How to Regenerate Degraded Pasture

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A Typical Situation

Land degradation caused by overgrazing, drought, and soil erosion.

Degraded Land in Upper-East Ghana

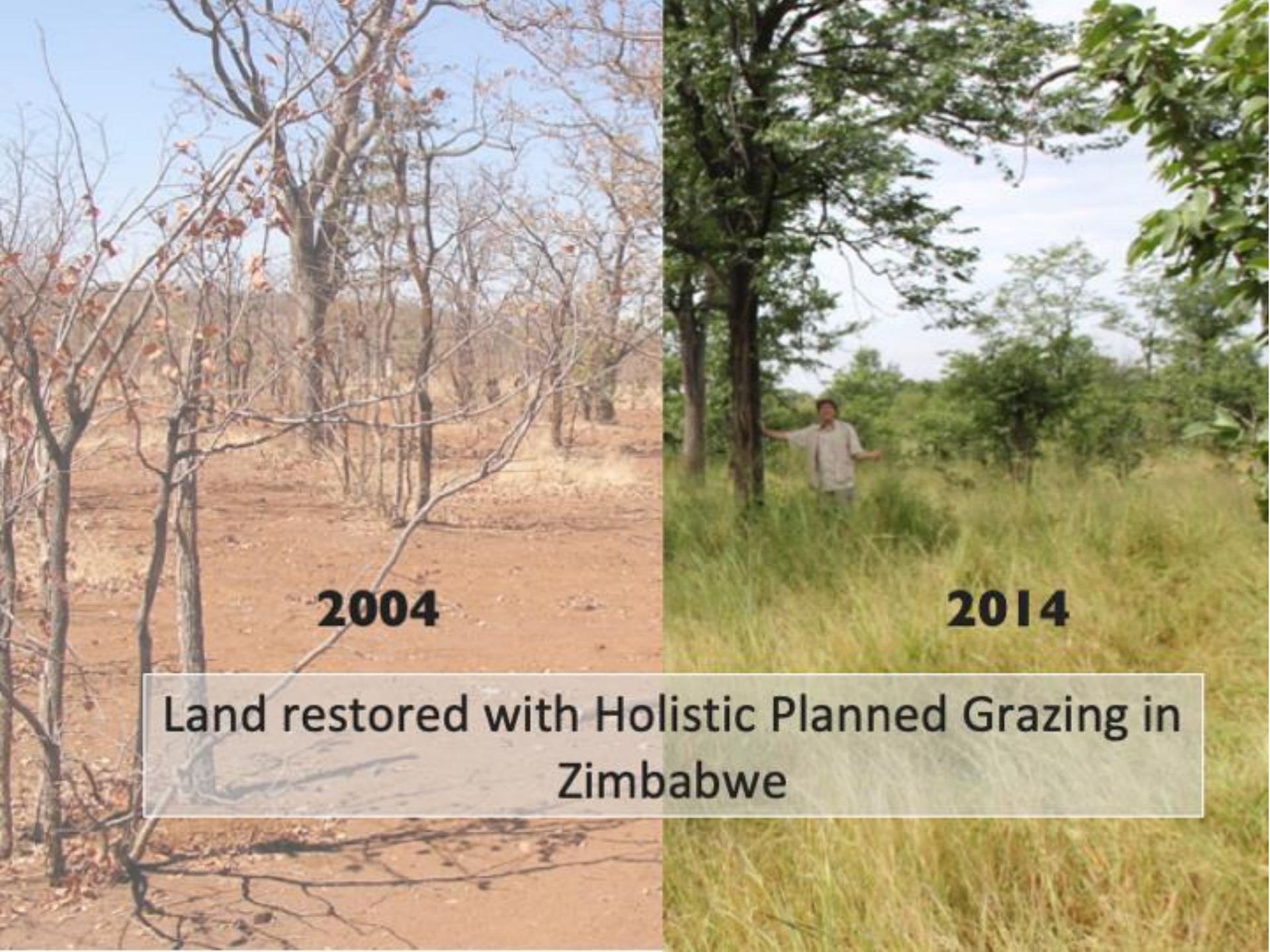
Overgrazed Land in Ghana

Grazing Cattle on Overgrazed Land

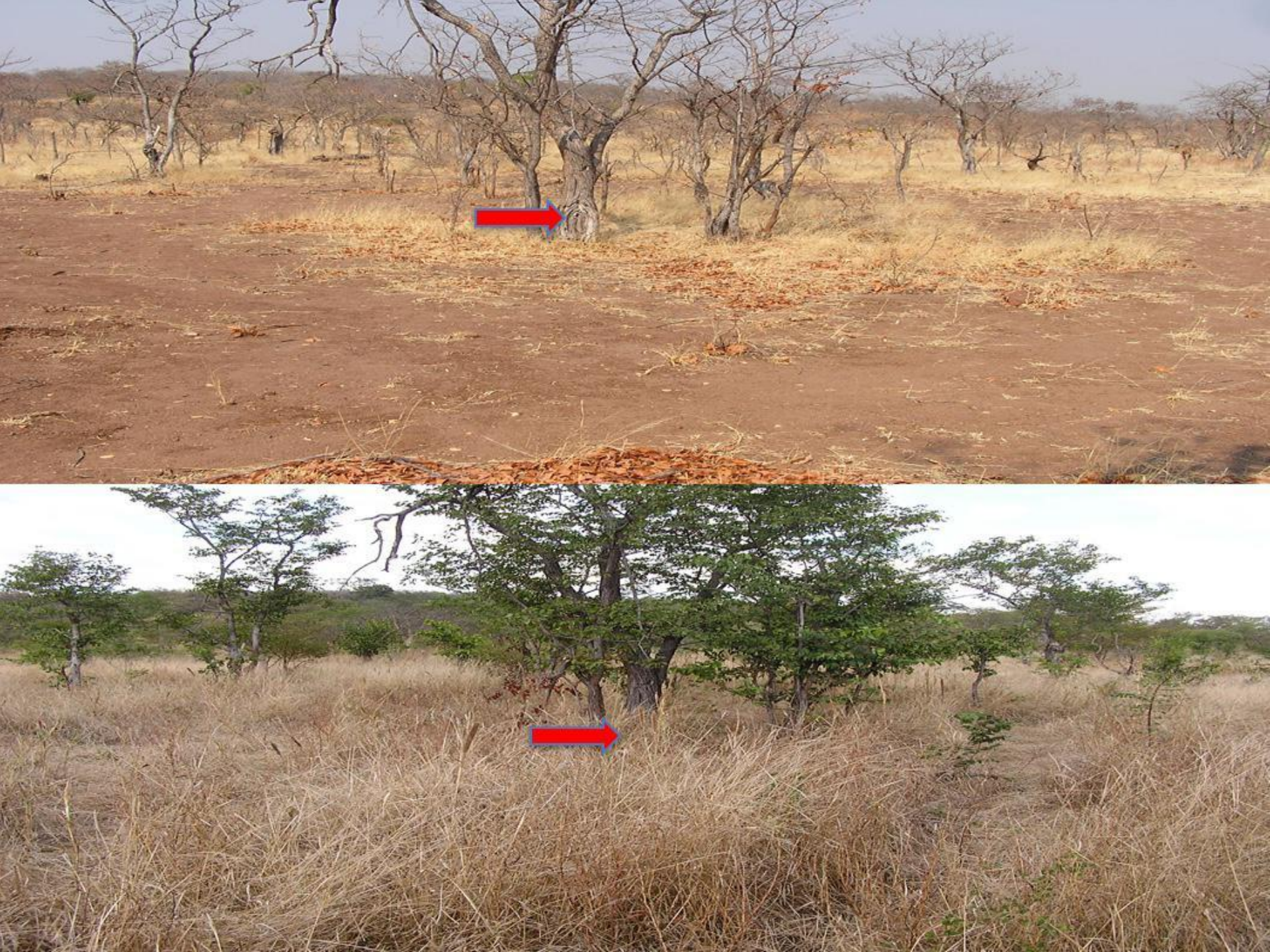
Grazing Cattle in Nigeria on Degraded Pasture

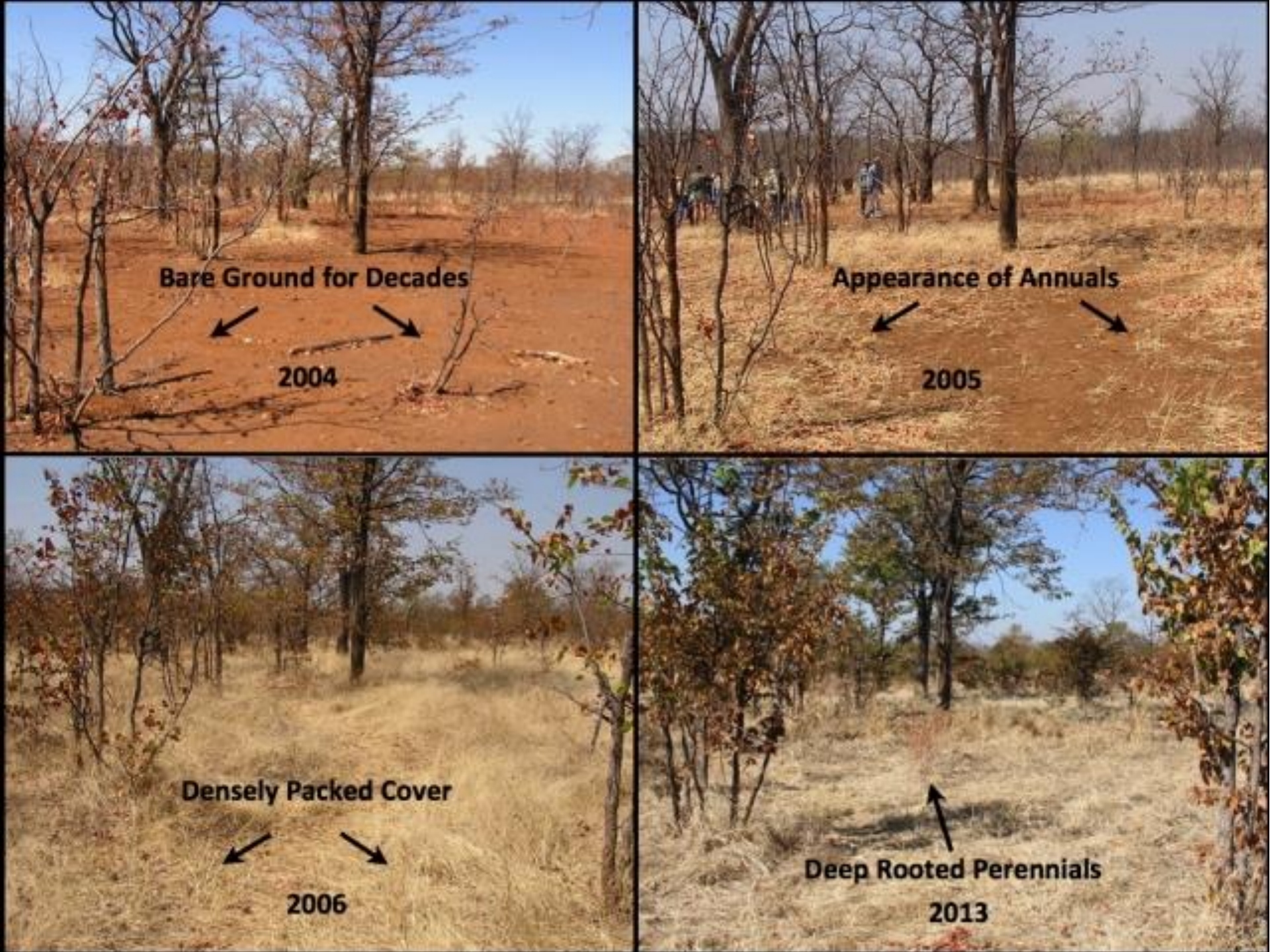
Degraded Pasture Provides Poor Nutrition for Livestock

Can this situation be changed?



Land restored with Holistic Planned Grazing in Zimbabwe




Bare Ground for Decades
2004
Appearance of Annuals
2005
Densely Packed Cover
2006
Deep Rooted Perennials
2013

Contents

We are going to learn about how to restore degraded pasture by:

1. Seeding it with a no-till drill or by ripping the soil.
2. Preparing the degraded soil and creating a new pasture.
3. Planting a cover crop consisting of a grass-legume mixture of seeds.
4. Using livestock to seed the pasture.
5. Using Bio-Plant and Pro-Plant to help you to restore the degraded pasture.
6. Practising Rotational Grazing.

Part 1
Seeding a Degraded Pasture

If your pasture is in a poor condition, instead of replanting it, consider first improving it by seeding it.

1.1

How to Seed a Degraded Pasture with a No-Till Drill or by Hand

Plant the Seeds with a No-Till Seed Drill

- The best way to plant the seeds is to use a tractor with a no-till seed drill. It opens the soil to create a narrow, shallow trench, places a seed in the it, and then covers the seeds with soil.
- Soak the seeds before planting in a mixture of Bio-Plant and water (20 cc in 20 litres of water to inoculate them.)
- The drill should be set to push the (grass-legume mixture) seeds half an inch to one inch into the soil depending on the species.

A No-Till Drill

No-Till Seeding into a Pasture

No-Till Planting Alfalfa Seeds into Grass

Alternatively Broadcast the Seeds by Hand

- If you do not have access to a no-till seed drill, broadcast the seeds by hand. *(See the photos.)*
- Loosen the soil first. Then broadcast the seeds onto the loosened soil.
- The top layer of soil with the seed must then be rolled into a firm seedbed by a tractor-pulled cultipacker, a hand roller, or by tramping the seeds down with your full body weight.
- Do this when the rainy season starts.

Broadcast the Seeds by Hand


Or Broadcast the Seeds by Hopper

Or Use a Hand Seed Spreader

Or Use a Tractor Seed Spreader

Then Roll the Seeds into the Soil

Further Guidance

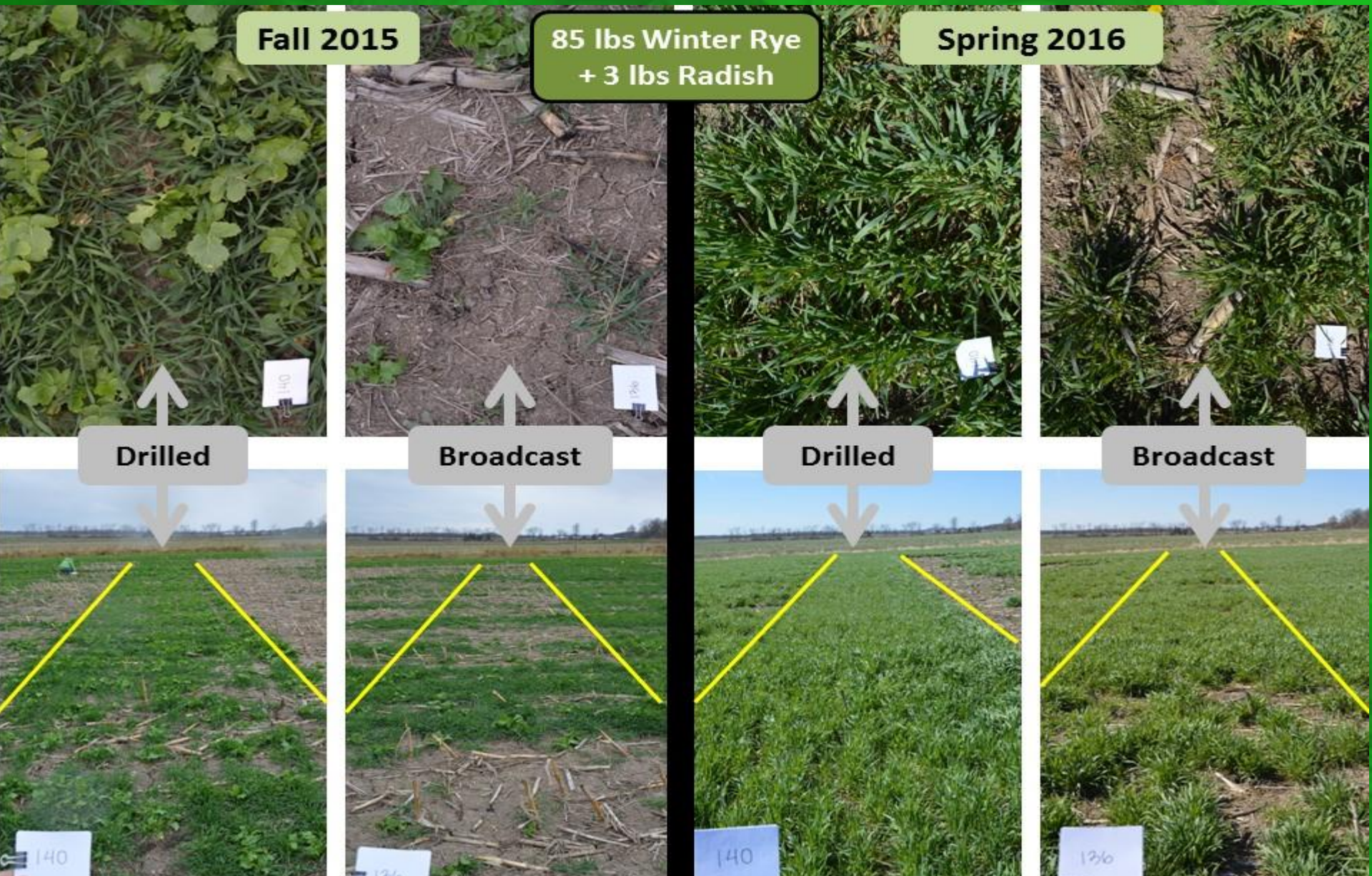
- When broadcasting seeds by hand, loosen up the ground lightly first, such as with a harrow.
- You also have to get the planting depth correct, which is usually half an inch to one inch for grass and legume seeds.
- If you do not have a roller, you can put animals in the pasture for 7-10 days to press the seeds into the ground with hoof action.
- Spray Bio-Plant (500 cc in 500 litres of water per hectare) or spread compost over the soil before or after seeding. Cover with mulch afterwards.

A Tractor-Pulled Harrow

Here a harrow creates shallow planting rows in the grass. A seeder drops seed into the rows. A cultipacker presses the seeds into the soil. Bio-Plant would need to be sprayed afterwards to fertilise the planting rows.

An Oxen-Pulled Harrow

Drill-Seeded vs Broadcast-Seeded



Help the Seeds to Grow

- Controlling competition from the grasses during legume establishment is critical.
- Typically, the existing grass will regrow more rapidly than new seedlings. Thus, the degraded area should be grazed at a high stocking density – enough animals to graze the grass to 4 inches tall in 24 to 48 hours – to prevent the regrowing grass from blocking the sunlight of the developing seedlings.

The Grass-Legume Seed Mixture

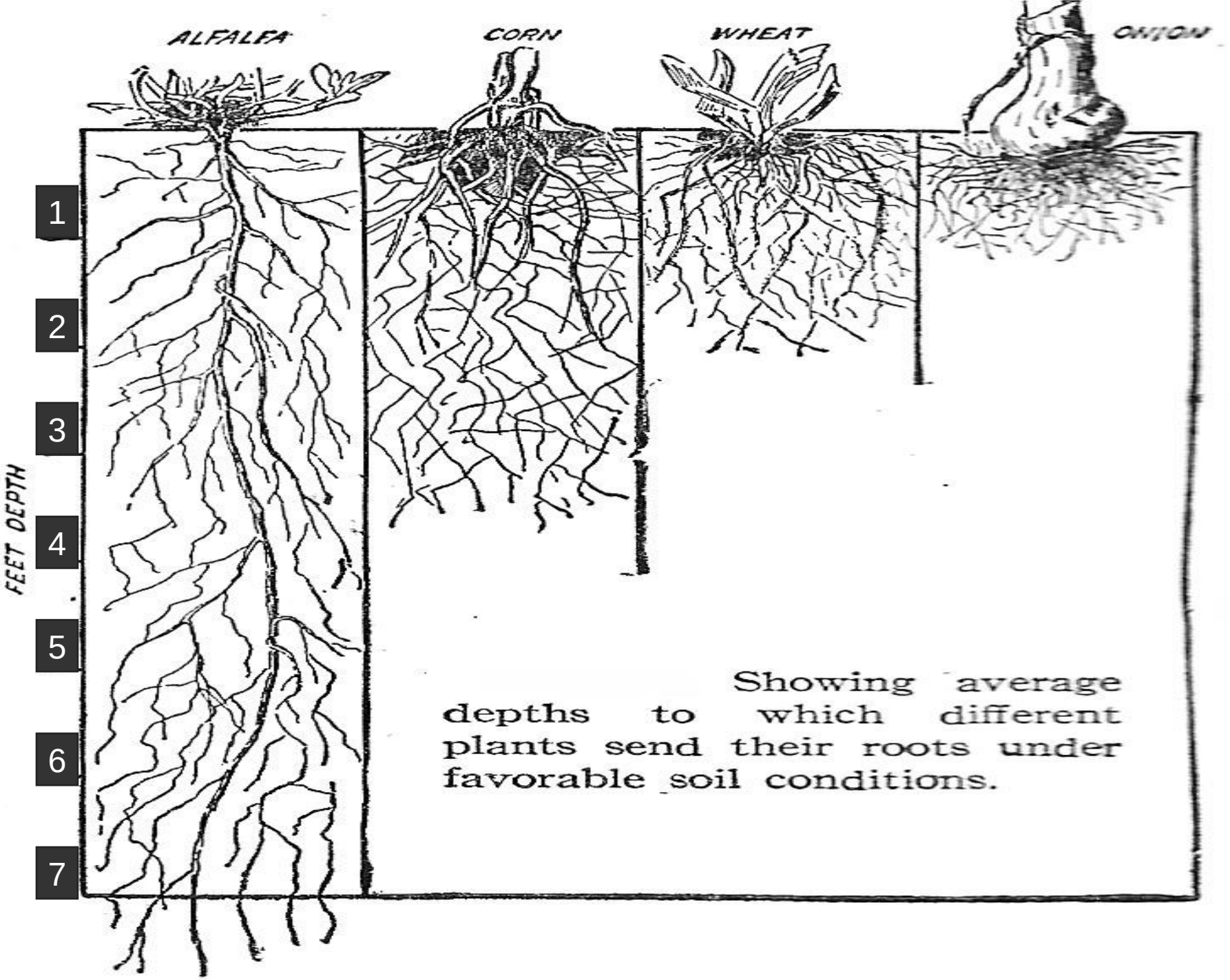
- The seed mixture should combine perennial grasses, legumes, and annual crops.
- **Legumes:** alfalfa, clovers (red, white, kura, etc.), stylo, centro, pigeon pea, peanut, desmodium, lentils, etc.
- **Annual crops:** oats, rye, ryegrass, barley, wheat.
- The annuals will grow quickly and provide forage for the animals and increase the nutrition of the pasture.
- Include a species, which prevents weeds from growing.

Nutritional Benefits of Legumes

- Deficiencies of Nitrogen (N), Phosphorous (P), Sulphur (S) and Molybdenum (Mo) are common in many pastures. It is, therefore, important to have a healthy legume component in the pasture to improve the quality of the feed and to provide Nitrogen to the roots of the grasses.
- Legumes such as clovers (white and red) or alfalfa improve a pasture's nutritive value; increase the amount of forage; and provide abundant Nitrogen.

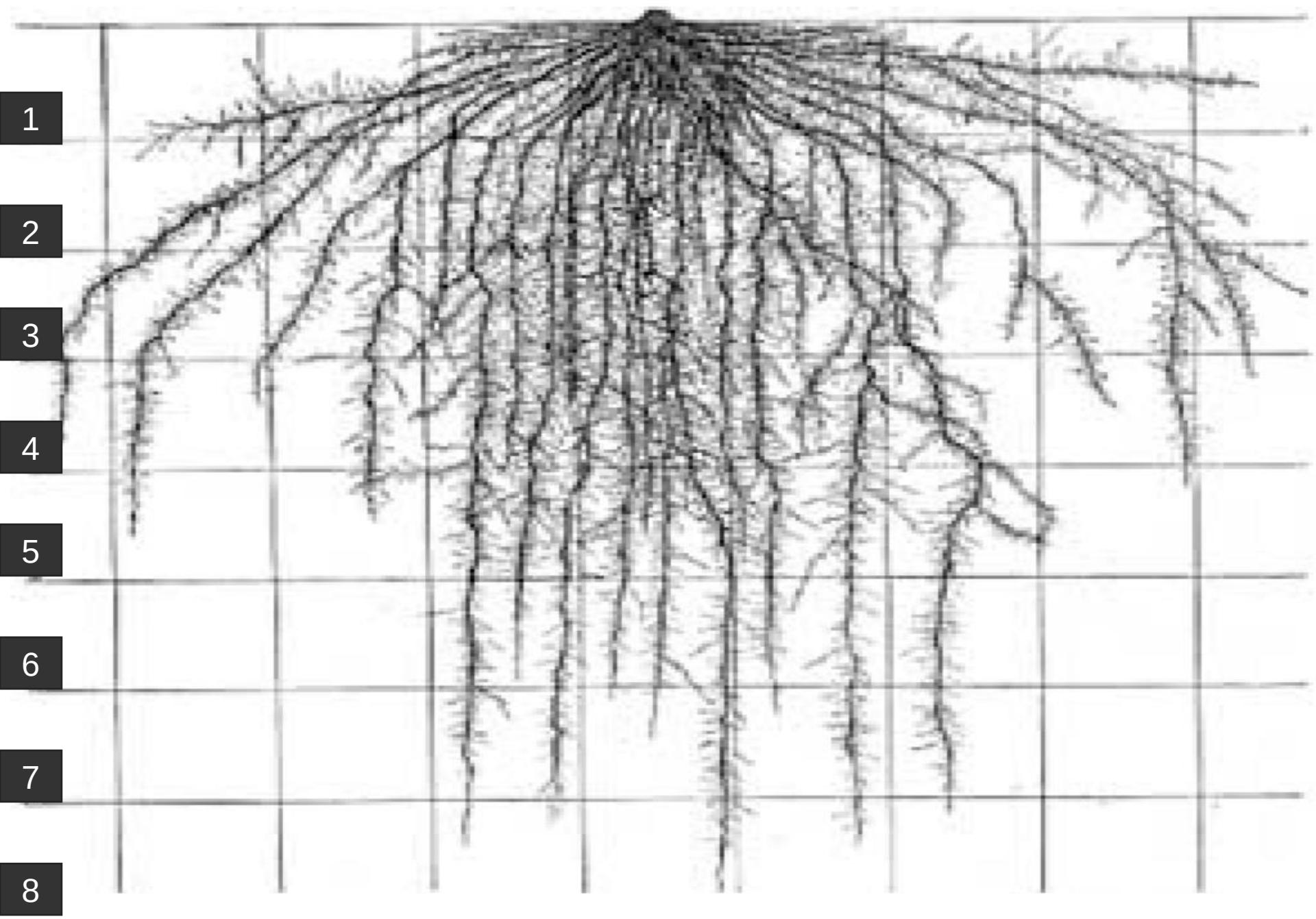
Alfalfa Planted by No-Till

(The Grass Benefits from the Legume.)



Showing average depths to which different plants send their roots under favorable soil conditions.

White Clover Planted with Grasses



Red clover’s root system: Year 1: 4-6 feet. Year 2: 8 feet.

Plant a Polyculture of Grasses

- Livestock prefer a “buffet” of grasses.
- Growing a variety of forage plants in the pasture also benefits the soil and the environment.
- Legumes add extra Nitrogen and restore the Soil Food Web effectively.
- Legumes (e.g. clovers, alfalfa, and peas) increase protein and nutrients in the available forage.
- Polyculture pastures offer a kind of “insurance policy.” By combining different species the pasture is better protected from a variety of inclement conditions, e.g. drought, flooding, insects, etc.

A Polyculture of Grasses and Legumes

1.2

How to Seed Degraded Pasture by Ripping the Soil

Ripping the Soil as an Alternative to Using a No-Till Seed Drill

- If you do not have a no-till drill, you could rip the soil to create shallow planting rows.
- Many legumes need to be planted half an inch from the surface, so the ripping must be very shallow.
- Place compost in the rows.
- Then place the seeds in the rows and cover them with soil.
- Cover the rows with mulch afterwards.

The ripping should be deep enough to provide compost and to leave the seeds about half an inch from the surface.

Jab planting

Oxen ripping

Oxen direct seeding

Restore the Soil's Biology

- If the soil fertility is poor, you must restore the soil's biology first. Adding compost to the rows and then placing the seeds on the compost would be very beneficial.
- If you do not have any compost, spray the planting rows with Bio-Plant mixed with water: 500 cc in 500 litres of water per hectare while you plant the seeds in the rows. Cover the seeds with soil after spraying.

A plough can rip the soil. Place compost in the planting row and then the seeds on top. Tread on the soil to close up the row. If you have no compost, spray Bio-Plant mixed with water in the row before you close up the soil.

This pasture was ripped by a tractor so that rows of legumes could be planted. It is important to fertilise the planting rows. Add compost or spray the rows with Bio-Plant and water. Do this just before the rainy season.

This pasture was growing poorly in compacted soil. The soil was ripped because of the soil compaction, and legumes were planted. The planting rows were fertilised and seeds were sown onto the fertiliser.

This pasture was ripped because of soil compaction and brassica legumes and ryegrass were planted into a poorly growing ryegrass pasture. The planting rows were fertilised and the seeds were sown onto the fertiliser.

1.3
Seeding a New Pasture Together with Mulching

Plant the Seeds and Cover with Mulch

- First, loosen the soil by light tilling or harrowing. Roll the soil so that it is flat.
- Apply compost or spray the ground with Bio-Plant mixed with water.
- Spread the seeds with a large broadcast sprayer (or by hand).
- Then roll the seeds using a roller or a cultipacker to ensure that the seeds are planted firmly into the soil.
- Next, apply straw mulch to protect the seeds as well as retain moisture to help the seeds grow faster.
- Do this when the rainy season starts.

Broadcast the Seeds by Hand


Or Broadcast the Seeds by Hopper

Broadcast the Seeds by No-Till Drill

It creates a furrow, drops the seeds into it, and then rolls the seed into the soil.

Use a Broadcast Seeder

Then Use a Cultipacker (or Roller) to Press the Seeds into the Ground.

Blowing Mulch to Cover the Seeds and Compost (Rolled Already)

After the Mulch Has Been Applied

(Spray Water with Bio-Plant on the Mulch to Break It Down and Feed the Seeds.)

Seeds Covered by Shredded Tree Mulch

(Broadcast the Seeds onto Compost or Spray them with Bio-Plant Mixed with Water. Then Roll the Seeds.)

Pasture Establishment Checklist

1. **Assess, select and plan early:** Assess existing pasture, weeds, pests, and soil fertility.
2. **Control weeds and pests:** Prevent the weeds and pests from seeding / reproducing beforehand.
3. **Pre-sowing activities:** Remove excess plant material before sowing.
4. **Absolute weed and pest control:** Allow full weed germination after rain, then graze to keep weeds small until moisture in the soil profile is right for sowing.

Pasture Establishment Checklist

5. **Adequate soil moisture:** Do not dry sow. Ensure that there is stored soil moisture.
6. **Accurate seed placement:** Aim for 5 mm of soil over the seed. Direct drill. Soak the seeds in Bio-Plant beforehand.(Apply compost or spray Bio-Plant mixed in water to fertilise the soil.)
7. **Monitor weeds and pests:** Look for pests and weed seedlings every 10–14 days after sowing.
8. **Grazing:** Do not graze until the plants have seeded down. Improve the growth by spraying Pro-Plant mixed with water every 15 or 30 days.

Control the Weeds with a Heavy Seeding Rate

- Dense forage stands, with a good fertility program, proper pH, and rotational grazing management, generally do not have a weed problem.
- Farmers could plant annual grass and legume mixtures to control weeds with a heavy seeding rate. The crops will grow so thick that they will cover the soil and smother weeds. There is basically no space for the weeds to grow.

Control the Weeds with a High Livestock Density

- You could also fill the paddock with a high livestock density in order to use the cattle to control noxious weeds.
- In high stock densities cattle behaviour changes and, although they are not forced to, they readily consume less desirable species.
- This will enable you to greatly reduce the weeds, and at the same time, increase the diversity and health of other grasses in the pasture.

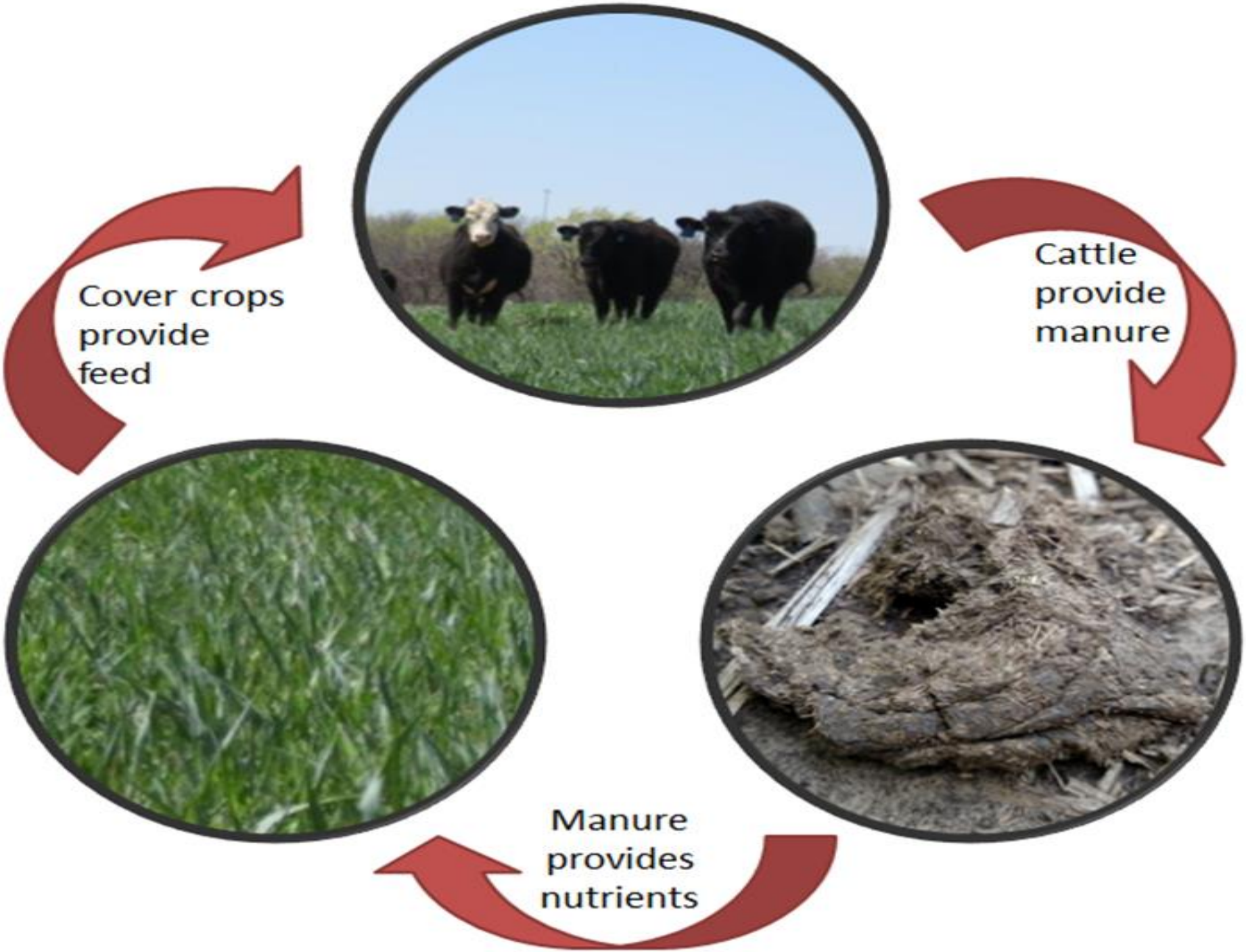
1.4

Restoring Degraded Pasture by Planting a Legume Cover Crop

“When the grasslands of the world co-evolved, and which are the world’s second largest carbon-sink, they did so with grazing animals. When a cow or a gazelle or any grazing animal eats grass, the roots release polysaccharide sugars. That feeds a biological community in the soil which mineralizes the carbon that’s either in the root mass or in the manure or in the grass that’s being trampled into the ground, and it turns into mineral carbon in the soil. That’s why when the first pioneers went west from here, they found ten feet of thick black soil. That black is carbon, and as Karl Thidemann said, the world around, it’s now down to inches. We have decarbonized the soil …”

Hunter Lovins at the Massachusetts Institute of Technology (MIT), Nov 13, 2018

Cattle Grazing in a Cover Crop Field


Cover crops provide feed
Cattle provide manure
Manure provides nutrients

Restore the Soil's Biology

- In order to restore a degraded pasture, you must restore the soil's biology.
- It is essential to increase the soil's organic matter, such as by adding compost or by growing a cover crop on the degraded pasture.
- Organic matter from the compost or cover crop provides organic carbon. Organic matter is the primary building block for soil organic carbon.

Restore the Soil's Biology

- An increase in soil organic carbon leads to increased microbial life.
- In turn, this results in soil structure, water infiltration, soil water-holding capacity and nutrient cycling, as well as reduced erosion, and other desirable ecosystem services.
- Increased nutrient cycling and nutrient availability is largely the result of symbiotic relationships developed between plants and soil microbes (bacteria, fungi, protozoans, nematodes, etc.).

Restore the Soil's Biology

- The microbes not only increase organic soil carbon, but they also turn organic matter into its nutrient components to help the plants grow.
- The fungi create networks, which extend the reach of plant root systems and go into soil spaces too small for root entry.
- This relationship allows plants to reach new areas of nutrients, such as Phosphorus; and to connect to a wider soil moisture pool.

Restore the Soil's Biology

- If the soil is in a degraded condition and we want to build the biology, you must provide the food source. You must build soil organic matter.
- You can do this by managing a cover crop on the pasture for a season or two.
- Include in the initial seed mixture grasses and legumes, which will persist as the biology improves.
- When the annual cover crop dies, reseed the pasture with legume seeds.
- In this way you can build the soil's capacity to support the grasses that you want to grow.

Experiment to Find the Best Combination of Legumes and Grasses

- With some thorough planning and on-farm testing to find multi-species mixes suited to the local climate and soil, cover crops with a mixture of species will restore the soil and provide nutritious forage for the livestock farmer.

Grasses and Legumes for Fodder

Agro-ecological Zone **otential Fodder/pasture** astute grasses	*Upper highlands (UH)*	*Lower highlands (LH)*	*Upper midlands (UM)* Star grass,	*Lower midlands (LM)*	*Inland lowlands (IL)*
odder (ley) grasses	Kikuyu grass, Rye grass, Cocksfoot, Tall fescue, Blue grass	Kikuyu grass, Napier grass, Nandi setaria, Rhodes grass, Congo grass, Signal grass, Rye grass, Paspalum, Andropogon,	Napier, Nandi setaria, Rhodes grass, Maasai love grass, Sudan grass, Congo grass, Signal grass, Giant panicum, Guinea grass, Rye grass, Columbus grass, African Foxtail, Star grass, Themeda, Sweet pitted grass	Napier grass ,Maasai love grass, Giant panicum, Guinea grass, Buffel grass, Columbus grass, Enteropogon, Guatemala, Plume Chloris, Columbus grass, Themeeda, Sweet pitted grass	Themeda, Sweet pitted, Maasai love grass, Buffel grass
odder legumes	Lucerne, Kenya white clover, Purple vetch, Common stylo, Glycine	Stylo, Desmodium, Lucerne, Purple vetch, Lablab, Lupins, Glycine, Velvet bean	Siratro, Stylo, Desmodium, Glycine, Lablab bean, Velvet bean, Purple vetch, Lupins, Butterfly pea, Townsville Lucerne,	Stylo, Siratro, Glycine, Lablab, Velvet bean, Lupins,	Stylo, Butterfly pea Siratro, Glycine, Lablab, Velvet bean Lupins, Mauritius beans
oot crops		Sweet potato vines, Fodder beets, Fodder radish,	Sweet potato vines,	Sweet potato vines	Sweet potato vines, Vigna lanceolata, Winged beans
odder cereals	Oats Fodder barley	Oats Fodder barley, Fodder sorghum, maize	Fodder sorghum, maize		
odder trees & shrubs	Calliandra, Leucaena	Calliandra, Leucaena, Mexican wild flower	Calliandra, Leucaena, Sesbania, Cassia, Mexican wild flower	Leucaena, Calliandra, Mexican wild flower, Sesbania, Gliricidia	Saltbush, Gao tree, Mesquite

A Cover Crop Growing on Formerly Degraded Pasture Land

Growing Cover Crops in Rotational Grazing

- Cover crop grazing offers benefits, including improved soil biology, increased soil life, higher soil organic matter, better soil structure and fertility, increased water infiltration and moisture-holding capacity of the soil, and increased production through seasonally available forage.
- Also, well-managed cover crop mixes can decrease weed problems and provide a higher quantity of forage for livestock.

Growing Cover Crops Improves the Nutritional Value of the Forage

- A mix of plants can often be a good diet for cattle. Including legumes, such as clovers, increase the protein and calcium content in the forage.
- Providing different species will help to improve the nutrition-intake, reduce livestock-feed supplement costs, and take advantage of moisture and growing conditions at different times of year.

A Multi-Species Cover Crop Field

Benefits of a Grass-Legume Mixture

- A diversified pasture of grasses and legumes allows for different plants to thrive in different conditions, adding drought resistance.
- Legumes have a deep root tap and penetrate deeper into the soil profile where there’s more moisture.
- Without legumes you may have less pasture and a lower quality of forage.

Allow Time for the Soil's Biology to Recover

- When the soil biology has recovered enough after roughly 2 seasons of cover crops, plant grasses and legumes together.
- Aim for at least a 60-40 mixture (60% legumes, 40% grass) for optimum productivity, nutrient recycling, and animal performance.
- Practise rotational grazing as the pasture regrows.

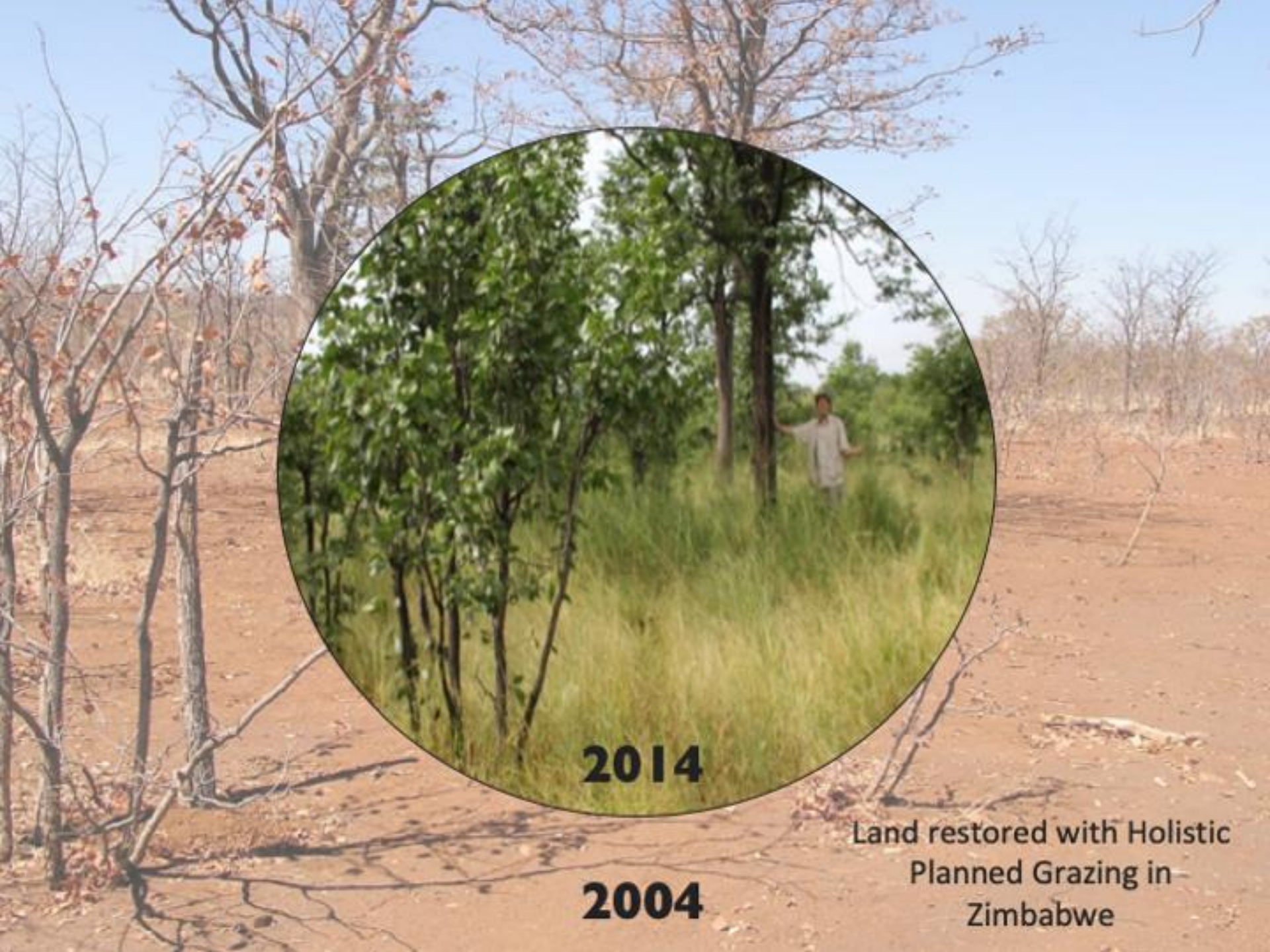
You Can Restore a Very Degraded Pasture With a Grass-Legume Cover Crop

Some Guidelines

- Shortly before the rainy season loosen the soil by light tilling or harrowing. Roll the soil so that it is flat.
- Apply compost or spray the ground with Bio-Plant mixed with water.
- Spread the grass and legume seeds with a large broadcast sprayer (or by hand).
- Then roll the seeds using a roller or a cultipacker to ensure that the seeds are planted firmly into the soil.
- If possible, next apply straw mulch to protect the seeds from birds, the sun, and heavy rain; as well as to retain moisture.

Further Guidance

- Before planting the seeds soak them for 18-24 hours in Bio-Plant and water (20 cc in 20 litres).
- If you do not have any compost for the seed bed, spray the soil (or the planting rows) with water mixed with Bio-Plant. (500 cc in 500 litres of water per hectare.)
- If the soil is hard and compacted, loosen up the soil by ripping planting rows. Or harrow the soil.
- Spray Pro-Plant mixed in water (same ratio) every 30 days once the leaves appear to provide extra nutrients until the growth is strong.



Land restored with Holistic Planned Grazing in Zimbabwe


2014
Climax Perennial Grass
(Panicum maximum)
"Guinea grass"
Mid-succession Perennial Grass
(Heteropogon contortus)
"Spear grass"

How to Improve an Existing Pasture (Not Degraded) with Legume Seeds

Some Guidelines

- First, soak the seeds for 18-24 hours in Bio-Plant and water (20 cc in 20 litres).
- Use a harrow to loosen up and aerate the pasture.
- Broadcast the seeds by hand or with a spreader.
- Press the seeds into the pasture with a cultipacker or a roller to increase seed-to-soil contact.
- Pastures need fertilising, so spray it with Bio-Plant mixed with water. (500 cc in 500 litres per hectare.)
- You could also spray Pro-Plant mixed in water (same ratio) every 30 days to provide extra nutrients.

Further Guidance

- Graze the pasture down to about 4 inches. You should not broadcast seeds into tall grass.
- Run a harrow over the pasture in at least two directions using a wire, tine grass harrow to smooth the pasture before you broadcast the seeds. The harrow also spreads out dung and breaks up dead material in the grass before the seeds are broadcast.
- Planting legume seeds is invaluable because they provide a lot of forage; improve the nutritional content of the forage; and improve the soil biology.

A Grass-Legume-Seeded Pasture

1.5
Seeding a Pasture by Using the Livestock

Using Livestock to Seed Grasses in Other Pastures

- We know that livestock can spread weed seeds, but we can also use this to our advantage to move desirable seeds around.
- At times, opportunities arise where a grass or a desirable broadleaf is seeding. The farmer can let the livestock eat the seed heads so that they can move the desired leaf to an area that lacks that species through their manure.

Using Livestock to Seed Grasses in Other Pastures

- When seeds are spread in the manure, they are sitting in a nutrient-rich environment – just perfect for the growth of the grass once it germinates.
- Strategic grazing of different paddocks can quite easily allow this to happen – improving the pastures with no seed or planting costs.

Seeding by Feeding Grazing Cattle a Desired Grass with Seed Heads

The Cows are Then Moved to an Area Needing the Grass

The Same Technique Restored This Pasture

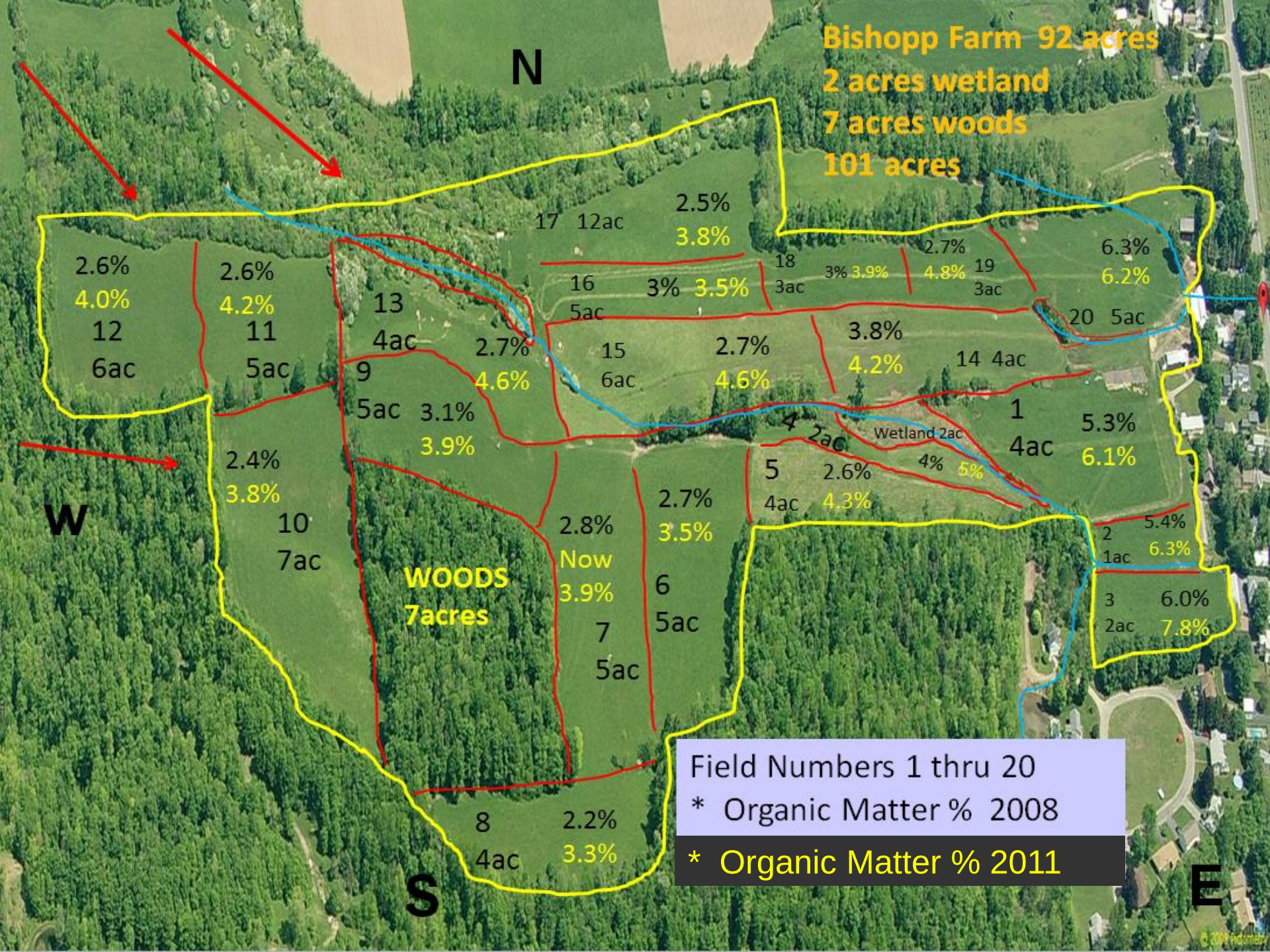
Part 2

Implement Rotational Grazing

Plants need “rest” and time to recover from leaf removal. Rotational grazing maintains plant growth, pasture productivity, and animal health. Rotational grazing provides the rest needed for the grasses and legumes to regrow.

Degraded Pasture (Left). Recovering Pasture (Right)

Rotational grazing has been bringing financial benefits to livestock farmers in the North of Nigeria, for example, and is helping livestock farmers to deal with the depletion of pasture and the soil, and also with increasing desertification.


Bishopp Farm 92 acres
2 acres wetland
7 acres woods
101 acres
N
W
S
E
2.6%
4.0%
12
6ac
2.6%
4.2%
11
5ac
13
4ac
9
5ac
2.7%
4.6%
3.1%
3.9%
17 12ac
2.5%
3.8%
16
5ac
3% 3.5%
15
6ac
2.7%
4.6%
18
3ac
3% 3.9%
2.7%
4.8%
19
3ac
6.3%
6.2%
20 5ac
3.8%
4.2%
14 4ac
1
4ac
5.3%
6.1%
Wetland 2ac
4% 5%
4 2ac
5
4ac
2.6%
4.3%
2.4%
3.8%
10
7ac
WOODS
7acres
2.8%
Now
3.9%
7
5ac
2.7%
3.5%
6
5ac
2
1ac
5.4%
6.3%
3
2ac
6.0%
7.8%
8
4ac
2.2%
3.3%
Field Numbers 1 thru 20
* Organic Matter % 2008
* Organic Matter % 2011

The Value of Rotational Grazing

- Grasses and legume plants become “stressed” from grazing and need sufficient time to grow back once grazing has occurred.
- Without a break from the stresses, forages can lose the ability to re-establish new growth, as the ability to photosynthesise is minimized when grasses get below a certain length.

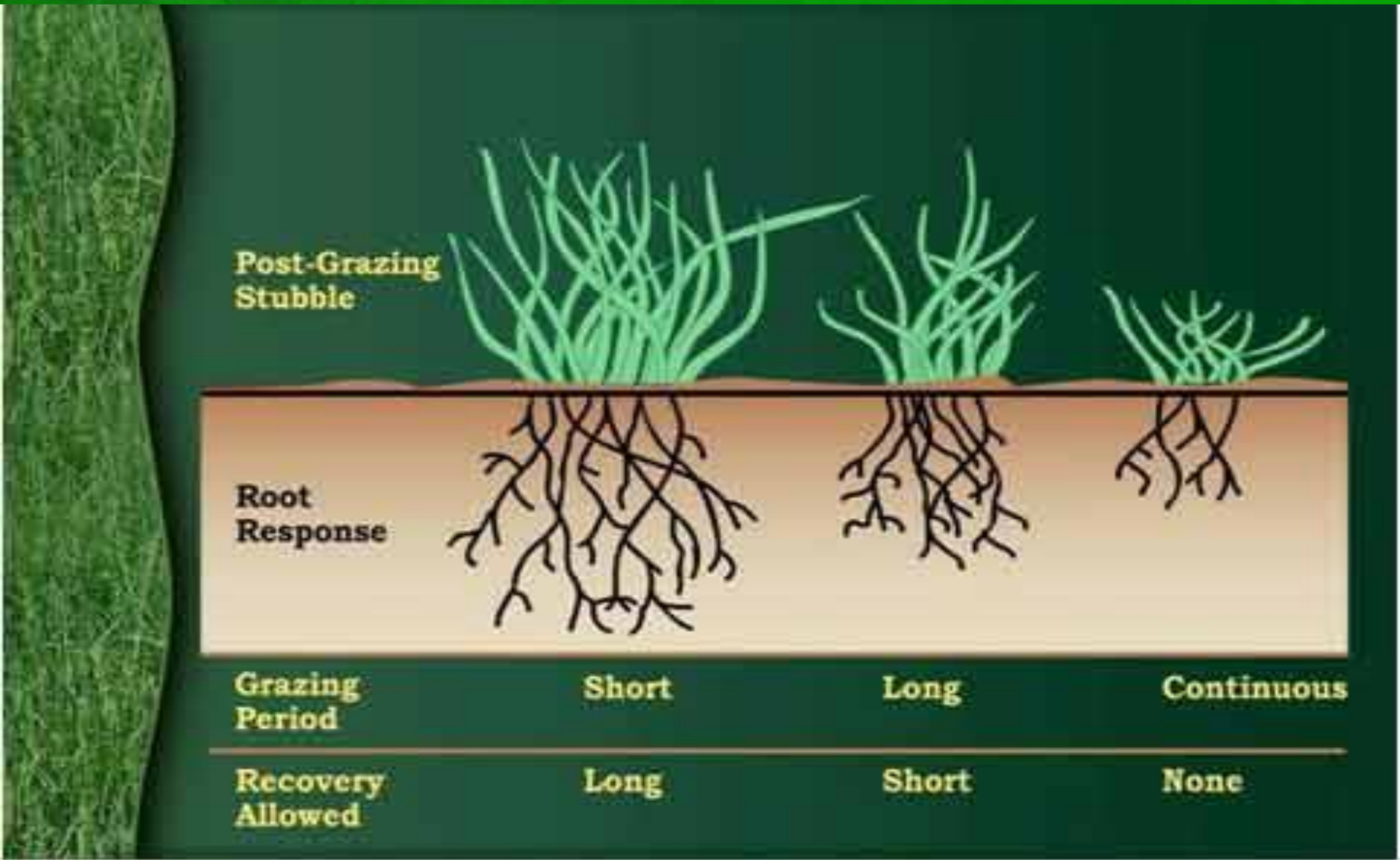
The Value of Rotational Grazing

- When livestock are allowed to graze a pasture continuously, they will eat the most savoury grasses first, leaving some parts of the pasture overgrazed while other less palatable areas lie undergrazed.
- Animals will keep going back to the more palatable sections and graze without giving the plants optimal time to develop strong roots and to recover, if rotational grazing is not practiced.
- Eventually these plants will die and weeds will begin to take over the pasture.

Recovered Pasture (Left). Grazed Pasture Recovering (Right)

Grazed Pasture Recovering (Right)

The Effect of Rotational Grazing on Growth



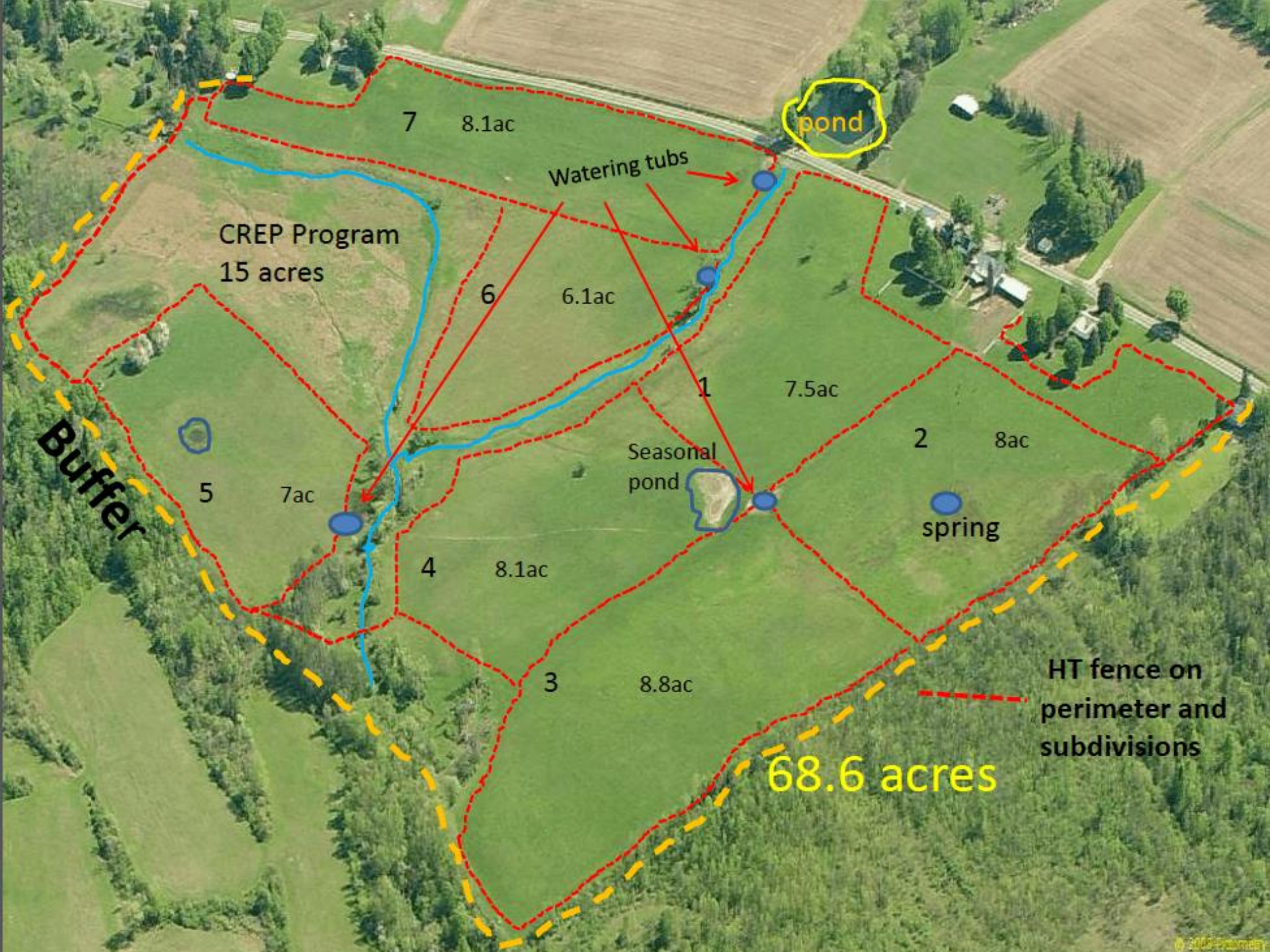
The Benefits of Rotational Grazing

1. Increased forage production.
2. Increased soil fertility.
3. Increased resistance to drought.
4. Less wasting of forage.
5. Reduced soil compaction.
6. Control of less desirable plants easier.
7. You can save the best forage for the animals that needs it the most.

The Benefits of Rotational Grazing

8. Grazing animals can be used to help prepare areas for reseeding.
9. Improves feeding during times of drought.
10. Improved animal management.
11. You can allow certain species of plants to go to seed.
12. You can preserve the grass cover of favourite forage species.
13. It facilitates the assessment of the growth and health of the animals.

Provide Water and Shade in Each Paddock


7
8.1ac
pond
Watering tubs
CREP Program
15 acres
6
6.1ac
1
7.5ac
2
8ac
Seasonal
pond
spring
Buffer
5
7ac
4
8.1ac
3
8.8ac
HT fence on
perimeter and
subdivisions
68.6 acres


gates
permanent perimeter fencing
potential paddock halving
pasture #1
#2
#3
#4
#5
#6
#7
#8
#9
barn
corn crib
chicken run
livestock distribution area


Week One
Resting
Grazing
Week Two
Resting
Grazing
Resting
Week Three
Resting
Grazing
Resting
Week Four
Grazing
Resting

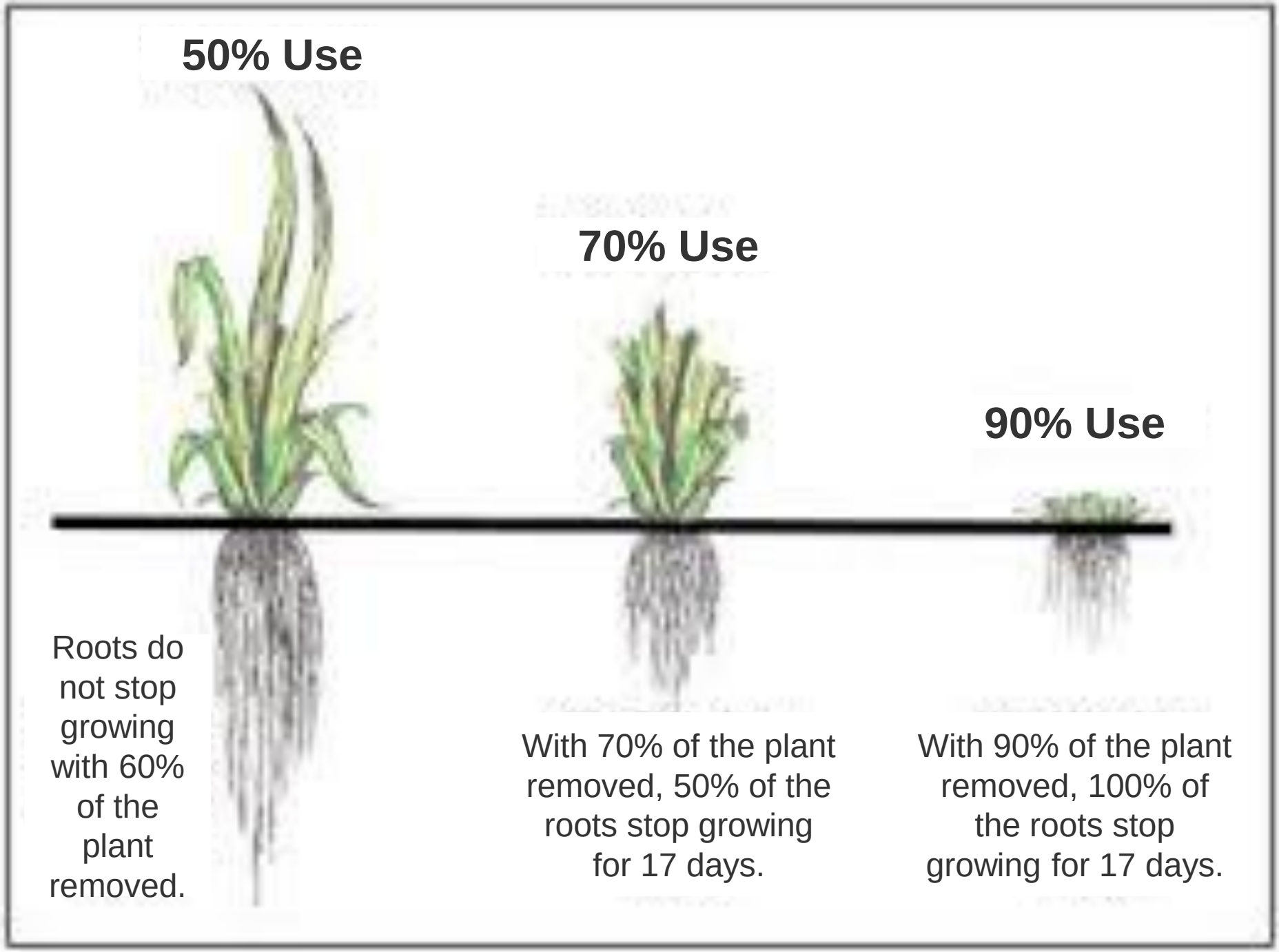
Length of the Grazing Period

- **Use short grazing periods.**
- Livestock is moved frequently (every 1–3 days) through a large number of paddocks (up to 20 or 30) in **intensive rotational grazing** systems.
- Since livestock graze selectively, they will eat the highest quality forage when first turned out into a paddock, and will be forced to eat lower quality forage each day they remain in the same paddock.
- They also tend to eat more when first turned out onto a fresh paddock.

Species	Plant Height Start Grazing	Plant Height End Grazing
Tall-growing Grasses: Orchardgrass, quackgrass, reed canarygrass, smooth bromegrass, tall fescue, and timothy.	8-10 inches	4-5 inches
Tall-Growing Legumes: Alfalfa, alsike clover, birdsfoot trefoil, kura clover, ladino clover, and red clover.	8-10 inches	4-5 inches
Tall-Growing Legumes: Ryegrasses (Italian and perennial).	6-8 inches	3-4 inches
Short-Growing Grasses and Legumes: Kentucky bluegrass and white clover**.**	4-6 inches	2-3 inches
Warm-Season Grasses: Big bluestem, indiangrass, sorghum / sudangrass, and switchgrass**.**	12-14 inches	6-7 inches

Check the Height of the Plants

- Short-growing grasses and legumes should be 4-6 inches high when the grazing starts again.
- Tall-growing grasses and legumes should be 8-10 inches high when the grazing starts again.
- At these heights pasture quality is high, forage is easy to eat, and the plants have recovered sufficiently from the previous grazing.
- If the plants are under stress (drought, low soil fertility, cold weather, etc.), the rest period may need to be longer for the plants to regrow to these heights.


50% Use
70% Use
90% Use
Roots do not stop growing with 60% of the plant removed.
With 70% of the plant removed, 50% of the roots stop growing for 17 days.
With 90% of the plant removed, 100% of the roots stop growing for 17 days.

Relationship Between Leaf Area Removed and Impact on Roots

1. Up to 40% leaf area removed = no effect on root growth.
2. 50% leaf area removed = 2-4% root growth inhibition.
3. 60% leaf area removed = 50% root growth inhibition.
4. 70% leaf area removed = 78% root growth inhibition.
5. 80% leaf area removed = 100% root growth inhibition.
6. 90% leaf area removed = 100% root growth inhibition.

What Happens in Practice

- **Where the grazing duration is over 3 days:**
  - Pasture regrowth will be re-grazed before the leaf area has recovered, reducing stores of soluble carbohydrate in the roots and slowing the regrowing process.
  - Repeated re-grazing can cause plant death and loss of productive pasture species.
  - Forage will be wasted by the excess of livestock manure and by the excessive trampling of pasture.

Length of the Grazing Period

- Look at the forage height to guide you.
- Generally, stop the grazing when the grasses and legumes are 2 - 4 inches high, depending on the species.
- Sufficient photosynthetic tissue must remain on plants for production of carbohydrates to meet growth and respiration demands of the plant.

What Happens in Practice

- **Where the grazing duration is under one day:**
  - Labour and capital (fencing and water) costs are high because of the more frequent movements of herds.

Length of the Resting Period

- A very important part of a successful rotational grazing system is allowing the forages an adequate resting period to recover and regrow. Allowing plants a sufficient rest period is vital to maximize forage quality, yield, and persistence.
- This period not only gives the plants time to regrow; to replenish stored carbohydrates; and to develop their roots.
- But, if plants are allowed too long of a rest period without grazing or mowing, plants will become mature and lose their nutrient value and palatability.

Crop	Suggested Length of Rest (Days)
Alfalfa (hay types)	35-40
Alfalfa (grazing types)	15-50
Bahiagrass	10-20
Bermudagrass	7-15
Big Bluestem	30-45
White Clovers	7-15
Clover (other types)	10-20
Eastern Gamagrass	30-45
Indiangrass	30-40
Kentucky Bluegrass	7-15
Orchardgrass	15-30
Pearl Millet	10-20
Ryegrass (annual)	7-15
Small Grains	7-15
Smooth Bromegrass	20-30
Sorghum (forages types)	10-20
Sorghum/sudan hybrids	10-20
Tall Fescue	15-30

How to Calculate the Paddock Size

- The calculations use “Animal Units” (AUs), which are a livestock standard based on a mature 450 kgs. cow.
- Rotational Grazing assumes 33 AUs per acre per day. So that is 33 cows, or about 14,500 kgs.
- Keep in mind, this is dependent on the pasture quality and productivity. It could be as low as 25 AUs or high as 80 AUs. But for the purposes of getting started, start with the 33 AU number.

How Big Should Paddocks Be? How Many Do I Need?

- If Rotational Grazing requires 33 cows per acre, you should allow 123 square metres per cow.
- So, if you have 25 cows, the paddock size should be 3,075 (123 sq.m. x 25 cows) square metres, which is 55 metres x 55 metres.
- Square paddocks are recommended as opposed to rectangular or wedge-shaped which do not tend to get evenly grazed.

Part 3

How to Apply Bio-Plant and Pro-Plant in Rotational Grazing

The Pasture Needs Fertilisation

- All pastures with less than 40% legume content need Nitrogen fertilization for optimal growth.
- Mixing legumes with the grasses helps to improve the soil biology and to increase the amount of Nitrogen the pasture receives.
- Bio-Plant will provide extra Nitrogen and a wide range of nutrients by restoring the Soil Food Web and the Nutrient Cycle.

Method 1: Spread Compost

- If the pasture has some grasses growing, the compost can fall between the grasses.
- Fill planting rows when you seed the pasture.
- Make compost using Bio-Plant. You will need one litre of Bio-Plant mixed with 5 MT of organic matter.
- Spread at least 5 MT over each hectare of pasture, more if the pasture has been badly degraded.
- If you make the compost fine enough, you will be able to spread it out easily over the pasture.

Degraded Pasture Land Which Would Benefit from Compost

Degraded Pasture Land with Poor Soil Biology

A Compost Spreader

A Compost Spreader

Frequency of Application

- The frequency of application depends on the condition of the pasture. Once a month would be beneficial to begin with, if the grass is in a degraded condition.
- The more even the compost is spread the better, and the better will be the distribution of nutrients.
- It can be tossed with a pitch fork; thrown from the back of a cart; or from a manure spreader.
- If you do not have enough compost, then spray Bio-Plant mixed with water over the pasture. *(See Method 2 for the ratio.)*

Method 2: Spray the Pasture with Bio-Plant and Pro-Plant

- **You Want to Improve the Soil Fertility and Increase the Growth**
- If you want to improve the fertility of the pasture soil and thereby increase the growth of the grass without planting any seeds, you could spray Bio-Plant mixed with water over the grass.
- The usual ratio is 500 cc of Bio-Plant mixed with 500 litres of water per hectare. The frequency of spraying depends on the condition of the pasture, but spraying monthly would be very suitable.

Method 2: Spray the Pasture with Bio-Plant and Pro-Plant

- **You Want to Improve the Soil Fertility and Increase the Growth**
- If you want to improve the growth of the pasture, you could spray Pro-Plant mixed with water over the grass.
- The usual ratio is 500 cc of Pro-Plant mixed with 500 litres of water per hectare. The frequency of spraying depends on the condition of the pasture, but spraying every 30 days would be very suitable until the growth of the grass has improved.

Method 2: Spray the Pasture with Bio-Plant and Pro-Plant

- **When the Pasture Grass is in Poor Condition**
- Alternatively, if the pasture grass is in a poor condition, mix Pro-Plant into the Bio-Plant-water mixture. Spraying both together is only needed at the beginning to restore the condition of the grass.
- If you mix 500 cc of Pro-Plant and 500 cc of Bio-Plant with 1,000 litres of water, this will cover 2 hectares.
- Once the grass is growing well, you can stop spraying Pro-Plant with Bio-Plant and return to 500 cc of Bio-Plant in 500 litres of water per hectare.

Method 2: Spray the Pasture with Bio-Plant and Pro-Plant

- **When the Pasture Grass is in Poor Condition**
- If you apply both bio-fertilisers monthly like this, and there is no problem with the cost, then apply this amount every month, though the Pro-Plant can be reduced or stopped once the condition of the grass has been restored.
- Saving on Bio-Plant is a false saving when you are restoring a pasture because the micro-organisms in Bio-Plant will sweep up the NPK in the soil and make it available to the grass; obtain extra Nitrogen from the air; and improve the soil's fertility.

Frequency of Application

- Apply the bio-fertilizers as described for about 4 months in a row. If the growth looks good, you can stop using the bio-fertilizers for a while.
- In the rainy season you might wish to stop as the grass will grow in the rain season anyway.
- If at any time the grass looks to be in a poor state, apply the bio-fertilizers once a month until the growth becomes healthy again.

Frequency of Application

- Applying the bio-fertilizers for 4 months in a row will give good growth. Make sure you start to spray again, if the growth starts to slow noticeably.
- If there are a large number of animals on the land, you might wish to apply the bio-fertilizers for 6 months or more per year in order to keep the growth strong and appropriate to the number of animals.
- Repeat this each year. If 6 months per year works for you, then apply the bio-fertilizers for 6 months each year.

Frequency of Application

- Ideally, once the growth is healthy, spray Bio-Plant mixed with water (500 cc per 500 litres of water) immediately after the grass in a paddock has been grazed and it is being left to rest before being grazed again.

Method 3: Seed a Field with Grasses and Legumes

- Soak the seeds for 18-24 hours in water mixed at the ratio of 20 cc of Bio-Plant in 20 litres of water.
- If you plant the seeds in rows with a no-till planter, spray all the rows of seeds with Bio-Plant at the ratio of 500 cc in 500 litres of water. 500 cc mixed with 500 litres is enough for 1 hectare.
- When the seeds have germinated and have leaves, it would be beneficial to mix the Bio-Plant with Pro-Plant in order to increase the rate of growth. Spray them together monthly.

The Effect on Forage of Seeding a Pasture with Legumes

Mixing a Large Volume of Bio-fertiliser and Water

- In the case of spraying from a 1,000-litre tank, the mix ratio is the same, but you will need to mix the bio-fertilizers into the water properly.
  - Mix 200 litres of water with 1 litre of Bio-Plant and 1 litre of Pro-Plant and then pour in the rest of the water so that the bio-fertilizers are mixed with the other 800 litres properly.
- In the case of 4 hectares, you will need 2 litres of each bio-fertilizer in 2,000 litres. You could mix the 4 litres with 200 litres again or 400 litres. It does not matter. This will make the mixing easier.

Summary

To restore a degraded pasture, you can:

1. Seed it with a no-till drill or by ripping the soil.
2. Seed it by hand or with simple seeding equipment.
3. Prepare the soil and create a new pasture.
4. Restore the pasture by planting a cover crop consisting of a grass-legume mixture of seeds.
5. Have the livestock seed the pasture for you.
6. Practise Rotational Grazing.
7. Use Bio-Plant and Pro-Plant to help you to restore the degraded pasture.

Summary

By restoring the pasture with legume-grass mixtures, the soil's biology is restored and the soil becomes fertile; the quality and amount of the forage increases; the forage is much more nutritious; and the livestock become larger and healthier. In addition, livestock farmers are helping to mitigate the effects of climate change.