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Range Improvements, Grazing Systems and Net Present Value, What is the Right Balance?

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As farms and ranches across South Dakota continue to endure increasing costs of production while receiving less cash for grain and livestock marketed; ranch managers must be extra diligent when implementing new range improvements and grazing systems on their ranches.

Finding the right balance of increasing efficiency and production while keeping expenses in check is the challenge for every ranch during tough economic times. Some ranches may choose to implement new range improvements such as livestock water pipelines, water tanks, and fences in order to develop a new grazing system or enhance and existing grazing system. A ranch's grazing system should strive to utilize the rangeland resources more efficiently and possibly increase the stocking rate and carrying capacity of the ranch. Cost-share opportunities on various range improvements are also available from agencies such as the Natural Resources Conservation Service (NRCS).

So what is the best combination of range improvements and grazing systems for your ranch? Each ranch is unique and therefore each ranch will have a different combination of range improvements and grazing systems for optimal efficiency. However a ranch manager can follow these guidelines to get started:

- Complete a resource inventory. For more information on conducting resource inventories.
- What are the ranch goals? Example: Profitable, maintain or improve natural resources?
- Must complete a cost/benefit analysis for range improvements.

Cost Benefit Analysis and Net Present Value

A cost benefit analysis can be made with the help of calculating the net present value (NPV) of a range improvement.

What is net present value?

"Net present value is the present value of the cash flows at the required rate of return of your project compared to your initial investment," (Knight and Berman 2006). In practical terms, it's a method of calculating your return on investment, or ROI, for a project or expenditure. By looking at the money you expect to make from the investment and translating those returns into today's dollars, you can decide whether the project is worthwhile or at least break even (Gallo 2014).

See Table 1 for an example. If the NPV of a range improvement practice is zero, the practice will exactly break even. If the NPV is greater than zero, then the practice will have a positive return to the investment in the practice. If the NPV is negative, the practice will drain money from the ranch business.

The discount rate is usually the cost of borrowing money for the practice. In Table 1 a 7% interest rate is applied to the $10,000 loan to implement the new practice. The discount rate is subjective and a manager will have to determine the correct discount rate for their operation.

Determining the expected future return of an improvement practice is also subjective and critically important. A ranch manager must use caution when utilizing partial budgets (Table 2) when calculating expected future returns. A partial budget only

Table 1. Discounting of returns of example improvement practice.

Year	Expected future return	Discount rate	Present value
1	$1,000	7%	$934.60
2	$1,000	7%	$873.40
3	$1,000	7%	$816.30
4	$1,000	7%	$762.90
5	$1,000	7%	$713.00
6	$1,000	7%	$666.30
7	$1,000	7%	$622.70
8	$1,000	7%	$582.00
9	$1,000	7%	$543.90
10	$1,000	7%	$508.30
11	$1,000	7%	$475.10
12	$1,000	7%	$444.00
13	$1,000	7%	$415.00
14	$1,000	7%	$387.80
15	$1,000	7%	$362.40
16	$1,000	7%	$338.70
17	$1,000	7%	$316.60
18	$1,000	7%	$295.90
19	$1,000	7%	$276.50
20	$1,000	7%	$258.40
Total present value of returns from improvement practice			$10,593.80
Cost of improvement practice today (already in present value)			-10,000.00
Net Present Value			$ 593.80

Source: USDA Grazing Land Economics Made Simple: Understanding Internal Rate of Return and Net Present Value. https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_009836&ext=pdf

measures the profitability of change in a single production cycle (Dunn, 2004). For example in Table 1, the expected future return of the improvement practice is $1,000 per year for 20 years. However, a ranch manager must take into account several factors that may impact the expected future return in future years. Sensitivity and variability from cattle markets and weather are just a couple of variables to factor into the analysis. For example, drought which could lead to decreased rangeland production and decreased stocking rates is one factor. Another factor is the cyclical nature of the cattle cycle and the price received for marketed calves off the pasture with the new range improvement will vary year to year.

Calculating NPV can be difficult to do by hand. Excel spreadsheets have NPV function. There are also apps for smartphones that will calculate NPV (https://apps.apple.com/us/app/npv-calculator/id889682585). The formulas in Figure 1 detail the formulas for calculating NPV by hand.

Marginality and the Law of Diminishing Returns

As previously mentioned, a ranch business must try to go beyond simple partial budgets in determining a cost benefit analysis and NPV. A key factor of determining whether or not to implement a conservation practice is to determine the "marginality" of the conservation practices. The principle of Marginal Utility is defined as the amount of additional benefits provided by an additional unit of an economic good or service. (Dunn, 2006) described the basic concept of marginality as "the level of economic measures, cost or product for example, will be different for varying levels of an input. As a production function (Figure 2) reaches its point of diminishing returns, additional units of input do not

Table 2. Example of partial budget.

Partial Budget	
Technology:	
Additional Costs:	Additional Revenues:
Reduced Revenues:	Reduced Costs:
A. Total additional costs and reduced revenue $	B. Total additional revenues and reduced costs $
Net Change in Profit (B-A)	

Source: Kay, R.K., and W.M. Edwards. 1999. Farm Management, 4th Edition. McGraw-Hill. pp 124.

$$\frac{FV}{(1 + \text{Discount Rate})^5}$$

Where "FV" is the projected cash flow for each year.

$$\frac{FV_1}{(1 + \text{Discount Rate})^n}$$

Where "FV" is the projected cash flow for each year and "n" is the number of periods out the cash flow is from the present.

$$\text{Net Present Value} = \sum \frac{\text{Year n Total Cash Flow}}{(1 + \text{Discount Rate})^n}$$

Where "n" is the year whose cash flow is being discounted.

Figure 1. Formulas for calculating net present value (NPV).

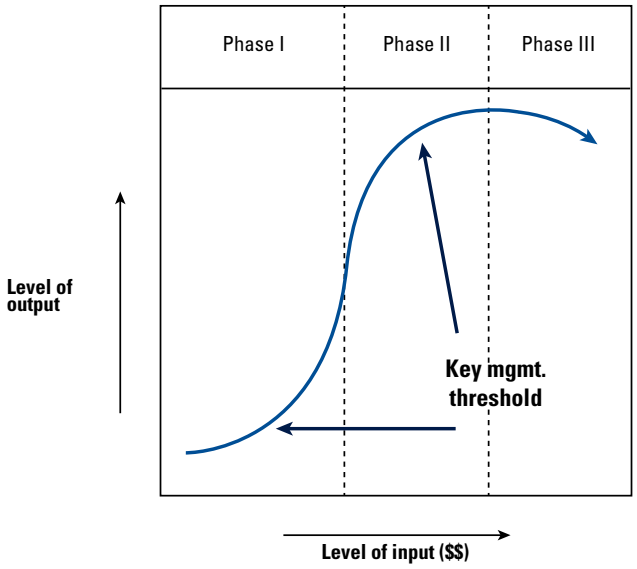

Figure 2. Production Function.

correspond with increased levels of output. Also, the unit cost of the last units produced soars."

So as a rancher is determining how many range improvement practices to implement on the ranch, he or she must be aware that the marginal cost (unit of input) of implementing the range improvement equals the marginal revenue (unit of output) gained from the improvements. If a rancher implements too many range improvements he or she may reach the point of diminishing returns. Once this point is reached, returns are not as great and returns will decrease per dollar invested. However, if the proper amount of range improvement practices are implemented where marginal revenue equals marginal cost, profitability may increase along with ranch sustainability.

This juncture where Phase II and Phase III on the production function (Figure 2) meet indicates where marginal revenue equals marginal cost for the ranch business and profit is maximized and sustainability can be achieved.

So as previously mentioned, each individual ranch will have different amounts of range improvements to maximize profit and efficiency. So what guidelines can a manager utilize to achieve that level?

Based on a 34-year study in western South Dakota, yearling steers grazing rangeland at stocking rates to maintain good and low-fair condition, had higher net income than rangeland stocked to maintain excellent condition (Dunn et al. 2008). Overgrazed convenience areas in a pasture may generally trend towards poor range condition and under-grazed, under-utilized areas may trend toward excellent range condition. Striving for improved grazing livestock distribution that will maintain the entire pasture in the fair to good range condition may be advantageous to the financial efficiency of the grazing enterprise.

So as a ranch is debating how many range improvements they need to add to their ranch, an excellent starting point is to do the minimum amount of range improvements to achieve a grazing distribution that equates to a fair to good range condition throughout the ranch. Other guidelines a ranch manager may utilize include:

- Start slow, use what you already have.
- Consolidate the herd and rotate.
- Minimize costly capital expenditures when first starting a rotation system.
- Cautiously utilize cost-share programs for range improvement.

For example, Figure 3 shows a 375 acre pasture in Tripp County, SD that had been continuously grazed. The pasture had two automatic waters on the north end of the pasture and two dams that seasonally had water on the southeast end. The pasture also had a live crick running through the northeastern section during the spring. Due to the only reliable source of water being the automatic waterers on the extreme north end of the pasture, the grazing distribution was not even throughout this pasture. The northern

third of the pasture would be overgrazed and the south end underutilized. In order to more efficiently utilize the rangeland resources, the manager of this property repaired existing fences (Figure 4) and installed an above ground water pipeline and tanks (Figure 5). These range improvements allowed the implementation of a 4 pasture rotation with more even grazing distribution throughout the entire property.

The grazing harvest efficiency was increased from 25% to 30% due to the implementation of a 4 pasture rotation. Total animal unit months (AUM's) available increased from 396 to 476. A total of 2,500 ft. of above ground pipeline was installed at $0.50/ft. plus $50 for couplers. Two 9 foot stock tanks were placed at the end of the above ground pipeline for $350/tank.

Above ground pipeline	$0.50/ft. x 2500ft	$1,250
Couplers for pipeline		$50
Stock water tanks	$350/tank	$700
Fence repair and labor		$1,500
TOTAL		**$3,500**

The owner of this property cash rents the 4 pasture rotation system for $50/AUM for a 6 month grazing season. By increasing the total AUM's available from 396 to 476 translates to an increase of 80 AUM's. For a 6 month grazing season this translates into an increase of 13 animal units per month (80 AUM's/6 months = 13.33). 13 AUM's x $50/AUM x 6 months = $3900 per grazing season.

Figure 6 shows the NPV of the range improvements made to this property. Since no loan was taken out for these range improvements, the discount rate utilized is a standard 3% inflation rate. Figure 6 shows the NPV assuming 3 out of every 10 years is drought and no income is made off the improvements. More variability can be added to the expected future return if needed.

This is one specific example off of one specific ranch. Every ranch is going to have its own unique needs for range improvements. The manager's goal on this ranch was to implement the minimum amount of range improvements to increase the grazing distribution of the entire pasture to maintain a fair to good range condition. This property has not yet met its law of diminishing returns based on the number of range improvements implemented. In fact, by implementing this first rangeland improvement, this ranch probably lies somewhere on the steep increase curve of the production function (Figure 2). This ranch needs to carefully evaluate each additional rangeland improvement as to not exceed the law of diminishing returns.

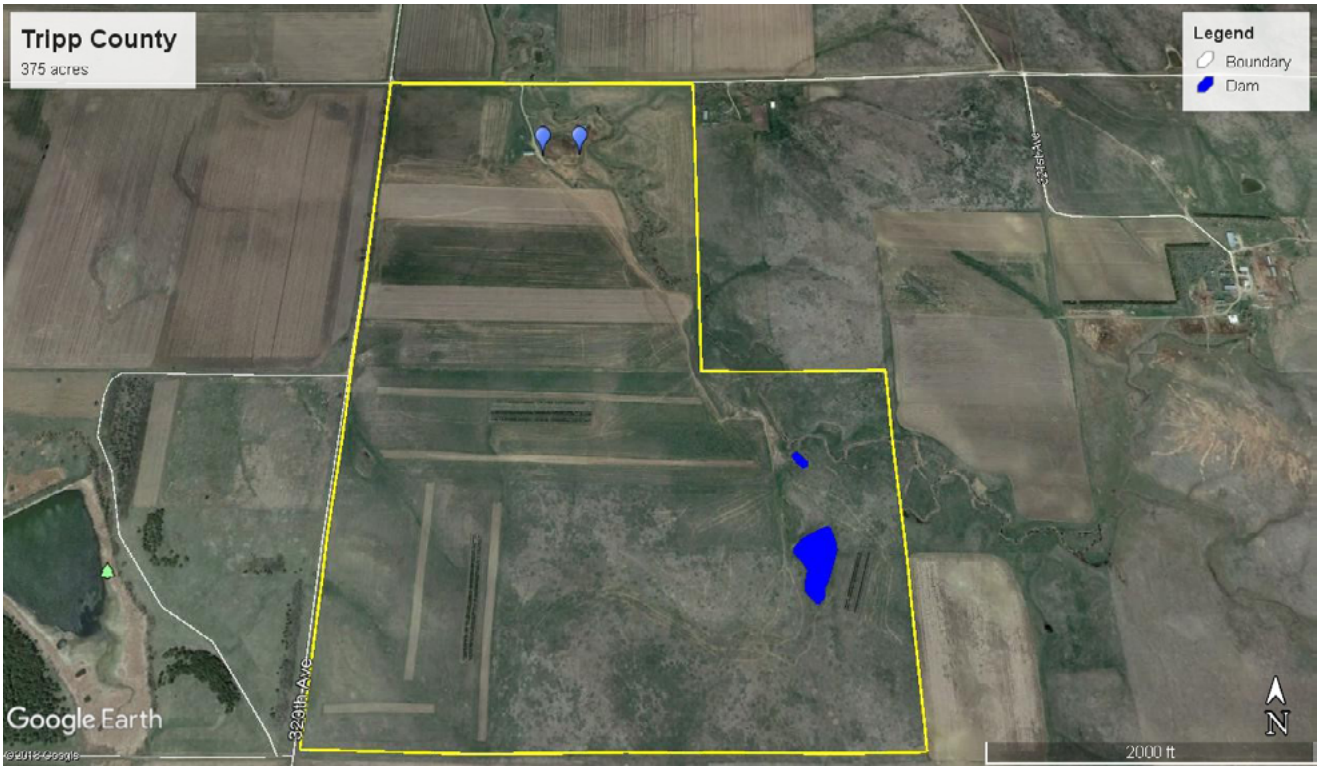

Figure 3. Continuously grazed pasture Tripp County, SD.

Figure 4. Repaired existing fences.

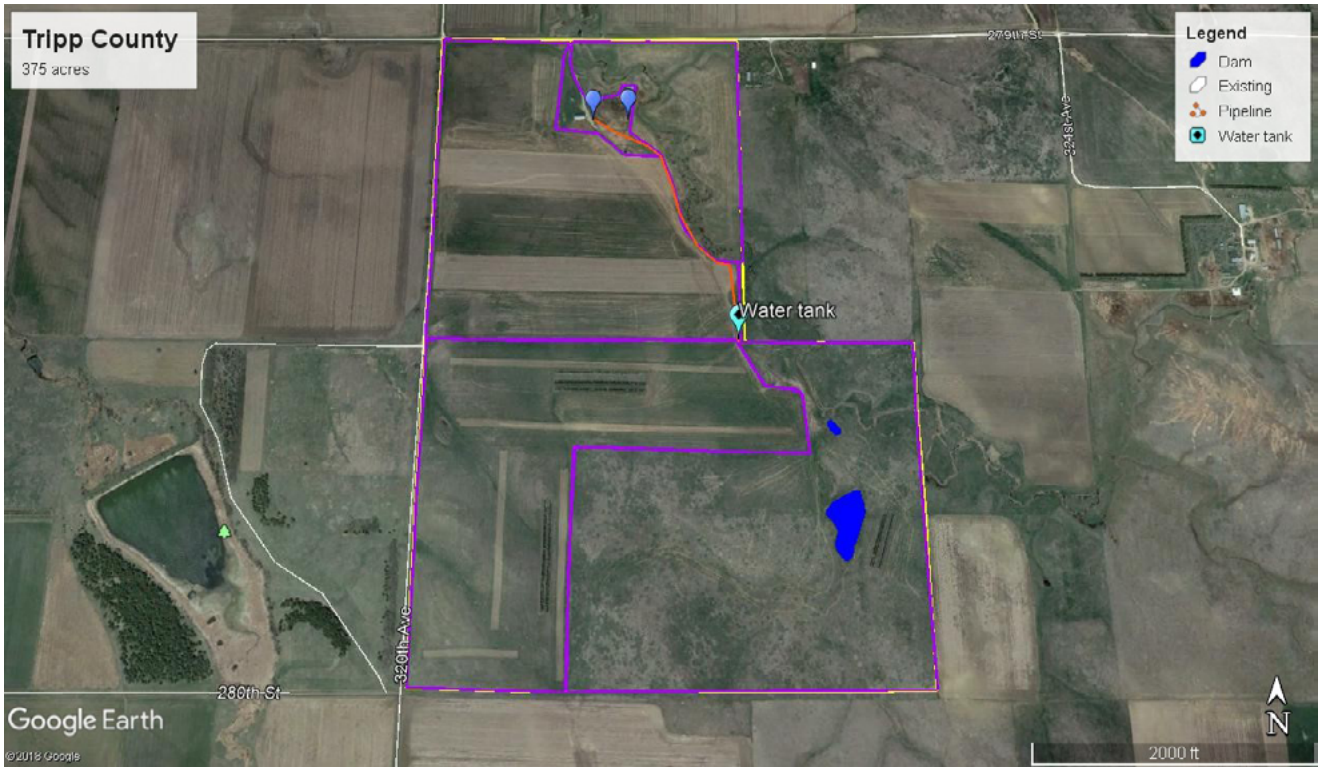

Figure 5. Tripp County pasture with range improvements.

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Net Present Value Calculation

Discount Rate % **3.00%**

Year	Expected future return	Discount Rate	Present Value
1	$3,900.00	3	$3,786.40
2	$3,900.00	3	$3,676.12
3	$3,900.00	3	$3,569.05
4	$3,900.00	3	$3,465.10
5	$3,900.00	3	$3,364.17
6	$3,900.00	3	$3,266.19
7	$3,900.00	3	$3,171.06
8	$3,900.00	3	$3,078.70
9	$3,900.00	3	$2,989.03
10	$3,900.00	3	$2,901.97
11	$3,900.00	3	$2,817.44
12	$3,900.00	3	$2,735.38
13	$3,900.00	3	$2,655.71
14	$3,900.00	3	$2,578.36
15	$3,900.00	3	$2,503.26
16	$3,900.00	3	$2,430.35
17	$3,900.00	3	$2,359.56
18	$3,900.00	3	$2,290.84
19	$3,900.00	3	$2,224.12
20	$3,900.00	3	$2,159.34
Total present value of returns from improvement practice			**$58,022.15**
Cost of improvement practice today			**$3,500.00**
NET PRESENT VALUE			**$54,522.15**

Figure 7. Net Present Value for range improvements for Tripp County pasture.

Net Present Value Calculation

Discount Rate % **3.00%**

Year	Expected future return	Discount Rate	Present Value
1	$3,900.00	3	$3,786.40
2	$3,900.00	3	$3,676.12
3	$3,900.00	3	$3,569.05
4	$0.00	3	$0.00
5	$0.00	3	$0.00
6	$0.00	3	$0.00
7	$3,900.00	3	$3,171.06
8	$3,900.00	3	$3,078.70
9	$3,900.00	3	$2,989.03
10	$3,900.00	3	$2,901.97
11	$3,900.00	3	$2,817.44
12	$3,900.00	3	$2,735.38
13	$3,900.00	3	$2,655.71
14	$0.00	3	$0.00
15	$0.00	3	$0.00
16	$0.00	3	$0.00
17	$3,900.00	3	$2,359.56
18	$3,900.00	3	$2,290.84
19	$3,900.00	3	$2,224.12
20	$3,900.00	3	$2,159.34
Total present value of returns from improvement practice			**$40,414.72**
Cost of improvement practice today			**$3,500.00**
NET PRESENT VALUE			**$36,914.72**

Figure 8. Net present value of range improvements with drought scenario Tripp County pasture.