Partial Budgeting Methods Using New Mexico State Crop Enterprise Budgets to Help Farm Management Decisions

Pilja Vitale, John Garlisch, Madhav Regmi, Michael Patrick, Mary Frances Miller, Eduardo Medina[1]

pubs.nmsu.edu • Cooperative Extension Service • Guide Z-123

The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico, improving the lives of New Mexicans through academic, research, and Extension programs.

Photo by Josh Bachman. NMSU, 2021.

Numerous studies have addressed the method of partial budgeting in various agricultural applications. This guide focuses on how to use the partial budgeting method with crop enterprise budgets in the New Mexico State Cooperative Extension Service.

HOW IS PARTIAL BUDGETING USED?

Partial budgeting is a useful tool to make decisions for farm management in terms of small, usually termed marginal, changes in farm practices. It is used when producers are considering a change in their farming practice(s) and predicts how much producers' net income will be impacted from those changes. Producers may use partial budgeting for the following cases:

- Purchasing new seed varieties.
- Adopting new technology, such as a precision farming method for water or leaf analysis.
- Deciding between buying a machine or using custom work.
- Modifying production practices
- Evaluating the impact of a conservation project before starting it.
- Adopting a new enterprise, discontinuing an existing one, and/or taking away an existing enterprise.

New Mexico State University
aces.nmsu.edu

[1]Respectively, Extension Economist, Department of Extension Economics (EE); Bernalillo County Agricultural Extension Agent; Associate Professor, Department of Agricultural Economics and Agriculture Business (AEAB); Extension Specialist, EE; Assistant Professor, AEAB; Extension Economist, EE ; All from New Mexico State University.

HOW DO PRODUCERS USE IT?

Main Method of Partial Budgeting

Partial budgeting focuses on assessing the impact of changes from traditional to more innovative farming practices—adopting new technology, buying new machinery, and adding new enterprise. The first step is to identify the changes in gains and losses resulting from the proposed modifications.

Partial budgeting specifically categorizes changes into gains and losses. Gains are obtained through increased revenue and decreased costs. Conversely, losses occur through increased costs and decreased revenues. When viewed in this way, partial budgeting is similar to the well- known T-chart (a two-column table used to organize information). The left side of T-chart includes gains while the right side of T-chart includes losses. The easiest way to use this method is a step approach.

Step 1: Identify gains and losses associated with the proposed changes and include a description of them (Table 1).

Table 1. Example of "Identification of Gains and Losses from Proposed Changes".

Gains	Losses
1. Increasing revenue • More yields. • Receiving higher prices.	**1. Decreasing revenue** • Lower yields. • Receiving lower prices.
2. Decreasing costs • Less labor required. • Less chemicals and fertilizers.	**2. Increasing costs** • Higher machine costs. • More chemicals and fertilizers.

Using the enterprise budget sheet in the Cooperative Extension Services NMSU (costsandreturns.nmsu.edu) will help identify what items should change costs and returns.

Step 2: Collect data for identified items of returns and costs from the first step. This requires quantities of inputs and prices from diverse sources. NMSU enterprise budget provides one way of sourcing the input data. In other situations, producers can get more accurate data by calling extension agents, obtaining local input, and contacting equipment vendors. As a producer, building personal relationships with local cooperative extension agents, vendors, and suppliers can be beneficial for obtaining reliable data. Appendix 1 lists potential sources for input data.

General items typically required include yields, prices of crops before and after performing the project, unit cost of purchased input, and machinery costs. After gathering data, determine the budget baseline based on convenient units such as per acre, per head, or per pound.

Table 2. Gains and Losses Analysis Example: Impact of Planting New Seed Variety

Gains	Amount/Acre	Losses	Amount/Acre
1. Increasing revenue • More yields. • Getting higher prices.	• **20** pounds • **$2/pound**	**1. Decreasing revenue** • Lower yields. • Getting lower prices.	$0
2. Decreasing Costs • Less labor is required. • Less chemicals and fertilizers.	• **3** hours reduced. • Wage rate **$20**/ hour	**2. Increasing costs** • Higher machine cost at once. • Pay more costs (i.e. seeds).	• $0 • **$3**/pound • **25**-pound seeds per acre required.

Table 2 illustrates how a producer might organize the data into the T-chart. In this example, a producer is planting a new seed variety:

- Gains (left side of T-chart):
  - Increased yield: 20 pounds per acre.
  - Increased revenue: $2 per pound.
  - Decreased labor: Reduction of 3 hours; with a wage rate of $20 per hour, this lowers overall labor costs.
- Losses (right side of T-chart):
  - Higher seed cost: $3 per pound increase.
  - Seed application: 25 pounds per acre.

Bolden the numbers on Table 2 to proceed to the next step.

Step 3: Calculate the values of gains and losses to determine the increase in marginal revenue and decrease in marginal costs. Finally, calculate the total benefit and costs. Table 3 illustrates this process, showing that the total marginal benefit is $80 while total marginal cost is $75.

Table 3. Calculating gains and losses per acre.

Gains	Amount/Acre	Losses	Amount/Acre
1. Increasing revenue • More yields. • Getting higher prices.	**20** pounds X **$2/ pound =** **$40**	**1. Decreasing revenue** • Lower yields. • Getting lower prices.	$0
2. Decreasing Costs • Less labor is required. • Less chemicals and fertilizers.	**3** hours reduced X **$20**/hour = **$60**	**2. Increasing costs** • Higher machine cost at once. • Pay more costs (i.e. seeds).	$3/pound X 25 pounds = **$75**
Total Gains	**$100**	**Total Losses**	**$75**

Step 4: Examine Table 3 to determine if the producer has missed some items. Compare the complete budgets from NMSU with the partial budget sheet. In this example, we assume that the producer has included all relevant items and their correct values.

Step 5: Make a decision based on the analysis. According to the information on Table 3, the total gains exceed total losses by $25.00 per acre. Therefore, the producer should opt for the new project based on the partial budget analysis. Larger gains make it easier to justify proceeding with the project. However, before finalizing the decision, the producer should also consider non-monetary factors, such as availability of labor in the area, weather conditions, financing options, among other factors.

LIMITATIONS OF PARTIAL BUDGETING

If producers omit important items in a partial budgeting sheet (T-chart), it can lead to misleading conclusions. To avoid this issue, producers should compare their partial budget with whole farm budgets, such as the NMSU enterprise budget (costsandreturns.nmsu.edu). Partial budgeting mostly focusses on small changes, so for significant changes, like introducing a new crop, a whole budget is necessary. For instance, if a producer wants to transition from traditional farming to organic farming, then, a whole budget should be created because many farm practices —from seeding to harvesting— will change.

TWO EXAMPLES USING PARTIAL BUDGETS

Example 1

Purchasing herbicide resistant varieties (Roundup Ready) for alfalfa seed instead of using traditional alfalfa seeds. The Roundup Ready alfalfa seed will benefit from eliminating weed competition during the establishment stage, resulting in a higher quality yield and increased production.

A producer growing grows alfalfa on 40 acres of land in Doña Ana County is considering introducing herbicide-resistant alfalfa seeds to reduce labor and increase yield and quality. The producer wants to assess how this will affect their income. The producer uses the step approach discussed to make a decision.

Step 1: Identify gains and losses.

Roundup ready seeds allow the producer to get higher yield and quality, resulting in increased revenue. This will also reduce tractor time by decreasing the need for cultivation. First, the producer should obtain the appropriate alfalfa enterprise budget from the NMSU website (costsandreturns.nmsu.edu) for identifying change items. To do this, the producer can visit the website and chose the following options: "Tear 2023", "Doña Ana County", and then choose the Alfalfa Budget Sheet from the list of available crops.

Based on this initial analysis, Roundup Ready alfalfa could bring both a higher price and yield by increasing quality while reducing weeding labor (gains). However, herbicide-resistant seed varieties come with a 100 percent higher seed price (losses).

Table 4. Step 1: Identifying gains and losses from proposed changes for Example 1.

Gains	Losses
1. Increasing revenue • Higher prices and yields by improving alfalfa quality.	**1. Decreasing revenue** • None.
2. Decreasing costs • Less weeding labor required.	**2. Increasing costs** • Higher seed cost - 100% more expensive than traditional.

Step 2: Collect data on alfalfa prices for traditional seeds and Roundup Ready seeds from local seed companies. Gather information on the quantity of seeds required per acre, labor hours, and wage rate per hour from NMSU CES budget sheet. Enter these figures in the T-chart.

On the gains side, Roundup Ready alfalfa fetches a higher price of $15.50/ton and yields an additional 7 tons per acre. Additionally, weeding is reduced by 3 hours per acre. On the cost side, traditional seeds are priced $4.50/pound whereas Roundup Ready is $7.75/pound, resulting in an additional cost of $3.25/pound. Roundup Ready alfalfa requires 25 pounds per acre, based on the whole enterprise budget for Doña Ana County (costsandreturns.nmsu.edu). The summary of gains and losses is provided in Table 5.

Table 5. Step 2: Data collected for Example 1

Gains	Amount	Losses	Amount
1. Increasing revenue • Higher prices. • Higher yields.	**15.50 per ton**, **7** ton of yields/acres	**1. Decreasing revenue**	$0
2. Decreasing Costs • Saving seed costs. • Less weeding labor required. • Reduced herbicide cost.	**3** hours of labor reduced. Wage rate **$20**/hour	**2. Increasing costs** • Buy RoundUp Ready seeds.	**3.25**/pound pay more. Seed quantity **25** lbs/acre

Step 3: Calculating an estimate of total cost using the numbers data collected from Step 2.

On the gain side, for a 40-acre alfalfa field, the higher price and increased yield raise revenue by $4,212. Additionally, reduced labor costs contribute to further $2,400 in revenue. This results in a total gain of $6,612.

On the loss side, the higher seed price increases seed cost by $3,250.

Step 4: Review estimates on Table 6 to determine whether any items have been overlooked. In this example, it is assumed that using the NMSU budget sheet is appropriate for typical New Mexico hay producers.

Step 5: Determine the decision. Based on Table 6, the total gains are greater than total losses by $3,364 ($6,614 - $3,250). The producer could choose the new project based on the partial budget results.

Table 6. Step 3: Estimating total gains and losses for Example 1.

Gains	Amount	Losses	Amount
1. Increasing revenue • Higher prices. • Higher yields.	15.50/ton X 7 tons X 40 acres = **$4,214**	**1. Decreasing revenue** • Lower yields. • Getting lower prices.	$0
2. Decreasing Costs • Saving seed costs. • Less weeding labor required. • Reduced herbicide cost.	3 hours X $20/hour X 40 acres = **$2,400**	**2. Increasing costs** • Pay more sed prices.	3.25/pound X 25 pounds X 40 acres = **$3,250**
Total Gains	**$6,614**	**Total Losses**	**$3,250**

Example 2

Buying a land leveler versus using the custom work for laser plane operations.

Consider a producer in Doña Ana County who grows 30 acres of chili, 60 acres of onion, 10 acres of lettuce, and annually establishes 25 acres of alfalfa as a rotation crop. The producer is considering buying a land leveler powered by a tractor rather than using custom work. The producer already has a 40HP PTO tractor that has been in use for 15 years (6500 hours).

Since the land leveler will be used for chili, onion, lettuce, and alfalfa, the producer wants to evaluate the financial impact of owning the leveler versus outsourcing the work. The producer will begin by creating a partial budget sheet using the step approach to assess the potential gains and losses.

Step 1: On the benefit side, there are no direct revenue changes to considered, as the land leveler does not affect crop yield or quality. The primary benefit is the reduction in costs due to eliminating custom leveling payments.

On the marginal cost side, expenses increase with the purchase of a land leveler and ongoing costs of a tractor, such as fuel, lube, repair, and machine operating labor cost (Table 7). A land leveler is operated by attaching it to the rear of a tractor. Land leveling promotes improved water conservation and electricity savings when irrigation is powered by a well, due to more efficient use of inputs. Since these gains are difficult to measure, they are not explicitly included in the table.

Table 7. Step 1: Identifying Gains and Losses for Example 2.

Gains	Losses
1. Increasing revenue	**1. Decreasing revenue**.
2. Decreasing costs • Eliminating custom work payments for laser plane operation.	**2. Increasing costs** • Purchasing cost for a land leveler. • Fuel and lube costs for operating a tractor. • Repair costs both tractor and leveler. • Labor cost for operating tractor with a leveler.

Step 2: Collect data on each item's cost. Custom work rate for a laser plane at Doña Ana County is $122/acre (refer to the 2023 Dona Ana County whole budget sheet from the NMSU's website). Land leveler purchase price totals $16,235 (land leveler $13,595 plus laser implement $2,640). Table 8 shows the T-chart of the gains and losses.

Table 8. Step 2: Collecting data for Example 2.

Gains	Amount	Losses	Amount
1. Increasing revenue	$0	**1. Decreasing revenue**	$0
2. Decreasing Costs • Eliminating customer works.	$122 per acre	**2. Increasing costs** • Buying machine cost. Land leveler + laser.	$16,235

Step 3: Estimating total gains and losses.

Since the land leveler will be used over many years, its cost needs to be distributed over its expected service life (here we assume 15 years). To estimate the spreading cost of equipment (tractor and land leveler), traditional engineering equations are used. These costs are divided into two categories: ownership costs and operating costs. Ownership costs include depreciation and TIH (tax, insurance, and housing); operating costs include repair, fuel, lubrication, and operating labor.

To estimate these costs, the producer would gather the following information:

	Land Leveler	Tractor
1. Remaining life expectancy	15 years	8 years (used)
2. Annual hours use	188 hours	450 hours
3. Operating interest rate	9.75 percent	9.75 percent
4. Fuel price	$4.33/gallon, diesel	Not required
5. Operator wage rate	$20 per hour	Not required

Using engineering equations based on Iowa State University's factsheet (reference 1, 2), the following calculations are made to spread the cost of purchasing the equipment over its expected service life. The ownership cost, which includes depreciation and TIH, amounts to $18 per hour. Operating cost, which is the sum of repairs ($5.21), fuel $7.62), lubricant ($1.14), and labor ($22.00) is $35.97 per hour. The total machine cost (ownership cost plus operating cost) is $67.98 per hour.

To compare the benefit cost on a per acre basis, all relevant expenses should be converted from a per-hour to a per-acre format. The total cost per acre of owning the machine would be $84.98, assuming the land leveler can be operated at a rate of 1.2 hours per acre. Comparing the total cost between custom work and owning the machine from Table 2, owning the machine is the most cost-effective option. Appendix 2 includes a workbook for machinery calculations, which the producer can use to estimate their costs by entering data on the highlighted columns.

Step 4: Examine Table 9 to determine whether any items have been overlooked. Since the data was obtained from the NMSU budget sheet, the producer would be expected to have correctly specified the table.

Step 5: Determine the decision. Based on Table 9, the total gains are greater than total losses by $4,627. The partial budget thus supports that the producer would benefit from self-performing land leveling operations, instead of hiring custom labor. Before making a final decision, producers should consider whether a skillful operator will be available on their farms, or whether the skills of the custom operators would still be warranted.

REFERENCES

1. Iowa State University Extension and Outreach. (2015). Estimating Farm machinery Costs. (Ag Decision Maker File A3-29). Retrieved from https://www.extension.iastate.edu/agdm/crops/html/a3-29.html

Table 9. Step 3: Estimating total gains and losses for Example 2.			
Gains	**Amount**	**Losses**	**Amount**
1. Increasing revenue	$0	**1. Decreasing revenue**	$0
2. Decreasing Costs • Eliminating customer works.	$122 per acre custom rate X 125 acres = $15,250	**2. Increasing costs** • Machine cost • Ownership cost (depreciation +TIH) • Operating cost • Repair cost • Fuel cost • Lubricant cost • Labor cost • Total operating cost • Total cost per hour • Total cost per acre • Total acre cost	• $18.42 /hour • $5.21/hour • $7.62/hour • $1.14/hour • $22.00/hour • $35.97/hour • $67.98/hour • $84.98/acre $84.98 X 125 acres = **$10,623**
Total Gains	**$15,250**	**Total Losses**	**$10,623**

2. Iowa State University Extension and Outreach. (2016). Estimating the Field Capacity of Farm Machines (Ag Decision Maker File A3-24). Retrieved from https://www.extension.iastate.edu/agdm/crops/html/a3-24.html
3. New Mexico State Cooperative Extension Service. (2011–2022). Crop Enterprise Budget. Retrieved from http://costsandreturns.nmsu.edu
4. New Mexico State University Cooperative Extension Service. (2012). Recommendations for Roundup Ready Alfalfa Weed Management and Stand Removal in New Mexico. (Guide A-337). Retrieved from https://pubs.nmsu.edu/_a/A337/index.html
5. New Mexico State University. (2024). Crop and Livestock Enterprise Budgets: What Are They and Why Do Producers Need Them? – Enterprise budgets series 1/3. Cooperative Extension Service, New Mexico State University. Retrieved from https://pubs.nmsu.edu/_z/Z119/index.html
6. New Mexico State University. (2024). Understanding NMSU's Crop Cost and Return Budgets – Enterprise Budgets Series 2/3. Cooperative Extension Service, New Mexico State University. Retrieved from https://pubs.nmsu.edu/_z/Z121/index.html
7. New Mexico State University. (2024). Crop and Livestock Enterprise Budgets: How Do Producers Use Them? – Enterprise budgets series 3/3. Cooperative Extension Service, New Mexico State University. Retrieved from https://pubs.nmsu.edu/_z/Z122/index.html
8. Pennsylvania State University. (2023). Partial Budgeting for Agricultural Businesses. Agricultural Research and Cooperative Extension. Retrieved from https://extension.psu.edu/partial-budgeting-for-agricultural-businesses
9. United States Department of Agriculture Natural Resources Conservation Service. (2013, August). Basic Economic Analysis Using T-charts (Economics Technical Note). Retrieved from https://www.nrcs.usda.gov/sites/default/files/2022-09/stelprdb1176611%20Economics%20Technical%20Note%20TN%20200-ECN-1%2C%20Basic%20Economic%20Analysis%20Using%20T-Charts%20%28August%202013%29.pdf

APPENDIX 1: SOURCES OF CROP YIELDS AND INPUTS PRICES IN NEW MEXICO STATE

1. New Mexico Costs and Returns of Crop

Cooperative Extension Service of NMSU. (2013–2019). Retrieved from http://costsandreturns.nmsu.edu

2. Crop Yields

USDA NASS. (n.d.). Retrieved from https://quickstats.nass.usda.gov/

3. Prices of Field Crops

USDA NASS Agricultural Prices. (n.d.). Retrieved from https://www.nass.usda.gov/Statistics_by_State/New_Mexico/Publications/News_Releases/index.php

4. Prices of Vegetables

USDA AMS Market News. (n.d.). Retrieved from https://www.ams.usda.gov/market-news

5. Local Input Sources

Inquiry with Simplot, Nutrient Solution, Helena Chemical, and local input stores.

6. Water Value

NM Irrigation Districts (e.g., Elephant Butte Water District).

7. Machinery Prices

- **New Machinery:**
  John Deere: Build Your Own
  Case IH: Build & Price
- **Used Machinery:**
  Hotline Farm Equipment Guide 2023 or Machinery Pete.

8. Custom Rates

Google search for Oklahoma Custom Rates and Colorado Custom Rates.

9. Land Values and Taxes

Inquiry with each county assessor.

10. Interest Rates

American AgCredit.

11. Crop Insurance

USDA Risk Management Agency. Retrieved from https://www.rma.usda.gov/

Appendix 2. The Workbook for Example 2 - Estimating Machine Costs available upon request.

Pilja Vitale *is an extension economist in the Cooperative Extension Service at New Mexico State University. She received her B.S. in Agricultural Economics from Seoul National University, an M.S. in Agricultural Economics from Texas A&M University, and a Ph.D. in Agricultural Economics from Oklahoma State University. Vitale worked with vegetable farmers in Oklahoma for about 20 years and her interest areas are crop and livestock budgets and production economics.*