in value (e.g. wool, local seed varieties, honey.) Inputs from outside should be small in volume and multiplying in their effect— a sort of catalyst (e.g. seed for new crops, new livestock strains, micro-nutrients such as sulfur, seed of nitrogen fixing plants, knowledge.)

2. **Limiting water-use through a systemic approach is central to designing and operating the farm.** In this climate, water is the most important limiting factor for plant growth but the farm has numerous other constraints, including wind, short growing season, and deep-cracking alkaline clay soils. Irrigated arid-land agriculture is by definition precarious— the very water that makes farming possible is the eventual source of the destruction of the land through salting. While irrigation technology is important for managing water-use, a systemic approach should also include: a) adapted crops, b) strategies for limiting evaporation, c) protection from wind, d) soil cover, e) soil fertility and organic matter content, f) appropriate field size and topography, and g) careful management. We need to weave a tight basket of plant and animal communities— a basket that will enrich the farm by holding water and nutrients rather than letting them leak away.

3. **Integrating the Hubbell farm into larger systems (the watershed, the community, the National Park Service, etc.).** The Hubbell Trading Post was successful precisely because it was integrated into systems of abundant resources and exchange, both in terms of the landscape and the indigenous trade/gift economy. "Trading posts" were accepted by locals as an outlet for a system they were already using. In the past, the farm was less successful (e.g. financially) because it was not well integrated into these larger systems. If the goal is to develop a viable, sustainable farm, then we should learn from accepted cultural models and integrate the farm into practicing institutions to meet community needs.

4. **A management body for the Hubbell farm reflecting the community relationships will help realize the potential to contribute value to a wide variety of constituencies.** Given the challenges associated with creating a viable and long-lived farm at the Hubbell Trading Post National Historic Site, broad community support and resources will be required. Rather than having the future of the farm tied to the skills and commitment of an individual farmer, this plan aims to build on and nourish existing community initiatives (e.g. high school agriculture programs, diabetes programs, wool growers initiatives, etc.) Managing these diverse inputs to deliver the highest benefit and sense of "ownership" for everyone involved requires a holistic team approach.

5. **Agriculture practice, to be sustainable, must be tailored to the distinctive nature of a given place.** Sustainable, ecologically appropriate farms succeed through understanding and aligning with the distinctive character and dynamics of the place they inhabit, and through the intelligence brought to their processes and practices (e.g. intensive production of high-value crops, innovative production techniques that minimize outside inputs, etc.) In this way, they reflect the cultures of indigenous peoples. Indigenous peoples learn by experiencing natural processes around them, modeling economies and gardens to reflect the places they are a part of. At the Hubbell farm, it will be important to continually deepen understanding of the ecosystems of Ganado, through studying, adapting, and evolving the agricultural practices of local and indigenous people.

Given these premises, we believe that creating a successful farm will depend on the following:

Key Elements for Success

- **An integrated infrastructure (including physical structures as well as a managing team) that allows everything created on the farm to serve multiple productive purposes while reducing operating costs (e.g. terraces that conserve water, control erosion, and delineate manageable cropping units.)**

- **Creative and flexible product and distribution systems that draw from the deep cultural roots of the local community to create economic development opportunities that regenerate people and place.**

- **Becoming a valued educational resource to a wide range of stakeholders—the long term viability of the farm is linked to its relevance, for local people and the larger world.**

Structure of the Plan and How it is Meant to be Used

This farm plan is meant to provide inspiration and a vision of what is possible for the farm at Hubbell Trading Post National Historic Site. At the same time, it is meant to serve as a practical guide for how to move toward that vision. Farming at Hubbell is described here as an ongoing learning process. Each generation of farmers is intended to learn and to pass on their experience to subsequent generations. This plan is a sketch to be filled in and improved through experience and practice. In the early phases of the plan's implementation, the sketch is fairly specific and detailed. As time goes on, the plan becomes more and more general to leave room for the wisdom and innovations of those who will be using and evolving the farm into the future.

The farm plan grows out of three key relationships:

1. **To the land and the water and the living changing environment—**In order to be responsible farmers, it is critical to become responsible partners with nature. An understanding of the land, its natural processes, and the inherent capacities and limitations of the biotic and soil communities is essential. For this reason, the plan begins with a sketch of the natural and human history of the Hubbell farm. The sketch is amplified in the appendices with documentation of different aspects of what makes this place unique.

2. **With the National Park Service and the many visitors from around the world who visit this site and are potentially affected by the work carried out at the farm—** The Hubbell Farm is in a unique position, given its high visibility as part of a internationally known destination. The National Park Service and its visitors are a major potential resource to efforts to make the farm a success. In return, the farm offers a rare opportunity for the public to see a model of integrated, culturally and ecologically appropriate agriculture.

3. **With the community—**The farm is potentially a source of renewal for farming in the region—creating new models of locally appropriate land stewardship and locally adapted crops and markets. The more the community sees the farm as a source of value and a source of health, and the more the community becomes involved with the farm, the better its likelihood of success. Over time, local people have built up a deep and connected understanding of this place, passing it along through stories, names, and ceremonies. The farm has the potential to become a new way for the community to tell its stories—stories of how to be in balance and harmony with the land and with one another. This document in no way intends to replace these stories—only to augment and support them.

Plan Structure

Concepts: are proposed for all aspects of the farm's development, based on developing the three relationships.

Strategy: lays out phases for implementing these concepts. If the resources and interest are present, the phases allow for rapid implementation of the plan. Or alternatively, the phases can be implemented very slowly and a little at a time.

Design/Action: identifies first steps for implementing Phase I .

Appendices: contain more detailed information both for background and operational details and resources. As a whole, the plan is intended to provide a solid basis for ongoing improvisation and improvement.

Hubbell Farm Purpose & Vision

A Purpose for the Farm

All human activities are based on the productive capacity of the earth. Healthy relationships are always based on reciprocity.

The effort to regenerate the farm at Hubbell Trading Post National Historic Site presents an unusual confluence of interests and opportunities. Currently, the National Park Service recognizes the importance of its relationship to the surrounding communities. This relationship contributes vitality to the park and will help the park continue to be a living and relevant resource (to visitors as well as to local people) over time. The Hubbell farm could contribute to this community relationship in a number of ways:

- **by serving as active steward for the health of the land, and a stimulus for the regeneration of the larger landscape,**
- **by fostering the regeneration of agriculture at the park and in surrounding communities,**
- **by acting as a stimulus to place based and culturally appropriate economic development, and**
- **by enhancing the experience and understanding of park visitors, and the historic integrity and meaning of the Hubbell landscape.**

The farm plan that follows is organized around the premise that the optimal use for this site is as a facility that:

- **Demonstrates how to set up and operate an ecologically sustainable and culturally appropriate farm**
- **Catalyzes and supports community endeavors and projects that bring back farming and community cohesion**
- **Sources increased vitality, viability, and synergy among all those connected to it (the land, local farmers, the community, the the park and its visitors)**

A Vision of the Farm

We envision a farm where the majority of the land is planted to climatically adapted perennial cover crops. Fields are separated by hedgerows of diverse and useful plant species, providing protection from extremes of sun and wind, as well as habitat for the bird and insect species that contribute to the health and resiliency of the cropping areas. At the same time, the hedges are themselves made of productive species, generating crop yields. We envision livestock, especially churro sheep, grazing the pastures to maintain their fertility and to convert plant materials into higher value yields. Every few years, individual terraces are plowed under, used for growing annual crops such as corn or vegetables, and then returned to pasture to restore fertility.

We envision a diversified farm—one where crops and products are:

- **Selected to serve multiple purposes (for example, carefully selected pasture species could stabilize soils, build fertility, provide forage or hay, and potentially yield a high value seed crop)**

- **Diversified to augment the farm's economic stability and viability while enhancing its overall health (for example, besides core products like wool, meat, corn, or other vegetables, the farm could produce crops like honey, dye plants, wild fruits, and native grass seed—all of which contribute to an increasingly balanced ecological system.)**

- **Integrated so that outputs from one value adding process become inputs for another (for example, grass becomes forage for sheep, sheep provide wool for yarn production, etc.)**

We envision a special relationship between the farm and surrounding communities. We see the farm serving as a training and testing ground for important initiatives already underway in the community, including efforts to reintroduce traditional foods and traditional sheep raising. We envision much of the energy for setting up and managing the farm coming from community groups who see a natural alignment between the farm's aims and their own.

Finally, we envision the farm being a source of excitement and generativity for all those connected to it. By expressing the authentic living culture and personality of this place through its operations and marketing, we see the farm and the Ganado community attracting growing interest from a broad range of people who wish to participate in or learn from the culture of this place. We see a living farm as a way of introducing park visitors to an ongoing living culture and history that extends backwards and forwards well beyond the story of Hubbell Trading Post. A living farm managed collaboratively by local indigenous farmers in cooperation with the National Park Service helps make explicit the context (human and cultural) into which Hubbell entered and thrived.

The National Park Service interpretive programming about the site and the trading post serves as a natural entry point for an expanded audience, offering both orientation to place as well as opportunities to purchase local products that express the essence of place. At the same time, the farm extends the range of people who would be interested in the trading post, through being a living expression of place-based economic activity. In this way, the farm has the potential to catalyze economic development for the community.

Concepts for Development of the Hubbell Farm

Site Development Concepts

- Organize the farm around its historic pattern of east-west running terraces, but stabilized with shelter belts and perennial plantings.

- Use sheep and other livestock to graze perennial pastures.

- If no livestock are available, the permanent cover can be mown for hay or harvested for other purposes.

- A certain percentage of the farm can be periodically rotated out of pasture and into annual production of traditional crops, vegetables, herbs, ornamentals, or other high value crops.

- The diversity of crops produced and the processes for producing them can become increasingly complex, extending the financial viability of the farm.

TEACHING AND INTERPRETING CONCEPTS

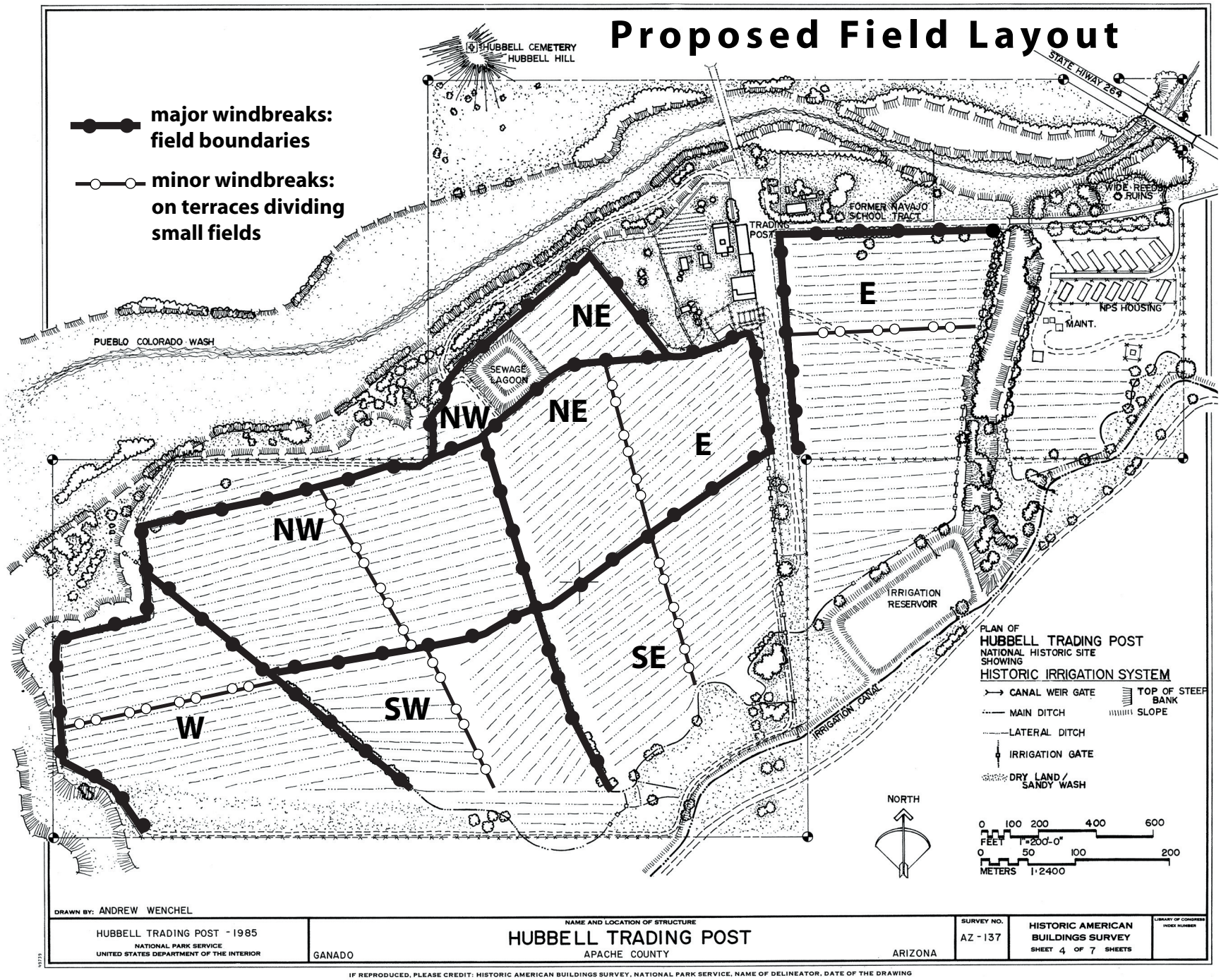
- Every phase and aspect of the farm's development and ongoing operations provides opportunities for local people to reconnect with and deepen their understanding of how to farm sustainably, and successfully in this place.
- The farm functions as a research facility for the community—gathering, integrating, and extending the collective learning about culturally and ecologically appropriate farming.
- Interpretive materials (site bulletins, ranger programs, etc) introduce visitors to a layered understanding of place
- Interpretive programs get extended to include experiential learning opportunities for visitors—opportunities that allow visitors to be in reciprocal relationship to local people and land and that encourage visitors to reflect on how what they are learning here could be applied in other parts of their lives.

MARKETING AND FINANCING CONCEPTS

- Create initial foundational markets and networks of exchange between the farm and its proximate environment
- Develop and market product systems that serve not only the farm but the evolution of a resilient and culturally regenerative local economy.
- Grow alliances of small local businesses that allow generation of sufficient volumes to be able to market products regionally or even nationally.
- Establish a distinctive market presence through branding based on the essence qualities that make this place unique.
- Seek sources of funding to underwrite the regeneration of the farm's/community's social, financial, and ecological capital.

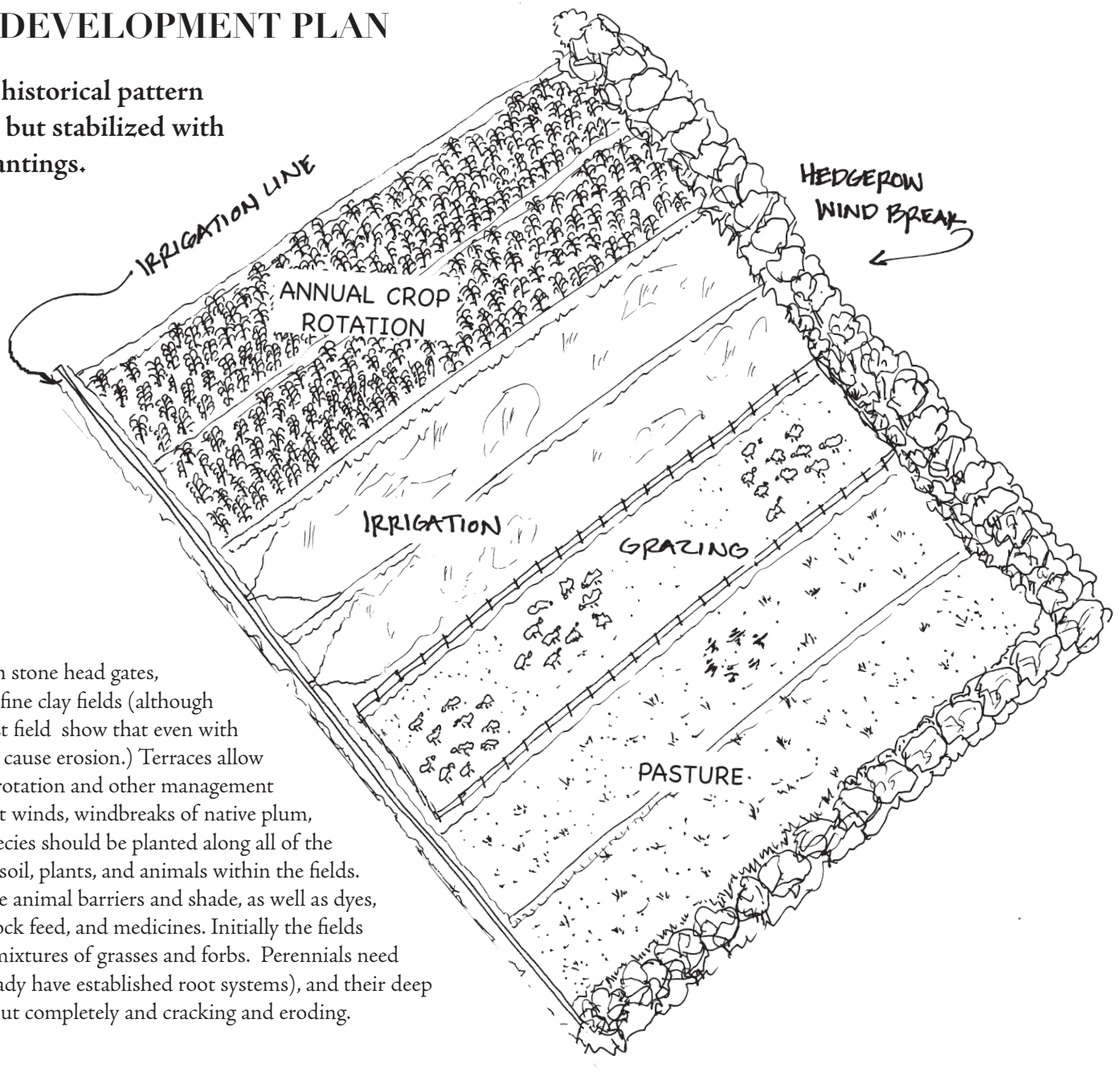
MANAGING CONCEPTS

- Form an organization (possibly a non-profit) to manage the ability of the site to serve the evolution of the larger systems it is nested in.
- Develop an organizational structure that is open, participatory, and reflects all of the constituencies with a real stake in the purpose of the farm.
- Foster ongoing learning and development among all who participate in and are affected by the managing organization and the farm.



CONCEPTUAL SITE DEVELOPMENT PLAN

- **Organize the farm around its historical pattern of east-west running terraces, but stabilized with shelter belts and perennial plantings.**



This topographic patterning, along with stone head gates, minimized erosion in these fairly steep fine clay fields (although the gullies on the south edge of the west field show that even with this optimal layout irrigation water can cause erosion.) Terraces allow control of water, and provide units for rotation and other management patterns. Because of the prevailing west winds, windbreaks of native plum, chokecherry, and other useful hardy species should be planted along all of the terrace ends. These hedges will protect soil, plants, and animals within the fields. Eventually they will also help to provide animal barriers and shade, as well as dyes, basketry materials, supplemental livestock feed, and medicines. Initially the fields should be planted to drought tolerant mixtures of grasses and forbs. Perennials need relatively little water (because they already have established root systems), and their deep roots help keep clay soils from drying out completely and cracking and eroding.

✣ **Use sheep and other livestock to graze perennial pastures.** The key to this plan is the sheep: the sheep provide the fertility; the sheep provide the high-value yield; the sheep provide weed control; the sheep are the farmers--they do the work and they don't need health insurance or vacation time. As in nature, the animals turn low value material into high value food and products. Through intensive grazing rotations—using electric fences and moving livestock daily—plant growth can be optimized, fertility returned directly to the soil, and little or no equipment needed once fields are established. Although daily labor is required to move the fences and sheep, it is minimal (20-40 minutes a day).

✣ **If no livestock are available the permanent cover can be mown for hay or harvested for other purposes.** The fields can provide hay yields if there is no interest or capability to graze them. This can provide income or incentive for managing the farm. However, it is important that fertility and organic matter be returned to the land somehow.

✣ **A certain percentage of the farm can be periodically rotated out of pasture and into annual production.** This should happen on a terrace by terrace basis. Annuals can range from adapted native crops such as corn varieties for traditional foods for local consumption or the tourist trade to vegetables for local consumption. Outlets for these vegetables could be the diabetes program kitchen or the school lunch program. Nutrition is a key factor particularly in diabetes prone communities. These annuals should be grown in rotation; heavy feeders (like corn) being followed by heavy givers (like beans). In general the same crop should not be grown in the same spot more than one year. After a maximum of 4 years (preferably 2) row cropped annual fields should be rotated back into permanent cover (unless cultivated in sunken, mulched beds that can remain in annuals indefinitely.) As in nature, annuals should comprise a relatively small percentage of the land.

✣ **The diversity of crops produced and the processes for producing them can become increasingly complex.** As ability and labor allow, rotations can become more diverse. Other livestock can be included to increase yields from the same available graze. Fields of carefully selected native plants can feed livestock during one part of the year and provide a cash crop of seed during another. This seed could also be used to help re-vegetate the surrounding grazing lands. An increased diversity of annual crops could provide additional products as well as more complex crop rotations. The edges of fields are prime places to increase the production of useful yields, for example dye and medicinal plants. Also, closing loops in production, so that waste products become inputs to another value generating activity, is a good way to enhance the overall financial viability of the farm. For example, corn stalks or other plant waste could be used as a substrate for mushroom production, and the decomposed corn stalks returned to the farm as animal feed or fertilizer.

Conceptual Plan for Teaching and Interpreting

✣ **Every phase and aspect of the farm's development and ongoing operations provides opportunities for local people to reconnect with and deepen their understanding of how to farm sustainably, and successfully in this place.** A deep reservoir of knowledge, cultural understanding, and tradition already exists within this community. The challenge is to connect this the collective knowledge of the community to present day circumstances and development needs, so that local farmers are able to be successful and sustainable at the same time that they are keeping alive a relationship to place that has been developed over generations. The farm as a learning institution is a repository and sharing place for passing on and renewing the relevance of this heritage.

✣ **The farm functions as a research facility for the community—gathering, integrating, and extending the collective learning about culturally and ecologically appropriate farming.** This could include introducing new crops or techniques (perhaps sharing and exchanging knowledge with people in similar climates), or imagining new ways to use ancient crops and techniques, but always with an eye to the contribution farming needs to make to the health of the whole system. As ideas are developed and tested, they are being carried out at scales and in ways that can be shared with and adopted by families throughout the region.

✣ **Interpretive materials (site bulletins, ranger programs, etc.) introduce visitors to a layered understanding of place**, including the history (human and natural) of the farm, the worldview of the Dine and their relationship to the earth and to farming, and the ongoing evolution of activities of a living indigenous farm. And it includes story telling and ceremony as ways of conveying systemic and spiritual values.

✣ **Interpretive programs get extended to include experiential learning opportunities for visitors.** These opportunities might include volunteerism, research, intensive workshops. Such opportunities extend the relevance of and hence the interest in and support for the park. The farm invites more people in for more reasons and longer stays.

Conceptual Plan for Marketing and Financing

✣ **Create initial foundational markets and networks of exchange between the farm and its** local and neighboring communities. These exchanges would address basic community needs, such as healthier diets, medicinal plants, and pasture for sheep.

✣ **Develop and market product systems that serve not only the farm but the evolution of a resilient and culturally regenerative local economy.** Initially these product systems would primarily be marketed through the park. A typical product system might include local wool from churro sheep, handspun yarns from local wool, dyes from traditional plants, and rugs woven from these materials using indigenous methods and designs. These products are all part of a value adding process that takes local materials and moves them to increasingly higher orders of value. At the same time, each level could be turned into a small business in its own right. And each of these production processes offers unique educational opportunities for local people who wish to relearn their traditions and pass them onto future generations as well as to outside visitors. Teaching about these processes is itself a potential source of economic value:

… Workshops and trainings for interested visitors are a source of income while cultural funding may be available for training local people

… Experiential learning helps to grow a new generation of people who are knowledgeable about, enthusiastic toward, and willing to invest in Navajo weaving.

✣ **Grow alliances of small local businesses that allow generation of sufficient volumes to be able to market products regionally or even nationally.** This assumes products that are high in value but do not export nutrients or other resources that are essential to the long term health of this place. Before European contact, the Navajo traded internally, within the tribe, as well as externally with tribes in other regions, expanding and contracting the scales and numbers of exchanges to maintain balance. As the community economy grows, it will become increasingly important to maintain and reinforce this indigenous emphasis on balance within the whole system as a basis for making key economic decisions.

✣ **Establish a distinctive market presence through branding based on the essence qualities that make this place unique.** As the farm becomes known for its quality of care in regenerating the land and community it is a part of, and the more this caring is expressed in the unique products, stories, and works of art of the community, the more unique, desirable, and valuable those products become in the world. If the farm and the community can establish a strong "Made in Ganado" identity, this enhances the value of all of the efforts of the community. Also, it may be possible to work with a larger, nationally known company such as Pendleton blankets to create a "Ganado" blanket based on local traditional patterns, where a royalty for the use of these patterns comes back into the community to support its regenerative efforts. In this example, the "essence" of Ganado is generating exchange without in any way depleting the community's material resources.

✣ **Seek sources of funding to underwrite the regeneration of the farm's/community's social, financial, and ecological capital.** As a model, the contribution that the Hubbell farm could make to indigenous communities locally and around the country, to the experience of park visitors, and to the National Park Service as it looks at how to better integrate with other communities, makes this project potentially attractive to a variety of funding sources. Diversifying the sources of funding for establishing critical physical and organizational infrastructure will reduce the need for an economically marginal activity like farming to cover these costs and acknowledges the larger benefits that the farm provides.

Conceptual Management Plan

✣ **Form an organization (possibly a non-profit) to manage the ability of the site to serve the evolution of the larger systems it is nested in.** The work of this organization includes ensuring that the creation of site based structures and systems occurs in an appropriate time frame and an appropriate physical array to support that larger evolution. For example, to get the farm program started, terraces, pastures, sheep, and irrigation need to be set up, and people who would be interested in managing these systems (perhaps youth from the local FFA club) need to be identified and trained. Later, more sophisticated projects (such as identifying buildings off-site for housing a wool growers cooperative, etc.) can wait for circumstances to evolve within the community that would ensure that such a facility would be fully utilized and would contribute in a real way to the economic viability of the community. Anticipating, assessing, and acting in response to these changing circumstances would be a key responsibility of this organization. Also, building and sustaining reciprocally beneficial relationships with other organizations will be a core responsibility of a farm management organization.

✣ **Develop an organizational structure that is open, participatory, and reflects all of the constituencies with a real stake in the purpose of the farm.** Because the farm has been organized from the outset as a collaborative effort with the National Park Service, and because of the relatively scarce resources of the local community, it is natural and appropriate to extend the model of collaboration to every aspect of farm management. As the farm diversifies, it will become increasingly important to have diversified skills and capabilities, as well as shared responsibility, within the network of people and organizations actively involved. Ultimately, a network of working groups or teams would take on stewardship for different aspects of the farm, with a managing team responsible for coordinating and supporting their efforts.

✣ **Foster ongoing learning and development among all who participate in and are affected by the managing organization and the farm.** To realize the full potential of the farm as a place where thinking and practices are continually evolving, the people involved will need to also be evolving their own capabilities and capacity. The organization will need to adopt as a key value and commitment the ongoing support for the development of its members, through processes of active dialogue and reflection.

Hubbell Farm Development Strategy

Development Strategy:

Appropriate Sequencing for Development of the Farm and its Programs

The implementation of this farm plan is conceived as a strategic sequence of phases. Each phase represents an increase in the complexity of the system, the number of exchanges it can engage in (internally and externally), and the capacities and capabilities that will be required. Each phase provides the essential foundation for the subsequent phase and builds on the foundation provided in the previous phase.

This development sequence is essential for any planning and development scenario. However, the scale of work can be expanded or reduced in response to resource availability and environmental conditions. For example, the infrastructure for all of the fields could be developed at the same time before continuing on to the next phase. Alternatively, the first field could be fully developed through Phase IV before continuing on to the next field. Most likely, the process will consist of some of both. The same developmental flexibility applies to non-physical dimensions of the project—community engagement, training programs, interpretive programs, marketing efforts, etc.—and are just similarly dependent on resource availability. It may turn out that certain marketing or education concepts are developed more rapidly than the farm site and operations, or vice versa, depending on the interests, energy and capabilities of participants.

Phase I

Developing infrastructure

During the initial phase of the farm's development it will be important to organize and establish the systems and structures that will enable the farm to carry out its work. These include physical things like irrigation and cropping systems. They also include the team that will be responsible for managing the farm, and the learning processes that will be needed for those involved with the farm to be successful in farming and successful in sharing what they are learning with others.

The purpose for this phase of work is to develop physical and organizational infrastructure for the farm in a way that creates a basis to become more diverse and generative over time. Ultimately, we envision the farm catalyzing the renewal of a place-based agricultural economy for its region, and this initial phase lays the groundwork for that potential future.

During this phase, it will be important to create not only physical and organizational infrastructure, but also a network of individuals and groups who can see the real contribution the farm could make and are dedicated to getting it established. Also during this phase, it will be important to establish programs that enable or support ongoing key operations (such as maintaining the pasture and irrigation systems.)

Within each key area, some of the likely activities one would expect to see during this phase are described in the box to the right.

Management

- Create management team.
- Set up management systems and agreements.
- Build relationships with local groups with a potential or expressed interest in the goals of the farm.

Site Operations

- Level and terrace fields.
- Plant cover crop (pasture) and windbreaks.
- Establish irrigation system and crops.
- Graze or mow at least 3-5 times a season.

Teaching and Interpretation

- Provide training for those actively working the farm.
- Create programs to orient local farmers to the farm plan and practices.
- Assess the educational needs of the local community and identify ways that the farm could serve them.
- Work with Park Service to design interpretive programs (could include site bulletins, reading materials, ranger programs, experiential education opportunities, etc.) that reflect the vision and potential of the farm.

Marketing and Financing

- Develop marketing strategy based on projected yields from Phase II.
- Develop initial market contacts based on this strategy.
- Identify and pursue potential sources of support (material, financial, expertise, etc) for key programs (e.g. education, windbreaks, etc.)

Phase II

Generating Value

Once perennial pastures and windbreaks are established and the soil's fertility and capacity to support crops improved, it will be possible to evolve farm operations to include generating marketable products. This evolution of farm operations also creates opportunities to evolve teaching and interpretive programs, marketing efforts, etc. During this phase, the social infrastructure will continue to evolve within its immediate environment (i.e. the National Park Service and the local community.) The organization will be growing its capacity to market products and programs, develop viable relationships with other organizations, grow the human resources needed to move into later phases, etc.

The purpose of this phase of work is to use infrastructure developed in Phase I to grow the viability of the farm and everyone connected to it through generating increasing streams of value (and revenue.) This should be done in a way that grows the capacity for evolving new orders of activity on and around the farm so that, over time, increasingly diverse and sophisticated resources and participants are attracted to the farm and its community of stakeholders.

During this phase it will be important to produce value on a number of fronts: marketable products, community and cultural relevance, new capabilities for participants, and a new source of excitement and inspiration for visitors.

Within each key area, some of the likely activities one would expect to see during this phase are described in the box to the right.

Management

- Formalize and refine the instruments (such as market contracts, agreements with participating groups, etc.) by which the organization engages in key relationships.
- Set up and assess one or more pilot projects through which the community can use the farm and its activities as learning opportunities.

Site Operations

- Produce wool and meat, or hay.
- Establish pilot, small-scale annual production.

Teaching and Interpretation

- Set up and test pilot interpretive programs.
- Establish programs that help those working on the farm play a teaching role in the educational and interpretive programs offered there.

Marketing and Financing

- Develop a clearly defined set of product offerings.
- Use market contacts generated in Phase I to develop and test small trial contracts for products.
- Continue to develop potential niche markets and outlets that value the unique nature of these products—assess where the highest value exists.
- Evaluate and improve systems and capacity for being able to consistently deliver products that are distinctive and of high quality.
- Investigate the viability of value added products from farm grown raw materials.

Phase III

Diversifying the Farm

At this point, basic operations of the farm will be in place and the managing team can work on creative programs to diversify the farm. In this context, diversification would focus on creating integrated systems of products (rather than merely creating multiple unrelated products.) Diversifying the farm will help increase its financial and ecological viability, but it will also increase the complexity of what needs to be managed. Thus, the organization will need to grow its ability to manage and extend marketing and other infrastructure out beyond this community. Thinking about product systems and diversification will need to respond to cultural relevance, emerging markets, the needs of the biotic systems within and around the farm, etc.

The purpose of this phase of work is to diversify the farm through creation of product systems that affirm and improve the lives of everyone the farm serves. In this way, the farm begins to nourish the creativity and generative capacity of an expanding circle of people that extends well beyond its local region.

During this phase, it will be important to produce an established brand that captures and reflects the real value that this farm has to contribute. This brand would serve as a way of growing the sense of identity of all those in the community who participate in working the farm, producing the products, etc. Diversifying is less about creating more stuff than about revealing (in multiple ways) the essence of this place.

Within each key area, some of the likely activities one would expect to see during this phase are described in the box to the right.

Management

- Rather than managing everything directly, the management group coordinates a growing array of working teams who have taken on the management of specific aspects of the farm and its related programs.

Site Operations

- Develop crop rotations that allow permanent cover to be periodically converted to production of annuals (and back into cover after 2-4 years).
- Diversify grazing systems to allow more complete utilization of nutrient cycling on the farm (e.g. a "flerd" of goats, cattle, geese, chickens, turkeys, horses, etc.)
- Begin to harvest and utilize diverse species from windbreaks, field margins, terraces, and other productive but underutilized areas (e.g. wild fruits, dye plants, native seed, etc.)
- Refine and improve products to meet increasingly sophisticated market standards for quality and value.

Teaching and Interpretation

- Build alliances with special interest groups to host and manage workshops, internships, and other educational programs.
- Move interpretive programs away from being observational and toward being experiential and participatory.

Marketing and Financing

- Help establish a network of small farms and cottage industries that the farm is serving and helping to grow.
- Create branding that reflects the community identity while supporting a marketing program that grows appreciation for the distinctive value that this place and its products have to offer.

Phase IV

Evolving a community based agricultural economy

Ultimately, the real potential of the farm is realized when it is able to establish a strong and meaningful presence in the world through its leadership in and collaborative relationships with the community it is part of. The farm will need to collaborate with other producers to generate enough of certain products to support a viable market. Also, some of the farm's products will achieve their highest value if they are utilized locally in value adding activities (such as hand spinning and weaving.) And as a community, Ganado has the potential to establish an identity within the marketplace based on its unique culture and relationship to a special place.

The purpose of this phase of work is to evolve an ecologically and culturally appropriate agricultural economy in the Ganado region in a way that helps local communities regenerate their traditional connection to place in a rapidly changing world. Through this effort, the community is enabled to play a significant and much-needed role in the world—providing a living demonstration of what it means to live in harmony and balance with the Earth.

During this phase, it will be important to produce:

- A farm that has evolved into one part of a larger enterprise working on economic development within the whole community.
- A role for the farm as a continuing source of evolution (through experimentation, education, and practical experience) for the larger region.
- A laboratory for creation of new products and technologies so that other farmers and small businesspeople in the area are enabled and encouraged to expand their own capabilities.
- Ability to provide the guidance and possibly the capital to help other communities who have been influenced by this project to begin their own place-based economic development efforts.

Getting Started:
Four First Steps

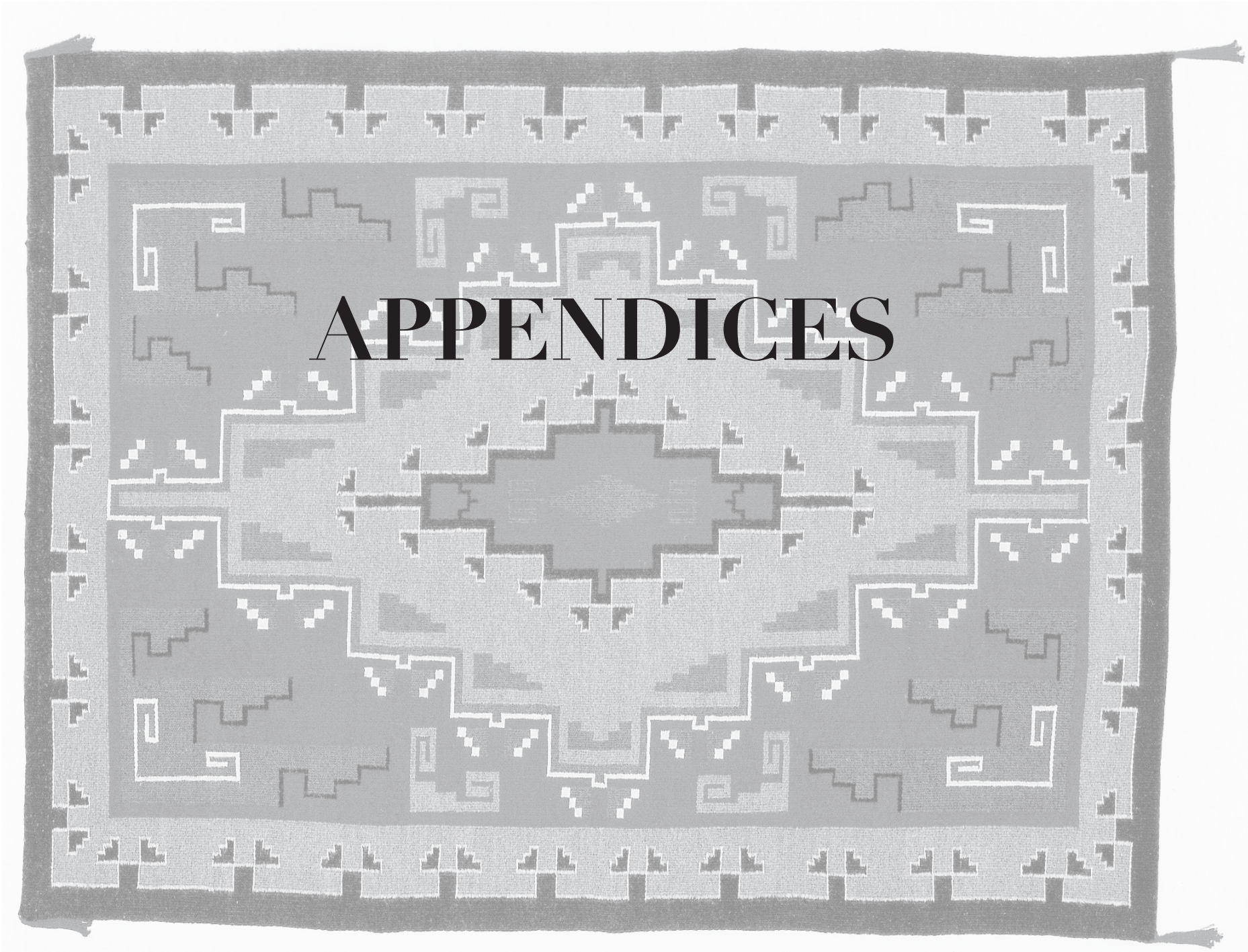
Steps for Getting Started:

- As an "incubator" to get the project started, have the National Park Service at Hubbell Trading Post Historic Site level terraces, set up the irrigation system, and plant and maintain the initial fields for the first year or two.

- Use a specific small project connected to existing efforts in the community to coalesce the initial managing group and recruit the first group to work on a project at the farm. (e.g. around the FFA, the Churro sheep project, or the hospital's diabetes project.)

- Locate sources of organizational support to help this group use the initial project to grow an organization that can move strategically toward the larger vision for the farm.

- Once the organization has begun to take shape, other activities become possible—searching for sources of funding, developing and piloting training programs, initial market research, seeking sources for livestock and indigenous crops, further organizational networking, etc.



APPENDICES

Appendix I: History of this Planning Process Project Background

Hubbell Trading Post was established as a National Historic Site in 1965 and deemed significant both for its historic relevance in connection with J.L. Hubbell, the trader, and as an example of early Western economic enterprise and development. The Hubbell Trading Post continues to operate as an active trading operation as well as a center for community social and economic interaction in Ganado and surrounding Navajo communities. For this reason, site operations are both evolving and dynamic in response to community interests as well as increasing visitor's awareness of a "living" trading post experience.

The 1966 Master Plan for Hubbell Trading Post National Historic Site laid out recommendations for reintroducing agriculture to the farmlands within the park to support restoration of the cultural landscape. With the advent of an improved irrigation system, this vision of farming is beginning to be actualized nearly four decades later.

In 2004, the National Park Service initiated a contract to help the park guide the process to reintroduce agriculture to the park. This farm plan is a response to that contract. The planning process has involved extensive collaboration between the National Park Service, local and regional organizations and institutions, and the people of the Ganado and surrounding Navajo chapters.

Under the guidelines of the Environmental Assessment (2003) for the Reintroduction of Farming at Hubbell Trading Post National Historic Site, design features and a planning approach were stipulated to meet the goals of the preferred alternative, specifically to recreate the view of a cultivated landscape similar in "feel and look" to the original Hubbell operation, whiled adhering to modern environmental and social practices that are feasible healthy, and sustainable. The following recommendations are outlined in the Scope of Work to which this plan responds:

- Crop Type and Pattern – The preferred alternative allows for a diversified mix of crops. This includes cash crops, those used historically and those utilized locally for traditional, health, medicinal, ceremonial, and dye purposes. Experimental crops including demonstration or research plots could be included. These experimental crops might provide insight into developing sustainable agriculture and "niche" markets in the region. Fruit trees would also be included. Division of the final yield from the fields will be determined in the lease arrangement between the farmer and the National Park Service.

- Irrigation - Water conservation and cost effective methods of irrigation such as drip, gated pipe and sprinklers or a combination of systems shall be considered for use based upon expert advice. Traditional flood irrigation in an open ditch and gate system will not be utilized due to poor water conservation.

- Grazing – The preferred alternative recommended experimenting with traditional churro sheep and other locally adapted livestock that would demonstrate the environmental advantages of water conservation and adaptability. Costs, benefits and constraints of this activity shall be identified. Sustainable grazing methods would be employed and manure wastes recycled within the farm. Grazing locations will be chosen according to biotic factors and site activities and will be rotated in accordance with sustainable grazing methodology. Community livestock might be rotated into the fields for specific periods of time to achieve the benefits of grazing animals.

- Work Force - The fields would be leased to a farmer willing to work within the modern model of sustainable agriculture and "holistic" management. These are terms used for the modern practices that have developed in agriculture to account for environmental and social sustainability. This may require consultation with associated organizations and available resources. Schools may utilize portions of the fields to teach sustainable agricultural methods to students. The National Park Service will choose a farmer based on these criteria and will monitor activities so that certain standards are met.

- Equipment – Needs for specific farm equipment will be identified along with associated costs. Choice of equipment by the farmer is flexible and would be individually or collectively owned. Equipment will be chosen in consultation with NPS according to the recommendations developed in the Farm Plan.

- Weed Control - The use of chemical herbicides would not be allowed due to farmer and visitor safety. Manual weeding and the use of biological control methods that are environmentally sound may be used.

- Soil Amendments - Synthetic fertilizers will not be used due to the negative effects on wildlife and ecosystem function. Instead, natural fertilizers such as animal manure, green manure (fresh, green plant matter) and composts may be used. Nitrogen fixing plants may be grown to replace/enhance nitrogen within the soils.

- Topographic Alterations - The historic terraces will be utilized to maintain the character of the cultural landscape. Stabilization efforts may be necessary to preserve and protect these features that are important components of the cultural landscape. The use of flood irrigation will not be used to maintain the historic terraces, and other methods of topographic re-creation or conservation may be considered.

- Education and Interpretation - Recommendations shall be developed for demonstration plots to be used by students, teachers, researchers, or other interested parties, in consultation with the park, for growing various plant types and experimenting with new techniques/equipment. The potential exists for tapping "niche" markets with specialty, locally -grown, organic and Navajo products. Marketing resources and education would provide the links to local restaurants, farmers' markets and education/health institutions that would value the locally produced/ environmentally sound/culturally reinforcing characteristics of these demonstration crops. Interpretation of the fields will be provided for park visitors.

- Fencing - No permanent new fencing will be used. Temporary, yet reinforced fencing will be used to contain livestock, protect archaeological sites and to keep visitors out of sensitive areas

- Implementation Sequencing/Phasing - Initial cover crops, green fertilizers, and nitrogen fixers may be used to prepare the soils for higher yield. Consultation would occur between NPS, farmers and agricultural scientists to determine a time frame for phasing and implementation.

- Monitoring - The farmer will monitor the soils and biotic properties of the fields to assure that positive trajectories are being attained. The farmer will provide NPS with monitoring data developed in conjunction with NPS and other agricultural specialists. Baseline data exists to make comparisons with ideal conditions. Consultation with agricultural scientists and soil specialists will assist with determining appropriate goals.

- The use of toxic agrochemicals such as pesticides, fungicides, herbicides, and synthetic fertilizers will be avoided in order to minimize hazards to visitor safety, water quality, and soil conditions.

Appendix II: Character of the Soil Today

In 1983 and 2002, soil erosion and geomorpholgy studies were undertaken for the site, on behalf of the National Park Service by Earth Technology Corp. and Archaeological Consulting Services, Ltd. The following information derives from these reports and provides details of relevance to the operation of the farm.

The soils in the agricultural fields are rich deep clays with sandier layers at various depths. Because of the proximity to the Defiance uplift and its endurance throughout time, the soils here were deposited by erosion not as seabed deposits. They are older, more worked, and more mixed in consistency than many of the soils in the hills.

Because these are heavy smetitic clay soils, the particle size is small and easily blown by wind or washed by water. They are easily compacted, preventing water, air and plant roots from easily penetrating. When dry, they form deep, wide cracks until they encounter a sand layer. When irrigated, water can rush through the cracks, eroding the sides and enlarging them (see photo). This can cause sink holes and other major soil disturbances.

These soils are highly erosible. They are particularly vulnerable when water moves quickly across them at any gradient. This is apparent from recent site visits and historical accounts. The wash between the housing at the site and the east field did not exist in 1900. It represents the loss of thousands of yards of soil. Similarly the washes in the south end of the west field indicate serious erosion caused by uncontrolled or inappropriate irrigation. To prevent further erosion, J. L. Hubbell terraced his fields and built large stone headgates to control and direct irrigation water.

Clear evidence of wind erosion can also be seen in the broad exposed fields of the farm. Around the base of shrubs adjacent to open areas in the fields, mounds of wind carried soil have accumulated.

While rich in many ways, these soils are poor in organic matter. Organic matter (decomposing leaves and plant stems and roots, manure and dead insects, etc.) is necessary to absorb and hold moisture, and to bind soil particles together to prevent erosion and cracking.

The soils have a pH ranging from 8 to 8.6. This is considered moderately alkaline. They need to be acidified to increase the availability of soil nutrients and to improve plant growth. The best way to do this is to increase the organic matter in the soil.

Implications For Farming

- Soils need to be protected from wind and water erosion, kept from drying out completely, broken up, and their organic matter increased.
- Planting and crop rotation plans should be designed to increase organic matter in the soil.
- Fields should not be flood irrigated without being terraced.
- Soils should not be worked or grazed when wet.

Appendix III: Planting Guidelines

IIIa. Overall Aim

To create a stable and diverse set of plantings that allow flexibility in response to changes in resources, needs, and markets.

Indicators of progress toward achieving this aim include:

- The land is able to survive dry years with little or no irrigation.
- A given perennial planting can be left virtually untended for a year or two without considerable loss.
- Crop yields are diverse.

IIIb. Recommended Crop Types

- **Perennials**
  - Pasture or Hay Field
  - Dye Plants, Basketry Plants, and other crops used in traditional crafts
  - Fruits
  - Traditional Medicinal Plants
- **Animal Crops**
  - Livestock
  - Meat
  - Wool
- **Annual Crops**
  - Corn for Traditional Foods
  - Vegetables

IIIc. Recommended Planting/Harvesting Patterns:

The following recommendations are intended to address the overall aim of stabilizing and diversifying yields from the farm, given variations in weather, markets, available resources, etc.

- As the primary and foundational planting for the farm, establish a permanent cover of grasses and clovers that will provide pasturage or hay (see seeding specs. below). Even without implementing any of the other recommendations, this primary planting will provide a yield for a minimum effort, creating a soil-building holding pattern for the soil until more advanced systems are established.
- Along the westerly edges of the fields, plant hedges of adapted and native fruits (such as plums, chokecherries, and pears—see fruit tree list below). These hedges provide shelter from winds and afternoon sun, as well as habitat for birds and beneficial insects. In addition, these native foods can be harvested and processed to create high value products (such as chokecherry jam.)
- In addition, field margins and terrace edges can be planted with a variety of useful plants, including dye plants, medicinal plants, basketry plants, culinary herbs, etc. These plants can be harvested for use (in dying wool, for example), sold as raw materials (to park visitors who want to learn dying techniques, for example), or allowed to produce seed for sale. As in the hedgerow example above, these field margin plantings improve the overall health of the farm through attracting beneficial insects, building organic content, and building fertility through concentrating soil nutrients.

IIIc. Recommended Planting/Harvesting Patterns continued:

✣ Crop Rotations are a key to managing both the health and the economic productivity of the farm. Several thoughts lie behind a successful crop rotation plan:

o Use short term annual crops as a "nurse" to provide protection while slower growing perennials are getting established. When the quick growing annual crop is harvested, the perennials are ready to take over. In the case of this farm, annual oats are recommended as the nurse crop for spring plantings. Winter wheat or winter rye are recommended for fall plantings. These annual grasses will provide graze for animals while the perennials get established.

o Heavy feeding annual crops like corn should not be planted year after year in the same place, as they will deplete the fertility of the soil and don't provide adequate protection from erosion. A rotation allows the farmer to build soil health with a permanent cover like pasture, then periodically plow it under to plant annuals. After 2-3 years growing annuals, the field should be replanted to pasture, and held under permanent cover for at least 4-5 years. (Not: Due to difficulty in establishing good paster cover, long rotations in pastures are desirable. Always plow under the least productive terraces.) Perennial grass and clover seeds can be sown in the fall, following harvest of the annual crops (see seeding specs and rotational calendar).

✣ Harvesting: The analysis of the farm undertaken for the purposes of this report suggests that the most effective method for harvesting is through intensive rotational grazing (primarily by sheep) using movable electric fencing (see below). This reduces the need for labor and costly heavy equipment. Also grazing, if effectively timed, stimulates plant growth in pasture plants. And grazing has the side effect of manuring the fields at the same time.

NOTES

IIId. Recommendations for Seeding

Recommended Spring Planting Mixture for Pastures

(can also be mown for hay)

12-14 lbs./acre		Endophyte-free K31 Tall Fescue
12-14 lbs/acre		Potomac Orchard Grass
2-3	lbs/acre	Salinas Strawberry Clover
5-7	lbs/acre	Alfalfa
2	lbs/acre	Chicory "Puna" or "Forage Feast"
60	lbs/acre	Spring Oats "Cayuse" "Colorado 37" or similar

Recommended Fall Planting Mixture for Pastures

(between August 15 and September 15.)

12-14 lbs./acre		Endophyte-free K31 Tall Fescue
12-14 lbs/acre		Potomac Orchard Grass
2-3	lbs/acre	Salinas Strawberry Clover
5-7	lbs/acre	Alfalfa
2	lbs/acre	Chicory "Puna" or "Forage Feast"
60	lbs/acre	Winter wheat or
25	lbs/acre	Winter rye

Notes regarding seed mixes:

- Recommended alfalfa varieties include: Archer, Cimarron VR, Jewel but whatever is being used locally will be fine.
- All legumes (clover, alfalfa) need to be inoculated. Inoculants are available from seed suppliers as a powder which is mixed with the seed prior to planting (see package for instructions.)
- In a fall seed mixture winter wheat or rye replaces the oats. Plant about 1/2 less rye than wheat, as it is very vigorous.

Why These Mixtures:

- Tall Fescue and Orchard grass provides the bulk of the forage.
- Strawberry clover provides nitrogen to the soil as well as increased protein for the animals. It is too low growing to produce much hay but is excellent for rotational grazing.
- Alfalfa also provides nitrogen and protein while being tall enough for hay. Its taproots help to open up the clay soils. While all of the other perennial elements of this system are cool season crops, alfalfa is a warm season crop that performs well in the hot months.
- Chicory provides excellent forage as well as nutrients not provided by the other crops. It also helps open up the clay soils.
- Oats (or Winter Rye or Wheat in fall plantings) provide a forage or hay crop the first year while the other plants are developing. and can be grazed throughout the first winter.

Recommended Soil Conditions and Seeding Processes:

- Irrigate field before planting.
- Plant while field is still moist but not so wet as to compact. Soil is too wet if it can be easily molded into a ball or cylinder.
- Soil should be 45 degrees Fahrenheit (after March 15)
- Plant seeds 1/4-3/4 of an inch deep. Ideally the seed would be drilled using a seed drill. An alternative tractor drawn seeding implement known as a cultipacker could also be used. In extreme cases hand broadcasting followed by very shallow disking or raking with a drag will work as well.

IIIe. Fruit Tree Recommendations

Planting Recommendations:

- Plant fruit trees in three rows:
  - Inner row: shrubby multi-stemmed species of fruit trees
  - Center row: taller single trunked fruit trees.
  - Outer row: hardy native shrubs (for dyes and other uses)
- Spacing:
  - Plant shrubs 3-6 feet apart;
  - Plant fruit trees 6-10 feet apart
  - Plant rows 3-6 feet apart.

Recommended Varieties:

Fruit trees should serve multiple purposes on the farm, providing windbreaks as well as fruit and dyes. Fruit crops were never a success in Ganado due to the extreme climate. Pollination may have also been a problem. By using native and adapted varieties both of these issues should be resolved. (see list below)

Shrubby Fruit Trees	*Fruit Trees*	*Native Shrubs (dye & basketry plants)*
Native plum (Prunus americana)	Mulberry (Morus nigra) also propagate from existing trees	Mountain Mahogany (Cercocarpus montanus)
Chokecherry (Prunus virginianica)	Pear: Anjou and Bartlet also grafts from existing trees	Rubber Rabbitbrush (Chrysothamnus nauseenses)
Western Sandcherry (P. bessyi)	Peach: Propagate from seed from Canyon de Chelly	Four-wing Saltbush (Atriplex canescens)
Manchurian Apricot (P. manshurica)	Apricot: propagate from seed	Wild Privet (Foresteria neomexicanus)
Nanking Cherry (P. Tomentosa)	Cherry: North Star and Meteor	Threeleaf Sumac (Rhus trilobata)

IIIe. Other Plantings

Field margins, especially under and around the hedgerow described above, provide a sheltered environment for a variety of useful and potentially valuable crops. These include berries (such as gooseberries, currants, and raspberries), asparagus, herbs (sage, thyme, parsley, oregano), and others. A variety of these crops can be tested on a small scale basis to establish which are the most viable for this farm.

Notes

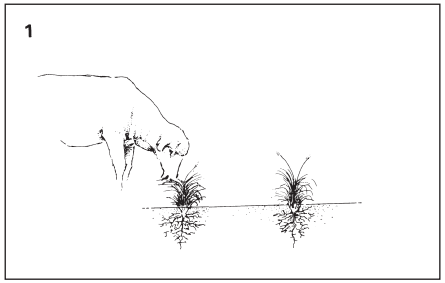
Appendix IV: Grazing Guidelines

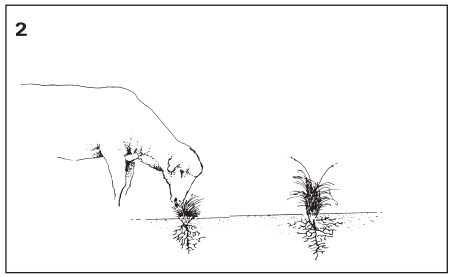
a.Overall Aim

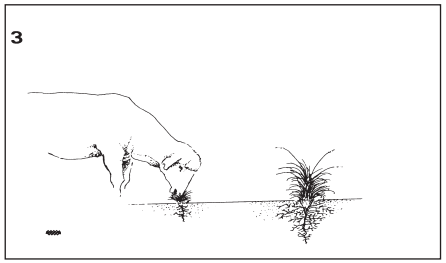
To provide the highest value yield while 1) minimizing input (and costs) of equipment and materials and 2) protecting and increasing the health of the soil.

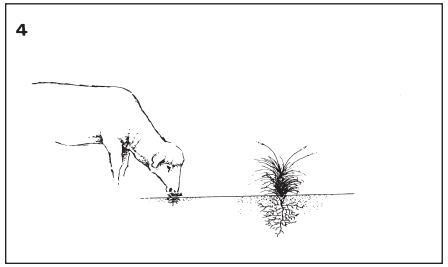
IVb. General Guidelines

- Keep livestock bunched so that paddocks are evenly and completely grazed and fertilized
- Leave sufficient time between grazings to permit plants to recover. (see illustrations below and on next page)
- Graze often enough to keep cool-season plants from going to seed and dormant. Observation will be the key to managing the grasses.
- Watering of pastures should follow grazing so that the field can dry out before the animals return. Allow at least 12-14 days between irrigation and grazing. Animals on wet pasture will cause soil compaction and reduce crop yields.





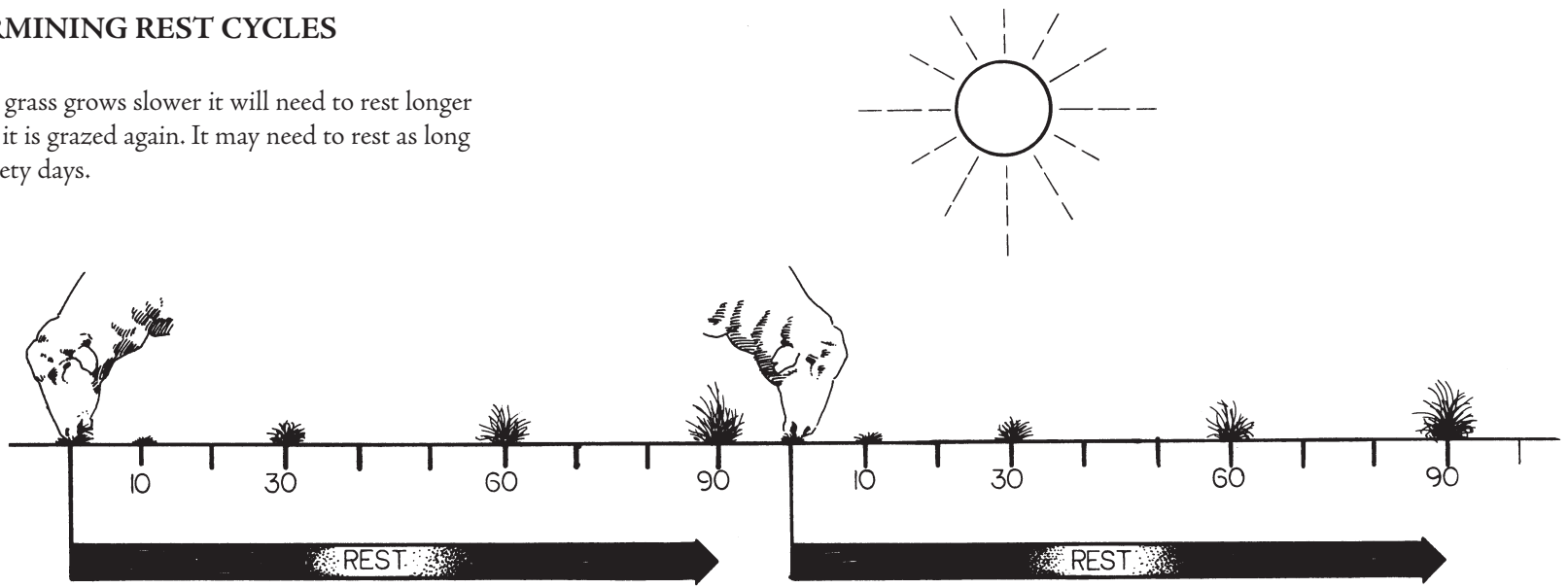




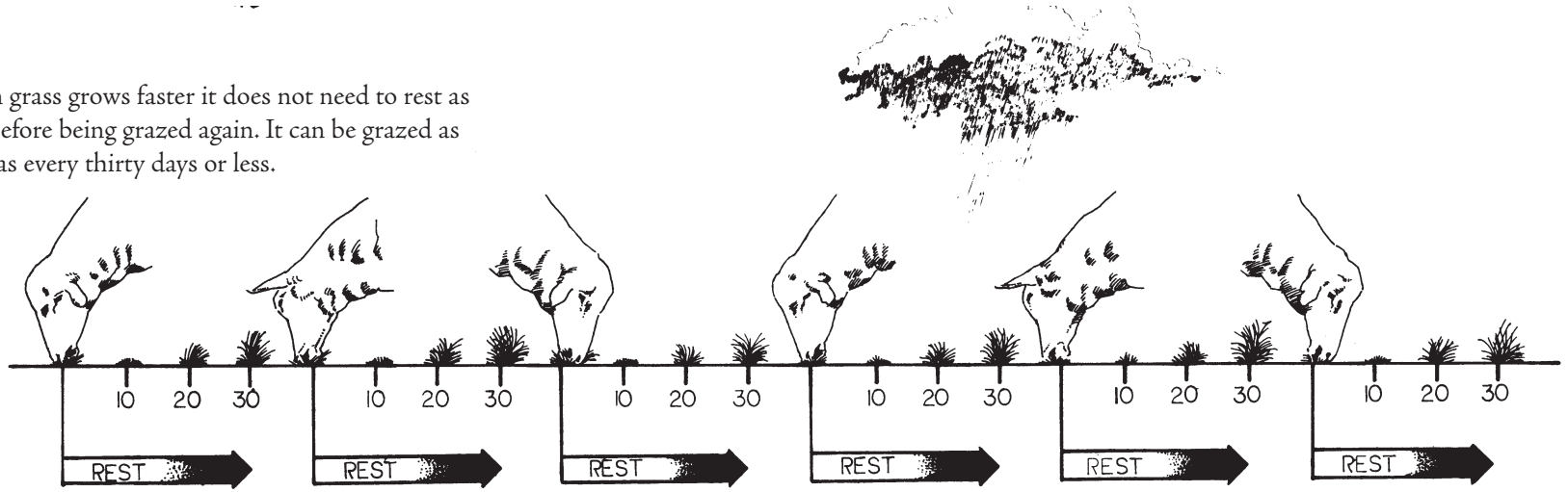
Over grazing
Each time a plant is grazed it regrows by eating nutrients stored in its roots. If it is repeatedly regrazed before it can regrow its roots, it will die.

DETERMINING REST CYCLES

When grass grows slower it will need to rest longer before it is grazed again. It may need to rest as long as ninety days.

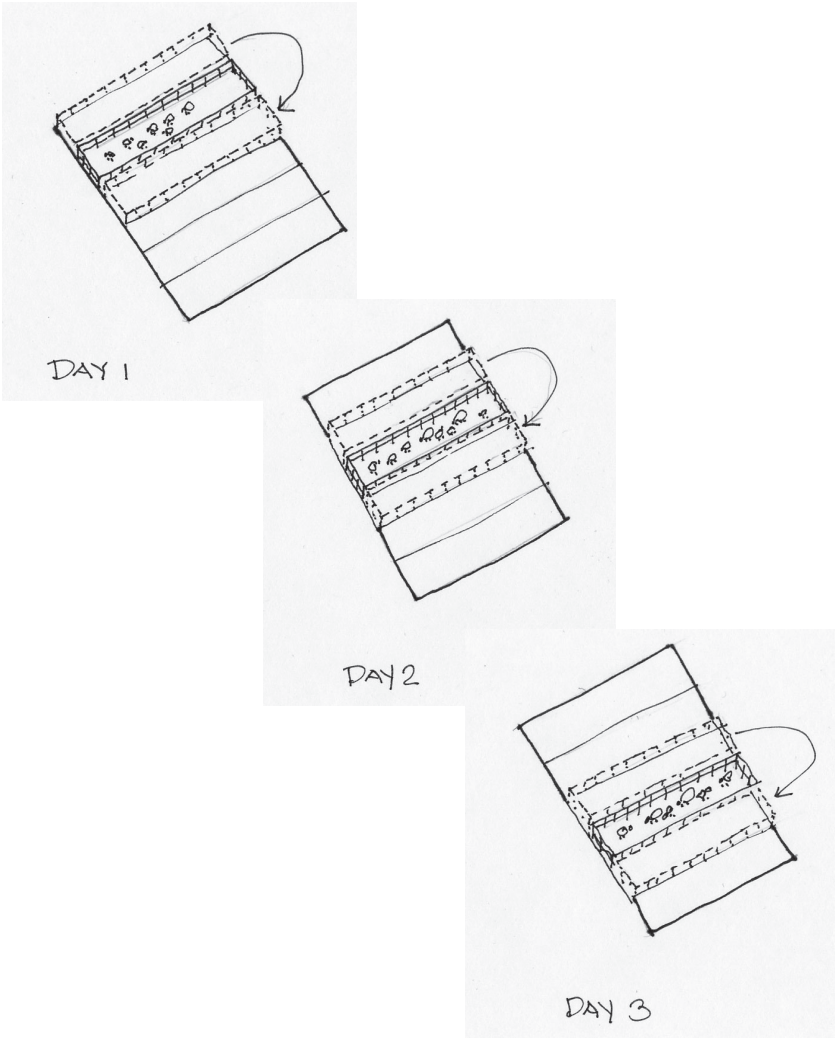


When grass grows faster it does not need to rest as long before being grazed again. It can be grazed as often as every thirty days or less.



IVc. Plan for Phasing in Grazing

Divide area to be grazed into approximately 30 equal areas. Each day the fence is moved to allow a new area to be grazed. By moving the animals more or less daily (depending on the recovery speed of plant growth—see below), they will return to the initial grazing area after about a month. (see illustration below)



IVd. Recommendations for Managing Grazing & Herd Size

Because this farm is dedicated to growing pasture, and being harvested by livestock (rather than being dedicated to raising livestock) its management will require ongoing assessment about the optimal speed of rotation and the optimal stocking rate of animals to generate and maintain the healthiest stand of pasture. A number of variables will need to be taken into consideration.

- ***In relation to fields:*** This grazing plan should carry somewhere in the area of 5-6 sheep per acre once established (the equivalent of 1 1/2 cow or animal units.)
- ***In relation to plants:*** Plants speed up and slow down their growth in response to heat, light, water, and grazing. The plants will need enough rest to re-grow and redevelop nutrient storages between grazings.
- ***In relation to seasons:***

Summer : Increase stocking rate and rotate the animals faster (potentially more than once a day at certain times or with lower stocking rates) to keep the cool season crops from going to seed. As the weather warms the cool season plants will want to send up flower stalks and go to seed. If they go to seed they will become dormant and stop growing and producing forage. Grazing needs to be frequent enough to prevent this.

Winter: Reduce the size of flocks in the fall. In early fall (September) 1/3rd of the pastureland should be taken out of the grazing rotation. In the middle to end of December these areas will provide forage. Areas that have been planted to annuals during the summer can be planted to winter rye in the fall to provide additional winter forage. All of this grazing needs to be carefully monitored and timed to available forage.

- Just as a diverse mix of plants can increase the health and viability of the farm, a diverse mix of animals, skillfully designed, can increase the health and viability of the grazing program. Different grazers tend to prefer different types of plants and, when used together, can improve the balance and

yield of a pasture. It may be useful, once a successful sheep flock has been established, to introduce complementary livestock (such as geese or cattle) into the grazing patterns. (For more information, see Benefits of Multispecies Grazing)

IVe. Comparative Advantages/Disadvantages of Grazing

The biggest advantage of grazing over cutting the pastures for hay is that haying exports the biomass produced by the farm, leading to soil depletion and the need for expensive equipment. Although alfalfa adds nitrogen to the soil, when cut and exported it depletes soil phosphorus. The greatest need of these soils is for organic matter, which would be continually removed through a haying operation.

Estimates of costs for equipment to run a hay operation range from $14,000 (see Navajo Small Farmer's Resource Guide by T. Showa—attached) to $40,000 or more (see Ganado Irrigation Project Appendix 9). As neither of these budgets includes a baler, baling would involve additional costs. Rotational grazing will require equipment in the order of $3,500. Most of this cost is for portable electric fencing and solar power/charger (see fencing). This cost also includes a portable livestock watering system and shade. (This does not include equipment for row cropping in the rotation as the possibilities and hence costs could vary from $3,000-$30,000.)

The grazing farm will require less labor per year than row crops but a bit more than the hay farm. Both the hay farm and grazing farm will require approximately the same time for irrigation (though grazing will require less irrigation water than alfalfa).

The hay farm will require intensive labor at certain times of the season for mowing, raking, baling, and bucking the hay bales—perhaps 120-150 hours labor. It will also require fuel and equipment. Hay could produce from 2-3 tons per acre per year. At 40 bales per ton and a price of $5 per bale this would equal a potential gross income of $4-600 per acre. Production costs would be $ 160-240 per acre. (see chart below)

The greatest drawback for the grazing operation is the need for daily attention and the production of a living crop that is not as easily transported or stored. The grazing option requires small amounts of labor but on a daily basis, perhaps 270-300 hours per year. In the first year grazing will be minimal, but soon phase one of the farm (the east field 11 acres) should support 55-66 sheep (or 5 sheep per acre).

Assuming 5-6 sheep per acre, yields of 5 lambs per acre and 6.5 lbs. of wool per sheep or 33 lbs. per acre are reasonable. Quality registered lambs can sell from $50 –$200(on-line) a piece. Churro wool can sell for $1.60-$9 a pound raw. This means an annual gross income of $335-$1,500 per acre—a big range. Marketing is the key to achieving the higher income. The grazing income is clearly in the same range as the hay income, but with lower equipment/production and environmental or fertility costs. The grazing approach could easily surpass the hay farm with proper marketing or further value added income such as turning wool into yarn. The educational possibilities of the grazing farm as well as the potential for regenerating the broad landscape and local economy are also obvious. (see chart below)

	EQUIP.	LABOR	BENEFITS	HAZARDS
Hay	$20-40,000	120-150 hrs.	less attention required	soil depletion
Grazing	$3,500	270-300 hrs.	fertility/productivity	daily labor

IVf. Fencing Recommendations

✣ ***Type of fencing:*** Moveable, solar-powered electric fencing is recommended. It can easily be put up or taken down by one person. Originally designed to hold sheep, it is now also used for goats, poultry, geese, dogs, rabbits, deer, calves, gardens, etc. It is reported to provide protection from predators, and is surprisingly easy and fast to put up and take down.

The equipment list below includes enough fencing to fence two terraces (one for each subsequent day.) This fencing can be used for managing the rotational grazing of livestock as well as protecting the historic corrals from the inside when used.

✣ ***Equipment List***

14 nets of mesh 7" stays electric goat fence	@ $ 97.95	$1,371.30
8 2/3" fiberglass posts	@ $ 3.75	$ 30.00
1 EXB25 Charger	@ $250	$ 250.00
1 mount Bracket	@ $50.40	$ 50.40
1 Sunsaver 6 voltage regulator	@ $ 215	$ 215.00
1 Cables	@ $ 26	$ 26.00
1 21 W Solar Panel 36" x 15" x 11/4"	@ $ 140.05	$ 140.05
2 100 amp deep cycle marine batteries	(aprox.) $130 ea	$ 260.00

Total $ 2,342.75

Here the charger, fencing and posts can be seen in use. Note the steps on fence posts for ease of installation.

Appendix V: Guidelines for Managing/ Growing Soil Fertility

a.Overall Aim

To develop the innate capacity of the soil to absorb and to cycle water and nutrients and support plant growth.

Vb. General Guidelines

- Cropping systems should protect and improve the soil.
- Fertility should be created through internal farming practices, rather than a reliance on outside inputs.

Vc. Recommendations for Improving Soil Fertility

- Three basic approaches are recommended for improving the fertility of the farm's soils without introducing artificial chemicals:
  - ***Animal droppings:*** The primary source of nutrients will be the urine and droppings of livestock grazing the pastures. Both urine and droppings are high in nitrogen and phosphorus and are left by the animals exactly where they are needed, reducing the need to collect and spread manure.
  - ***Nitrogen fixing crops:*** Nitrogen will be provided by field grown legumes (which are able to capture nitrogen out of the atmosphere and deliver it into the soil). In the pastures, these will include alfalfa and clover inter-planted with the grasses. Beans and peas will also provide nitrogen during the annual crop portion of the rotation
  -

- To protect fertility and soil health, the following practices should be observed:
  - Prevent soils from drying out completely.
  - Only terraced fields should be flood irrigated.
  - Do not work or graze soils when they are wet.

(Note: These methods differ from traditional flood-water farming and other forms of farming indigenous to the American Southwest. In more traditional approaches, nutrients were delivered by floodwaters to replenish soils. Where floodwater farming is possible, heavy feeding annuals such as corn can be grown year after year in the same fields without the need for external fertilization. However, irrigated agriculture focuses farming in areas above the active flood plain. While they receive plenty of water, irrigated fields do not receive the rich nutrient laden silts and organic matter carried by floodwaters (some O'odham floodwater fields exceed Iowa cornfields in nitrogen and organic matter). The recommendations above are designed to address the potential for soil depletion at this farm.

It may be useful to look at how some native farmers in similar climates have adapted to similar shifts in agricultural practice. In southern Arizona and northern Sonora the Pima and Papago have adopted many cool season European crops to extend harvests and maintain soil fertility. Peas or fava beans are often grown as a cool season crops to replace nitrogen removed from the soil by corn or other heavy feeding summer crops. These, along with winter wheat and rye, can also be grown as cover that is periodically grazed through the winter. In this way the nutrients are returned to the soil as manure and urine. The Tarahumara of Mexico often will use moveable corrals throughout the winter. Each night when the livestock are brought in from grazing they are penned in the fallow farm fields. Every week or two these pens (made of stacked logs) are moved so that over time the entire field is enriched with manure.)

Appendix VI: Water Management Guidelines

a.Overall Aim

To minimize requirements for and maximize benefits from the water used.

VIb. General Guidelines

- While irrigation technology is important, a systemic approach that includes adapted crops, strategies for limiting evaporation, protection from wind, maintenance of soil cover, increase in soil fertility and organic matter content, appropriate field size and topography, and careful management will be far more effective at limiting water-use.

- Use structure to conserve water: structuring terraces as basins lets them hold water more effectively, creating vertical structure at field edges through windbreaks reduces evaporative loss, and improving the structure of the soil increases permeability and water storage.

- Use appropriate management choices to conserve water: choosing the right plant and animal varieties and putting them in the right combinations can make a big difference in terms of the water required. Timing is also important: water during the cool part of the day; apply water when it's needed, not on a fixed but arbitrary schedule; minimize the time that fields are flooded to prevent slowdown in plant growth.

- Assess new technologies (such as drip irrigation systems) carefully. The systemic approaches described above may be far more effective methods of water conservation for the money required. New technologies can help improve the overall productivity of the farm, but only once more systemic approaches have been optimized.

- Use systems that are replicable by community farmers and not continual security and vandalism concerns.

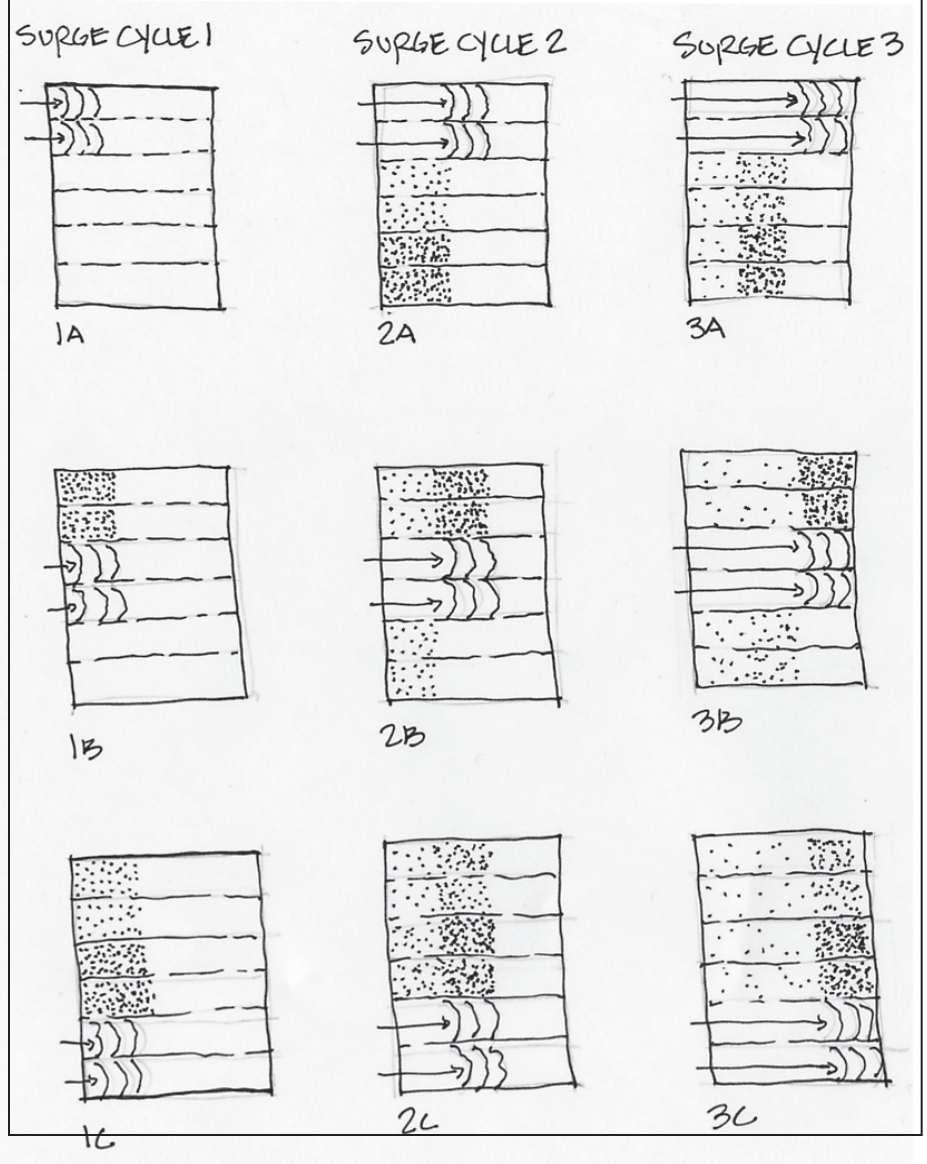
VIc. Irrigation Recommendations/Options

- ***Primary irrigation*** will be based on leveled terraces with depressed surfaces fed by gated pipe. The terraces provide water control as well as good units for rotations and other management patterns. Because these terraces will be flood irrigated, they should be no longer than 600 feet. As the terrace lengthens, more and more water is wasted.

- ***Pulse Irrigation:*** Flood irrigation should be done by the pulse or surge method. Each terrace should be watered only until the water flowing across the field slows down. This is because the soil, as it becomes saturated, begins to float, causing the water to "dive" to deeper levels. As a result, the part of the terrace closest to the irrigation inlet becomes over-watered, while the far end is under-watered. The solution is to water the terraces in pulses. Temporarily removing the water allows the soil to settle so that water can run across its surface and eventually reach the far end of the terrace. When the water in the first terrace begins to slow down, it should be shifted to the next terrace. When the water slows in the second terrace, it should be shifted to the third, and so on. Eventually the water is returned to the original terrace until it again slows. This pattern of irrigation rotates until all terraces are fully watered.

(SEE FOLLOWING ILLUSTRATION)

PULSE IRRIGATION ILLUSTRATION



- *Reel Sprinkler and Drip Irrigation:* **Annual crops can be watered in furrows from gated pipe. Ideally annuals will be grown in mulched sunken beds watered with drip irrigation or flooded in waffles.**
  - Can use less water than flooding from gated pipe.
  - Can increase yields.
  - Require 30-40 psi water pressure. Ganado Water system is not expected to maintain this level of pressure.
  - Drip irrigation also requires low silt water supply or effective filtration.
  - Either system would require a pump. Drip would also require a holding tank and filter system.
  - Either system could be served from blank pipe provde with t's and valves in the main system.
  - Low-tech drip from barrels could be filled from existing t's and valve at top of gated pipe system.

Appendix VII: Weed/Pest Control Guidelines

a. Overall Aim

To minimize crop loss from weeds and other pests through the basic productive operations of the farm.

VIIb. General Guidelines

- Address causes not symptoms
- Preventative measures are best
- Create healthy soil and plants that prevent weed and pest problems
- Do not create unhealthy conditions

VIIc. Weed Management Recommendations

- ***Understanding what makes weeds grow:*** Weeds are caused by:
  - Soil disturbance
  - Compacted soil
  - Bare soil
  - Being allowed to reseed
  - Being allowed to photosynthesize
- Weed ***Treatment Options***
  - Maintain permanent plant cover
  - Smother weeds with cover crops
  - Cultivate the soil for the crop beginning the year before.
  - Rotate annuals and perennial crops
  - Improve soil structure
  - Graze weeds
  - Plant densely
  - Mulch annual Crops
  - Plant row crops in furrows/Hill up with cultivator to form new irrigation furrows between rows, smothering weeds.
  - Cultivate weeds below the soil surface
  - Focus on problem weeds/Leave edible tap-rooted weeds
  - Plant crop to be easily mechanically cultivated

VIId. Pest Control Recommendations

- Understand the source of pest problems: Most pest problems are a reaction to poor soil or overuse for a single crop. Unhealthy plants can actually attract pests by smell.

Integrated Pest Management Approach

Here is an integrated pest management approach to crop pests. It is important to follow all of the steps and not to skip ahead.

1. First insure soil health and fertility. Beware of over fertilization or over watering.
2. Plant pest resistant crops and varieties.
3. Identify the pest clearly. Be certain that the insect is in fact a pest.
4. Learn adult and immature states of insect.
5. Learn causes of insect infestation.
6. Address causes
7. Determine extent of threat to crop
8. If small population, hand pick
9. If larger, use appropriate organic pest controls (turkeys, diatomacious earth, predatory insects, mineral oil, tobacco tea…) (see resources for sources of this information.)
10. Consult with Park staff about Park Pest Control policies.
11. Consult with Cooperative Extension Service for recommendations.
12. Insecticides including organic ones should only be applied as recommended with complete safety equipment.

Appendix VIII: Topographic Alteration Guidelines

a. Overall Aim

To use water efficiently and to protect the soils from erosion.

VIIIb. General Guidelines

- Reestablishment of east west terraces will be the primary topographic alteration.
- Fall between terraces should be approximately one foot. Within a given terrace, the gradient from east to west should be 1/4 inch per foot.
- Within these terraces sunken waffle type garden beds can be established for long-term vegetable cultivation. (For more information, see Food From Dryland Gardens by Cleveland and Solari) Note: Waffles can be much larger than those pictured here.

Appendix IX: Resource Requirements for Managing the Farm

Equipment

In the rotational grazing option, equipment would consist primarily of moveable electric fencing and a solar powered charger (see fencing). Any annual crops would require the use of plowing equipment. If initial plowing (disking) can be done by outside equipment all of the remaining work can be done with a large rototiller with furrowing and weeding attachments. A large BCS tiller could accomplish this work.

If a tractor is required the following attachments will be required:

- a set of disks,
- a two row planter,
- a furrower,
- a two row cultivator, and
- a seed drill.

Workforce

Once established, the basic rotational grazing component of the farm will require daily labor of perhaps 45-60 minutes. In addition 2 days a month will be required for irrigation. This would mean a total of $12,892 total, or $172 of labor per acre. Alfalfa hay would require $110 per acre in labor. Annual crops will require more labor depending upon the crop. Row cropping of corn using mechanized weed control could require perhaps $635 per acre. Intensive vegetable cultivation will require the highest labor input of $790 per acre.

Appendix X: Resources & References

- **Resources:**

Natural Resources: Ecosystem Services

ATTRA--National Sustainable Agriculture Information Service
On-line database with networking information for sustainable agriculture projects.

PO Box 3657
Fayetteville, AR 72702
800-346-9140
Fax: (479) 442-9842
http://www.attra.org/attra-pub/susagorg.html

Natural Resource Conservation Service
Federal agency that offers resources, information and technical services related to natural resources and land management.

St. Michael's Field Office
Highway 264
St. Michaels, AZ 86511-0499
Phone: (928) 871-4528
Fax: (928) 871-4530
Dan Bloedel: District Conservationist
daniel.bloedel@az.usda.gov

Navajo Nation Division of Natural Resources
Navajo Nation agency that offers resources, information and technical services related to natural resources and land management.

PO Box 9000
Window Rock, AZ 86515
Phone: 928-871-6592 / 6593
Fax: 928.871.7040
http://www.dnr.navajo.org/

✣ Resources continued:

Navajo Department of Water Resources
Water resources, information and technical services.

PO Box 678
Ft. Defiance, Arizona 87504
Phone: 520-729-4004
FAX: 520-729-4126

Natural Resources: Grazing Management

Navajo Nation Department of Agriculture
Offers resources, information and technical services for agricultural projects on Navajo Nation.

John Blueyes
Window Rock, AZ
Phone: 928-871-6605
john_b_87421@yahoo.com

Navajo Nation Division of Natural Resources
(also see ecosystem services)

The Savory Center
Offer services, resources and educational opportunities associated with rotational grazing and holistic resource management.

1010 Tijeras NW
Albuquerque, NM 87102
Tel: (505) 842-5252
Fax: (505) 843-7900

Quivira Coalition
Conducts community workshops for grazing management, road maintenance and grassland and riparian restoration. Facilitates multi-party collaboration between ranchers, environmentalists, planners, biologists and community members.

1413 Second Street, Suite 1
Santa Fe, New Mexico 87505
Tel.: 505.820.2544
Fax.: 505.955.8922
http://www.quiviracoalition.org

Natural Resources: Livestock

American Livestock Breeds Conservancy
Helps to preserve rare livestock breeds; network connections for breeders.

www.albc-usa.org
Don Bixby, dbixby@albc-usa.org

Heifer Project International
Supports rural economic development, sustainable development and food security. Funding and farm and livestock resources available for family and community farming and ranching efforts.

Southwest Regional Office
Albuquerque, New Mexico
330 Main St., Suite 203 A
Seal Beach, CA
Toll Free Phone: 877-663-1683
Email: sw@heifer.org

✣ Resources continued:

Navajo Sheep Project
Livestock breeding and exchange program for the Navajo-churro sheep.

Dr. and Mrs. Lyle McNeal
NSP Utah Office
P. O. Box 4454
Logan, Utah 84323 USA
(435) 753-7982

Mark Petersen
Navajo-churro sheep breeder/ Project Coordinator for Navajo Sheep Project

648 Parley Road
Park City, UT 84098
801-556-9229
Email: marpet42@aol.com

Navajo-Churro Sheep Association
Navajo-churro sheep breeders and organization for wool and churro product marketing and resources.

P.O. Box 94
Ojo Caliente, NM 87549
churro@newmex.com

Nikyle Begay
Navajo-churro Sheep Breeder

928-755-3577
Email: my_churro@yahoo.com

Natural Resources: Seeds and Plants

Native Seeds/SEARCH
Seed supplier for climatically adapted southwest crops and dry-climate varietals. Programs and foods and seeds for diabetes prevention; seed exchange and discount program for Indigenous peoples.

Phone: (520) 622-5561
Fax: (520) 622-5591
info@nativeseeds.org
Kevin Dahl, kdahl@nativeseeds.org
Suzanne Nelson, snelson@nativeseeds.org
Native Seeds/SEARCH
526 N. 4th Ave.
Tucson, AZ 85705-8450

Seed Savers Exchange
Seed supplier for heirloom crop varieties.

Kent Whealy, kent@seedsavers.org
www.seedsavers.org
3094 North Winn Road
Decorah, IA 52101
563-382-5990
Fax: 563-382-5872

Plants of the Southwest
Seed and plant supplier and nursery for southwest Native plants as well as plants climatically adapted for southwest region.

3095 Agua Fria Rd
Santa Fe NM 87507
(505) 438-8888
Fax: (505) 438-8800
plantsofthesw@juno.com

✣ Resources continued:

Social/Cultural Resources: Schools and Education

Center for Sustainable Environments at Northern Arizona University

Directory and on-line database of eco-regional food sustainability of Native Foods of the Four Corners region.

Gary Nabhan, Director: Gary.Nabhan@nau.edu
Ashley Rood, Ashley.Rood@nau.edu
PO Box 5765
Flagstaff, AZ 86011
(928) 523-0637
Fax (928) 523-8223

Ganado High school: FFA Program

Student organization for agri-science, natural resources and vocational skills training.

Nicomas Redhorse: FFA Coordinator
928-755-1400 ext 1454
nicomas.redhorse@ganado.k12.az.us

Keyah Be Iina

Educational program at day school focused on land-restoration through rotational grazing

Contact: bethmccauley@hotmail.com
Dinnebito, AZ

Quivira Coalition

(also see grazing management)

Rocky Point School

Navajo charter school with Navajo language and cultural education programs as well as environmental education programs involving sustainable grazing management.

Contacts for these programs at:
NAU
College of Education
PO Box 5774
Flagstaff, AZ 86011-5774
(928) 523-2611

The Savory Center

(also see grazing management)

Window Rock Immersion School
TSEHOOTSOI DINE'BI'OLTA

Navajo language & cultural education for head-start through grade 8.

(928) 729-6842

Social/Cultural Resources: Traditional Foods/Diabetes

Canyon Country Fresh

Supports food growers and provides technical assistance for local food production in the Four Corners region.

Catherine Freeman, Program Coordinator,
(928) 523-0664
Catherine.Freeman@nau.edu.
Center for Sustainable Environments at Northern Arizona University
PO Box 5765
Flagstaff, AZ 86011

✣ Resources continued:

Center for Sustainable Environments at Northern Arizona University
(also see schools and education programs)

Chefs Collaborative
Supports farmer to chef connections.

www.chefscollaborative.org

Navajo Diabetes Project
Offers glucose and cholesterol testing, healthy cooking classes and information and resources for diabetes prevention; supports gardens, nutrition, and exercise for health.

Navajo Health Foundation /Sage Memorial Hospital
P.O. Box 457, Ganado, AZ 86505
Tel. (928) - 755 4500
Diabetes outreach Coordinator—Deborah Cayedito
dcayedito@navajosage.org

Pinewoods Community Farming
Native (Iroquois) community farming project connected to traditional foods and diabetes prevention.

Director: John C. Mohawk
Speaker: Yvonne Dion-Buffalo
13456 Rte. 438
Gowanda, NY 14070

Renewing Americas Food Traditions (RAFT)
C/o The Cultural Conservancy
Native affiliated non-profit organization that supports native food and Native lands projects.

P.O. Box 29044
Presidio of San Francisco
CA 94129-0044
Ph: (415) 561-6594 Fax: (415) 561-6482
Melissa Nelson, mknelson@lgc.org
General, tcc@nativeland.org

Slow Food USA
International organization that supports local food traditions. Helps connect regional growers with markets and restaurants. NOTE: Navajo-churro sheep is added to these efforts.

www.slowfoodusa.org
Erika Lesser, Erika@slowfoodusa.org
Marsha Weiner, ContentMaven@ironicdelights.com

Traditional Native American Farmers' Association
Native non-profit supporting native crops and farming techniques; offers educational programs related to native agriculture.

Contact: Clayton Brascoupe
P.O. Box 31267, Santa FE NM 87594-1267
(505) 983-2172

Social/Cultural Resources: Native-affiliated Non-profit Organizations

The Cultural Conservancy
Native affiliated NPO that supports requisition of Indigenous lands and cultural resources and native community land-trusts.

P.O. Box 29044
Presidio of San Francisco
CA 94129-0044
Tel: (415) 561-6594 Fax: (415) 561-6482
www.nativeland.org

✣ Resources continued:

Diné bí' íína' (Navajo Lifeways)
Navajo organization that supports land-based cultural traditions such as grazing and weaving. Offers educational workshops, resources and information.

Contact: N.G. Manymules Bitsoi, DBI President
P. O. Box 539
Ganado, Arizona USA 86505

First Nations Development Institute
Grant funding and research organization supporting Indigenous communities.

2300 Fall Hill Ave., Suite 412
Fredericksburg, VA 22401
Tel/540.371.5615 Fax/540.371.3505
info@firstnations.org

Sheep Is Life
Navajo organization that supports land-based cultural traditions such as grazing and weaving. Offers educational workshops, resources and information.

Roy Kady
roykady@dinewoven.com

Prophecy and Survival
Website with resources, articles and networking connections for Native agriculture, economic development and cultural and natural resource management.

John Mohawk
http://www.prophecyandsurvival.com
mohawk@prophecyandsurvival.com

White Earth Land Recovery Project, Sustainable Communities
Native food and agriculture program on White Earth Reservation (Anishinaabeg of Mississippi Band). Good food program (Mino-Miijim): traditional food for diabetic elders and families. Also focuses on restoration of land base, ecological relationships, cultural practices; Native Harvest Food Program

WELRP
32033 E. Round Lake Road
Ponsford, MN 56575
Ph: 218-573-3448
info@welrp.org
www.welrp.org
Winona LaDuke

Economic Resources: Marketing

Canyon Country Fresh
(also see traditional foods/diabetes programs)

Chefs Collaborative
(also see traditional foods/diabetes programs)

Local Harvest
Non-profit organization supporting organic and sustainable agriculture practices. Provides resources, information and network contacts for food growers throughout the country.

220 21st Ave
Santa Cruz, CA 95062
Phone: 831/475-8150
gpayet@localharvest.org

Slow Food USA
(also see traditional foods/diabetes programs)

✣ Resources continued:

Southwest Marketing Network

Marketing organization connecting food growers with regional buyers, distributers and consumers. Provides information and technical services for marketing in the southwest region.

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Appendix XI: Annual Calendar

Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	April 1-15	April 16-30
			Start Seedlings Inside If there is a Thaw disk and Plant Favas (interplant w/ Corn in May)	Seed Hardy Greens/ Onion Family Potatoes	Seed Pasture Plant Early season crops i.e.: Peas/Favas Graze Out Terraces for Annual Cultivation	Seed Pasture Graze Out Terraces for Annual Cultivation	Disk Terraces for Annual Crops
May 1-15	May 16-31	June 1-15	June 16-31	July 1-15	July 16-31	August 1-15	August 16-31
Disk Annual Terraces Plant Early Warm Season Crops	Plant Warm Season Crops i.e... Corn, Beans, Tomatoes		First Cutting of Hay Completed			Second Cutting of Hay completed	Plant Cool Season Crops Plant Pasture if Warm Season Crop Harvested
Sept 1-15	Sept 16-31	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31
Set Aside Winter Graze	Finish Harvesting Warm Season Crops Thin Flock Seed winter cover crop	Seed Pasture/ cover crop Last Cutting of Hay (or previous two week period)	Seed Pasture				Begin use of stockpiled winter graze and annual cover crops

Note: Irrigation should occur every two weeks to one month during season.

Annual Calendar Work Sheet

Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	April 1-15	April 16-30
May 1-15	May 16-31	June 1-15	June 16-31	July 1-15	July 16-31	August 1-15	August 16-31
Sept 1-15	Sept 16-31	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31

Appendix XII: Monitoring Guidelines & Work Pages

a. Overall Aim

To insure that farm operations are protecting and developing the health of the farmland.

XIIb. General Guidelines

- **Basic Indicators of systemic/community health:** Soil fertility, water use and plant health. Monitoring these three provides the basic framework for determining when operations are getting out of bounds or out of balance.

- **Means for measuring** progress or decline in each area are offered below. Some of these measures are quantitative. Some are qualitative.

- **Value of Consistency**: Because conditions are dynamic and continually changing, ongoing, regular monitoring is critical to understand how best to partner with the changing capabilities of the land.

- **Monitoring cycles** vary depending on the indicator. While some are annual, monitoring of the graze in the pastures needs to be on-going to determine weekly grazing. This monitoring will give an excellent on-going picture of the health of those lands.

- **Tracking results:** Forms are provided below for tracking results of monitoring key indicators in a graphic form. These can provide a valuable educational as well as planning tool. They are helpful in maintaining continuity and alignment among those who work the farm.

XIIb. Indicators

Soil Health (the basis of health in the entire community)

Soil Samples need to be taken annually in five places in the farm and analyzed professionally or by students for the following indicators:

- Structure (the basis of water, gaseous, and fertility holding ability). Measured qualitatively by digging test pit(s) 2-3" deep to reveal soil horizons and compaction/structure. Photos should be taken for annual comparison. Over time should reveal increasing structure and permeability.

- Organic Matter Content (basis of soil structure, fertility and pH balance) Measured by %. Can be determined in simple float test or professional soil tests. Should increase annually. Decrease indicates serious issues. Should not be allowed to decrease over two or more years.

- pH/Salts (basis of ability of soils to sustain plant life) pH 7 is neutral. Currently the soils range around 8.5. This should go down annually until it approaches 7. It should not go above 8.5. This indicates severe problems.

- Fertility (Basic food for plants to grow)

  - *Nitrogen*: Primary nutrient for plant growth. Levels should increase annually. They will plateau. They should not decrease without recovering over two to three years.

  p*otassium*: Primary nutrient for plant health. Same as Nitrogen above

  - *Phosphorus:* Primary nutrient for blossoming of plants as well as general health. Easily depleted by removal of alfalfa hay from land. Should not be allowed to decline over two years.

XIIb. Indicators cont.

Water Use (Primary indicator of ability of land and plant community to function well)

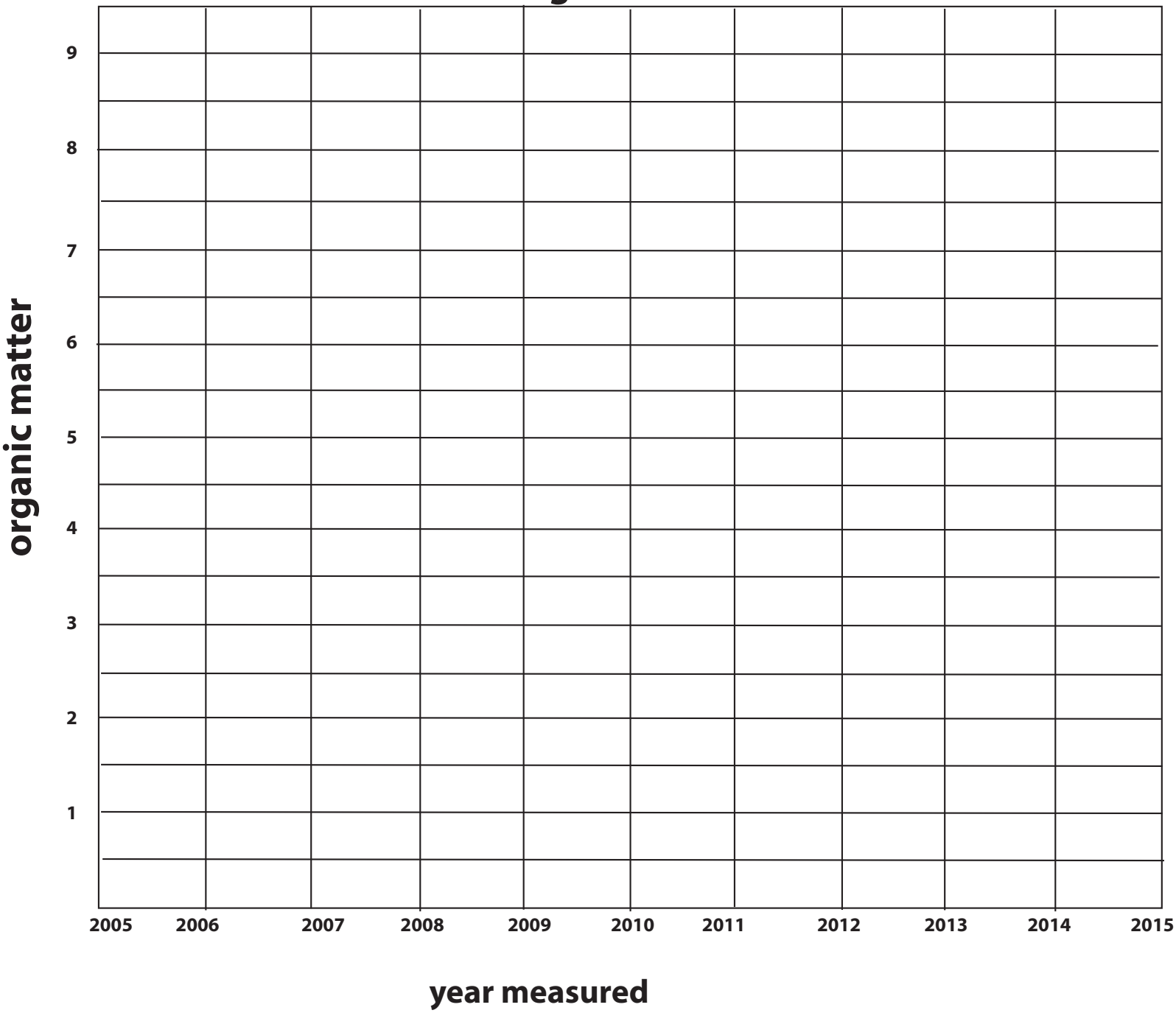
Should be measured either by being metered or estimated by time and volume run. Ideally water use will decrease over time. If it increases quickly at some point it may reveal a problem in the system.

Plant Health (Indicates health of the land community)

- Plant Cover (Indicates health of land, fertility, water holding ability, and effectiveness of management practices)
  - Plant cover in perennial pastures needs to maintain or increase beyond 80% cover.
  - Plant cover is based on foot step monitoring. Each pasture should be walked across in three places and note made at each step of presence or lack of plant cover at tip of shoe. This will provide a random plant cover percentage.
- Plant Health

A simple qualitative measure of plant health is visually by color. Plants should be a deep rich green. Yellow indicates lack of available iron. Brownish indicates dryness or lack of nutrients.

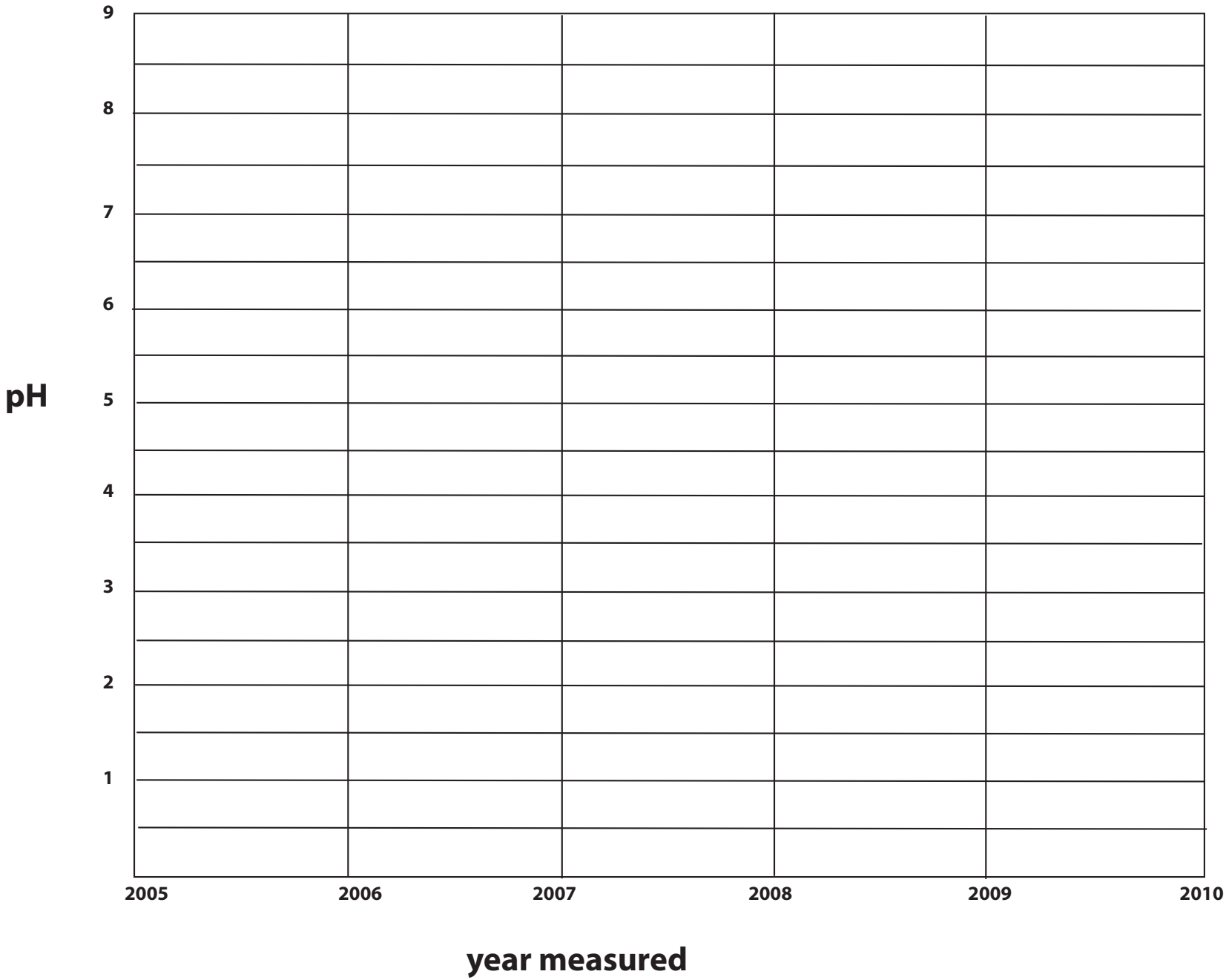
Percent Organic Matter in Soil



Notes

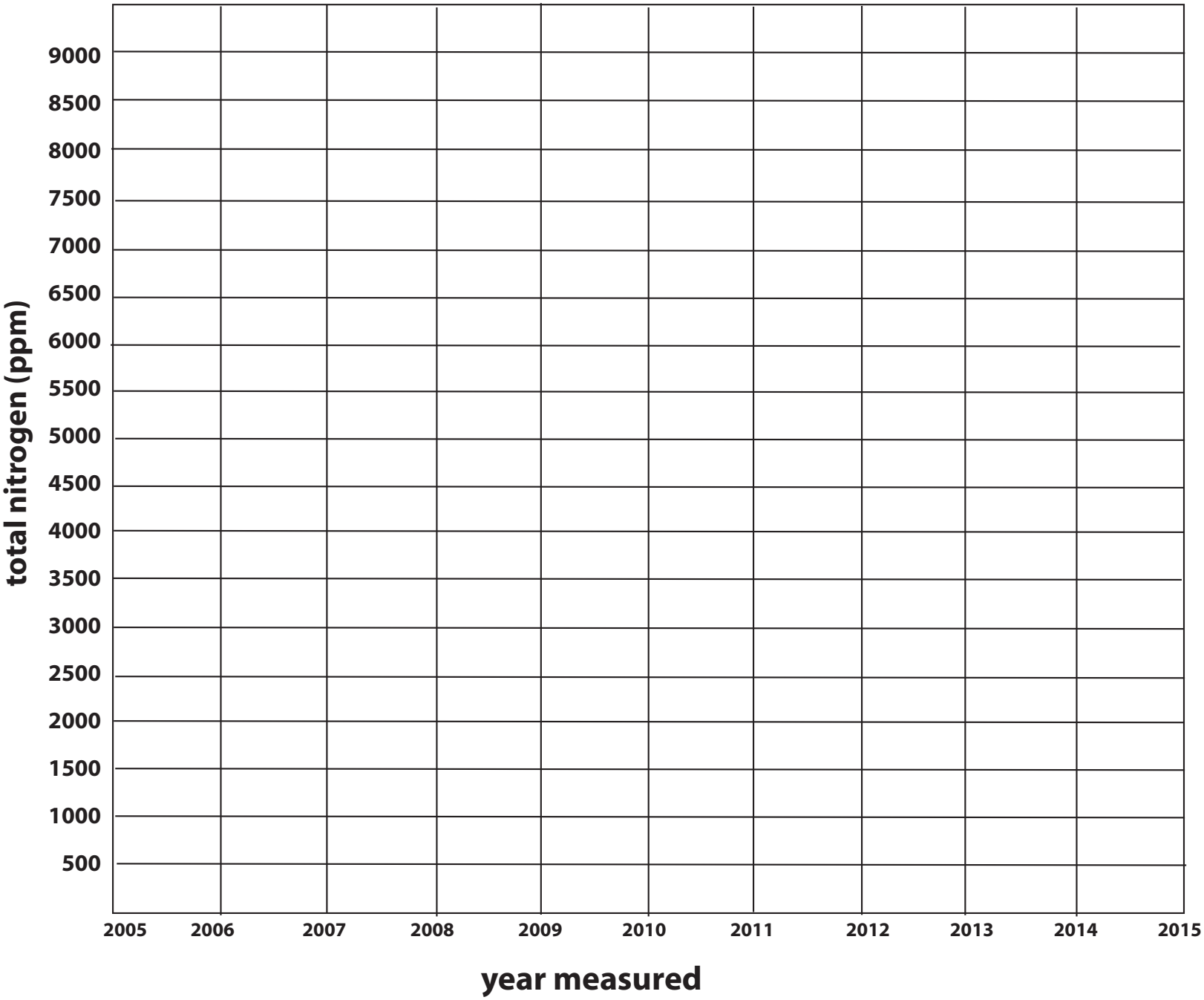
Soil pH Levels

Notes



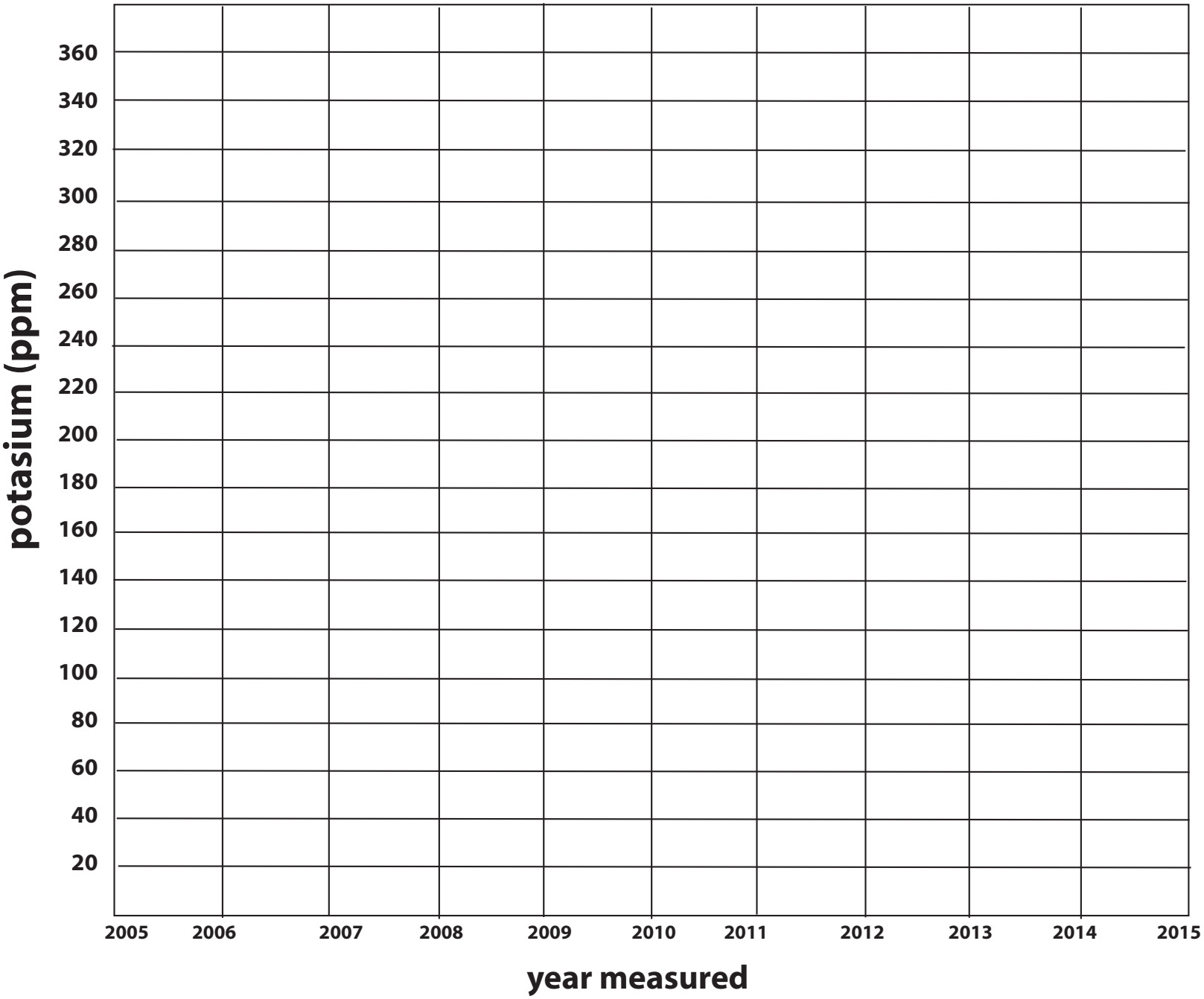
Nitrogen Levels

Notes

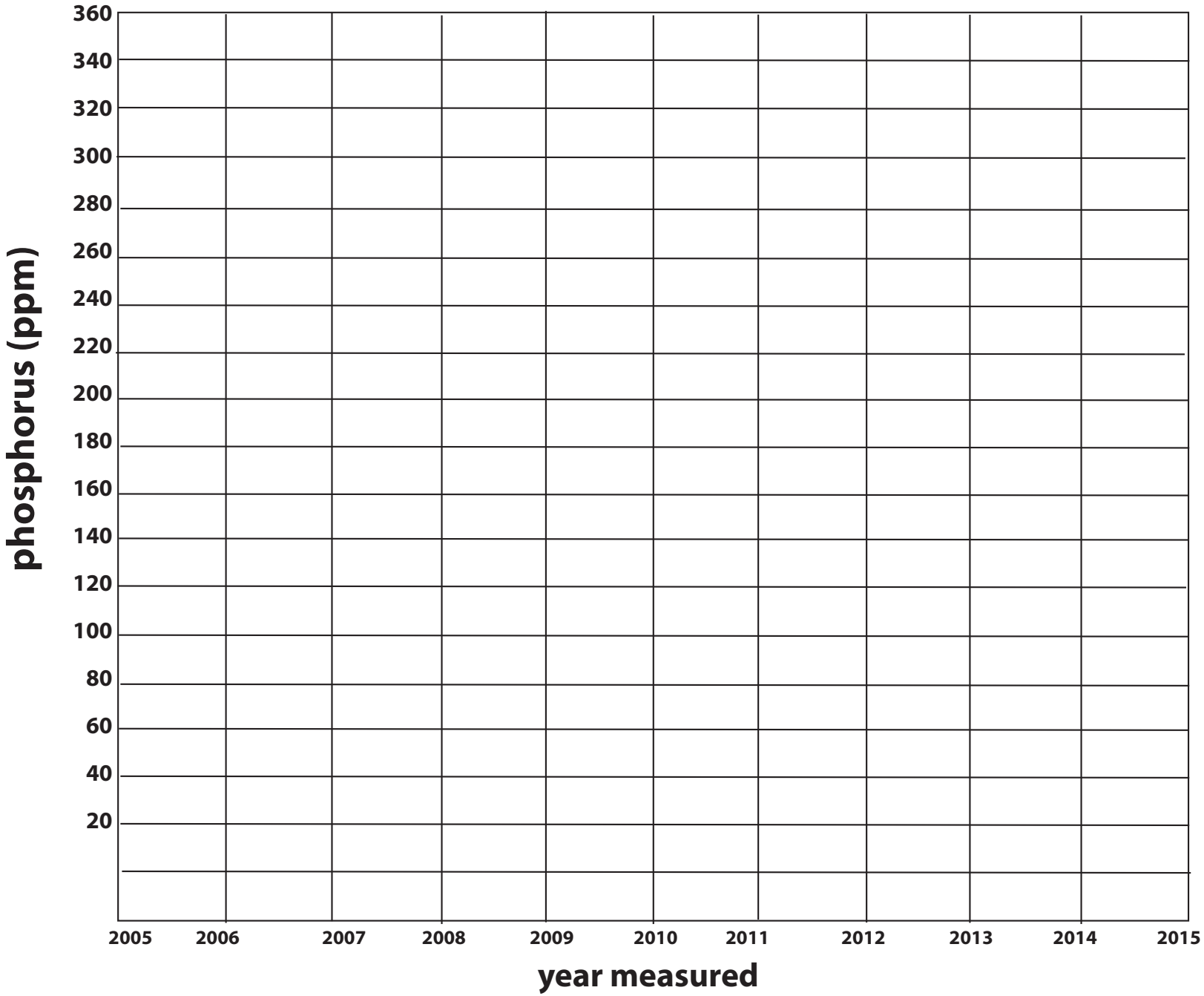


Potasium Levels

Notes



Phosphorus Levels



Notes

Percent Plant Cover

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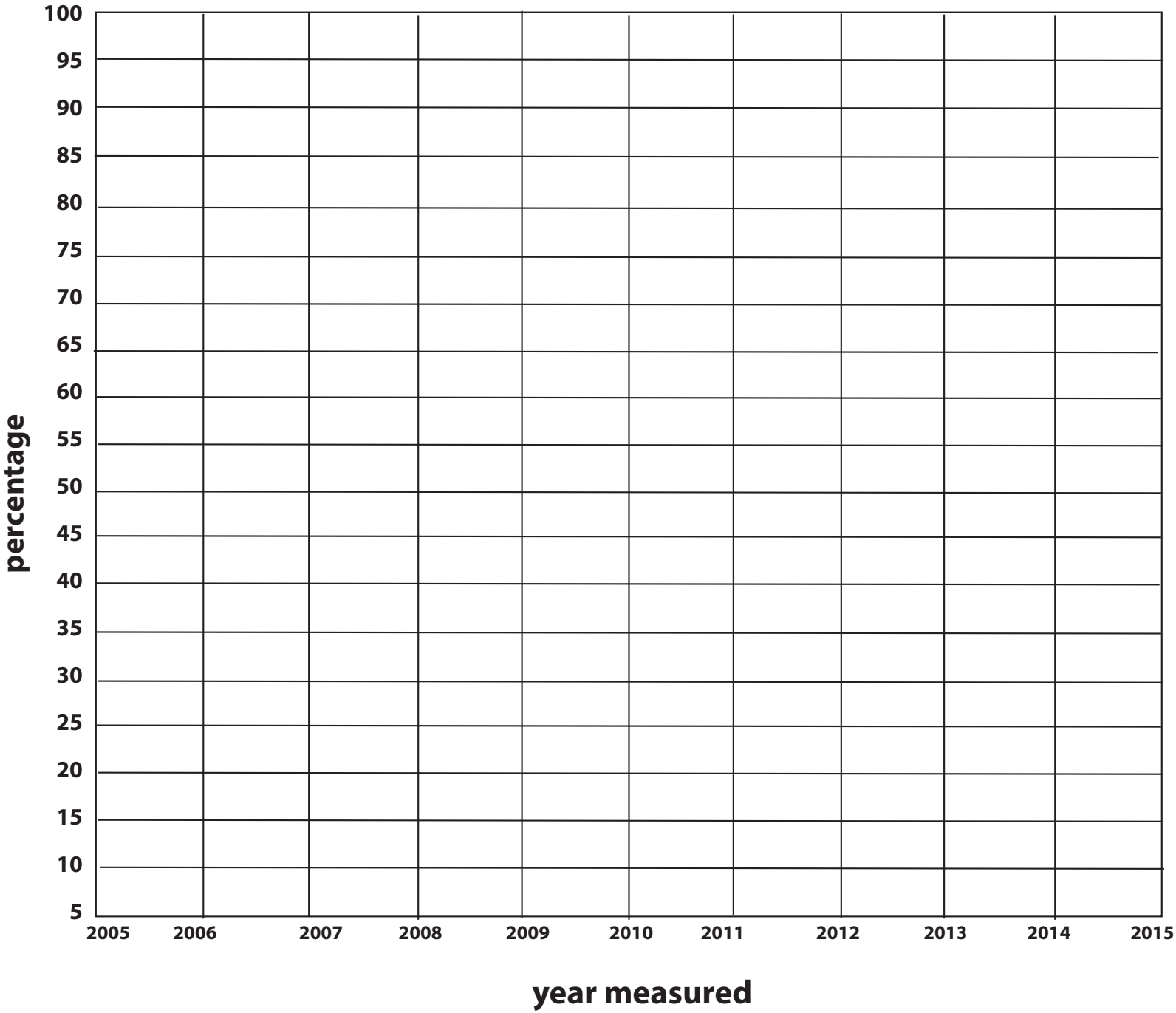

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