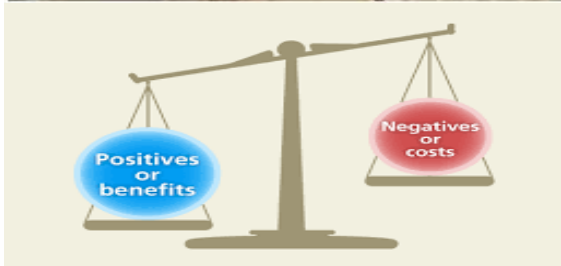


## Economic Assessment of Agricultural Technologies in the Arabian Peninsula

### A Guide to Partial Budgeting – A Financial Management Tool



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## Context of the Guideline

This manual is designed to serve as a guide to using partial budgeting for economic valuation and assessment of adopting a new agricultural technology. It is intended to provide a framework for constructing a partial budget that can help farmers estimate whether adopting a new agricultural technology or best practice is profitable and can increase net farm income. Partial budgeting is a great financial management and excellent planning tool for small and is specific change in farmer's operations.

### In a Nutshell – Take home message

- The partial budget analysis (PBA) can help a farmer estimate the net change in the business income before a management decision (i.e., adopting new proven technology);
- Partial budgeting allows farmers to handle better how a decision will affect the enterprise's profitability and, ultimately, the farm's profitability;
- The farm business is dynamic. Sooner or later, changes (increase profits and reduce costs) by adopting new technology;
- The PBA is useful in evaluating budgets that involve small, specific, and limited changes within an intervention by helping to determine the profitability of that change;
- The PBA serves as a benchmark for programs, operations, and sustainability assessment tools for agriculture practices, technologies, and value chains;
- The PBA informs and influences policy agendas of governments and development entities by providing evidence on the profitability of adopting new, improved agricultural technologies.

### Keywords

Partial budget analysis, partial budget form, technology evaluation, benefit-cost ratio, internal rate to return, agricultural technologies.

## 1 Scope of the Guideline

This guideline is prepared in the frame of the two projects: (1) ***“Improving agricultural production systems and conserving natural resources under climate change in the Arabian Peninsula”*** and (2) ***“Developing sustainable production systems for date palm in the Gulf Cooperation Council countries of the Arabian Peninsula.”***

These two research and development projects aim to produce new knowledge and climate-smart technologies and practices to improve the Arabian Peninsula's agricultural production systems (AP). This guideline contributes by the International Center for Agricultural Research in the Dry Areas - ICARDA to the existing literature on the economic valuation and assessment of adopting new agricultural proven technologies. The content of this document is intended to be formative as the purpose of doing partial budgeting may be useful for many reasons:

- Serving as guidelines for improving the ecological, societal, cultural, and economic sustainability of farms and businesses through helping identification of reasons to adopt these new and improved technologies;
- Serving a basis for setting research and development agendas for enhancing farmers adoption of new, improved technologies and consequently improving farmers livelihoods and sustainable farming and related value chains in the AP region;
- Serving as a benchmark for programs, operations, and sustainability assessment tools for agriculture best practices, sustainable technologies, and its value chains;

- Promoting the development and use of indicators and metrics to assist in an operation's self-evaluation or external evaluation and transparency;
- Enabling assessments of the local, regional, and global impact of specified sustainability technologies and agricultural best practices;
- Informing and influencing policy agendas of governments and development entities by providing evidence on the profitability of these improved technologies;
- It provides a resource for capacity building, education, and raising awareness about validation and sustainability by adopting these technologies.

## 2 Financial Analysis and Partial Budgeting

### 2.1 What is a partial budget?

Partial budgeting analysis also known as marginal analysis is a financial managerial tool that can compare the costs and returns as affected by a potential change in an intervention or change (i.e. adopting new improved technology). It is especially useful in evaluating budgets that involve small, specific, and limited changes within an intervention by helping to determine the profitability of that change by using a set of measurable and significant indicators such as benefit-cost ratio (BCR) and internal rate to return (IRR). The partial budget can be divided into three main sections: (I) costs, (II) benefits, and (III) analysis. The analysis section includes the net change in profits, net change in costs, net changes in net returns, and a break-even analysis, also known as benefit/cost ratio. The possible changes that can occur in an intervention (i.e., adopting new agricultural technology) fall into four categories when comparing the farm budget with and with this new technology. These categories are added returns, reduced returns, added costs, and reduced costs. The partial budget analysis section contains the net change in profits, net changes in costs, benefit/cost ratio, and internal rate to return analysis.

### 2.2 Which components does PBA consist of?

The partial budget (PB) analysis is best adapted to small changes in the business. Let's analyse two alternatives for business farming, comparing the first alternative (without technology) with a new situation where farmers adopt a new agricultural best practice or new technology. The analysis does not determine that these two are the most desirable enterprises for the farm. Sometimes, other alternatives would give more profit and reduce costs, i.e., using only one technology element and not the full package). The budget only indicates that the change will increase, decrease, or change net income and total costs. We then separate the positive and negative effects and list them in different sections of the PB (Lessley et al., 1991). The PB measures the positive and negative effects of a change in the business. PB's left side shows the positive effects on net income, including additional income and reduced costs. To counterbalance this positive effect, the PB's right side includes reduced income and additional costs or the proposed change's adverse effects. The PB has four categorical parts: additional income, reduced costs, reduced income, and additional costs (Lessley et al., 1991).

### 2.3 When should I use PBA?

The partial budget framework can be used to analyse the effect of several essential farm decisions changing in management and practices, including:

- Adopting new agricultural technology (i.e., new variety, new agronomic practice, new breeding, new irrigation technology, feed blocks technology)
- Expanding the business of the farm (i.e. adding new sheep to the existing ones).
- Substituting net houses with hydroponics greenhouses.
- Substituting commodities with similar requirements (i.e., tomatoes with cucumber or tomatoes variety A with tomatoes variety B).
- Buying new machinery or equipment (ex: buying new equipment rather than leasing or custom-hiring or vice versa such as feed block machine or irrigation equipment).
- Making capital improvement (i.e., making the new and small investment).
- Adopting or changing production practices (i.e., changing feed ration for livestock herd).
- Participating in a government program or considering an alternative enterprise (i.e., moving from rainfed to the irrigated farming system).

This analysis gives the practitioner of PBA an idea of the types of changes that partial budgeting can analyse. However, we should always keep in mind that partial budgeting can only analyse small business changes, not significant reorganizations or large investments.

## 2.4 Advantages and limitations of using PBA

As indicated in the above sections, a PBA considers all revenues and expenses that would change with an alternation to the farm operation. PBA is an excellent managerial tool to help evaluate the financial considerations caused by changes in a business. Although PBA can be applied in various situations, it has advantages and disadvantages to its use. The partial budget weighs the advantages (reduced costs and added returns) and disadvantages (added costs and reduced returns) to arrive at profitability.

### 2.4.1 Advantages of using PBA

The application of PB provides several advantages, including:

- The PBA is a quick and straightforward method of investment analysis.
- It can show the results of the projected changes clearly.
- It is not necessary to consider all costs in the business – only the costs and returns that will be changed by the investment under consideration (i.e., adopting new variety, new machinery, new practice, new technology).
- It isolates the impact of a change.
- It evaluates the farm's existing plan and guides the farmers to adopt and assess the new farm plan.
- It guides and encourages farmers on the most efficient and economical use of resources.
- It serves as a valuable basis for improvements in farm management practices.

### 2.4.2 Limitations on using PBA

Although partial budgeting can be applied in various situations, it does have limitations to its use.

- It is restricted to evaluate only two alternatives.
- It is useful for measuring short term simple changes. If the change involves longer-term changes or investments, then tools like capital budgeting may be more appropriate. These tools consider the time value of money that partial budgets may not. Labour and management changes may need to be considered.

- Partial budgeting does not always consider risks involved in the change, such as market availability or legal risks.
- The results obtained from a partial budget are only estimates and are only as good as the original data entered. If we enter inaccurate information in the budget, we receive inaccurate results.
- The partial budgeting only provides an estimate of the profitability of an alternative relative to current operations. It does not provide an estimate of the absolute profitability of the business.
- To have valid financial indicators from partial budgeting analysis, the data collected should be accurate. If not, results will also be inaccurate.
- Costs and returns that are not affected by an intended change are not included in the partial budget.

### 3 Partial budget analysis indicators


#### 3.1 Benefit-cost ratio (BCR)

Benefits-Cost Analysis (BCA) is a fundamental approach in neoclassical economics adapted by environmental economists to evaluate net social or private welfare from environmental remediation/projects. It is a systematic approach to estimating the strengths and weaknesses of alternatives that satisfy transactions, activities, or functional requirements for a business. It is also a technique used to determine options that provide the best approach for the adoption and practice in terms of benefits in labour, time and cost savings, etc. The BCA is also defined as a systematic process for calculating and comparing the benefits and costs of a project, decision, or government policy.

According to (Harberger 1971), BCA is considered one of the basic postulates of applied welfare economics. There are many justifications for this, but according to Boardway (1974), the one that appeals most to 'objective' economists is that aggregate monetary gains and losses measure the efficiency of a project. If the aggregate is positive, the gainers could compensate the losers and still be better off after the project is undertaken and vice versa. De Graaff and Kessler (2009) argued that the eventual aim of BCA is a comparison between the present value of the streams of benefits (positive effects) and the present value of all investment and recurrent costs (adverse effects). In a typical BCA, the inputs' costs are assessed and compared to the project's total benefits' monetary estimates. The evaluation process consists of several stages, each paying attention to such details as totalling the benefits and costs accruing to different groups/persons in different periods.

BCA's essential theoretical foundations are: Benefits are defined as increases in human well-being (utility) and costs are reductions in human well-being. For a project to qualify on cost-benefit grounds, its net benefits must exceed its net cost. Broadly, BCA has two purposes:

- To determine if it is a sound investment/decision (justification/feasibility), to provide a basis for comparing projects. It involves comparing the total expected cost of each option against the total expected benefits to see whether the benefits outweigh the costs and how much.
- BCA is related to but distinct from cost-effectiveness analysis. In BCA, benefits and costs are expressed in monetary terms and are adjusted for the time value of money so that all flows



of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their “net present value.”

In practice, the benefit/cost ratio is obtained by dividing the total benefits (added income) by the total costs (reduced income). The benefit/cost ratio is a handy tool in determining which alternative would be more profitable when compared between two partial budgets (with and without technology). Using the benefit/cost ratio can help the farmer determine which option would produce better returns by considering the high BCR value (i.e., the better option). Thus, new technology could be adopted if its corresponding BCR is higher than the control option (without technology) and vice versa.

### 3.2 Internal rate of return (IRR)

Internal Rate of Return (IRR): Way of evaluating a project investment (i.e., adoption of new technology) to accept or reject the project (comparing the profitability of adopting this new technology with no adopting this new technology). It is a discount rate at which the net present value (NPV) = 0. In the PBA, the IRR is a ratio calculated as follows: **% Changes in Net Returns / % Changes in Total Costs**. This measure is useful because it is easily comparable with real interest rates in alternative applications and because it avoids the necessity of selecting a discount rate. For agricultural technologies, the threshold to consider if the technology is profitable or not using IRR is the current existing interest rate (IR). Thus, if IRR exceeds the IR, the technology is profitable from the point of view it is worth to be adopted.

### 3.3 Net returns (NR)

The net return (NR) is an indicator used to compare between two alternatives. This measure is also useful because it provides a real comparison between total revenue and total costs. The NR ratio calculation is presented in the following form: **NR = Total Revenues – Total Costs**.

## 4 Components of Partial Budgeting

To use partial budgeting to evaluate a potential change in a business (i.e., adopting new agricultural technology or good management practice), a manager (farmer or researcher) must first be able to answer four questions about that change:

- What new or additional costs will be incurred by adopting this new technology?
- What will current costs be reduced or eliminated by adopting this new technology?
- What new or additional returns will be received from adopting this new technology?
- What will current returns be reduced or lost from adopting this new technology?

A PB contains only those incomes and expense items, which will change if the proposed alteration in the farm plan is implemented. In other words, the changes that could occur when the farmer adopts a new technology or good practice. Those incomes and expenses that remain the same on the farm when the change occurs are not included in the partial budget. The final result is an estimated (calculated when data is available) change in net farm income and the effect on revenue and cost due to the new technology's adoption.

To make these calculations, the partial budget's layout is as follows:

<b>Advantages</b>	<b>Disadvantages (Limitations)</b>
Reduced Costs	Added Costs
Added Returns	Reduced Returns

The left-hand side of the box identifies advantages, which could reduce present costs and/or increase profits by generating additional income from the adoption of the new technology. The right-hand side of the box identifies limitations, which could reduce profits by increasing the costs and/or reduce income by adopting this new technology. Subtracting the limitations from the advantages gives a positive or negative position. A position that can help identifying answers to the farmers concerns on adopting or not the new technology.

The partial budget analysis section contains net change in profits, net change in costs, and benefit/cost ratio analysis. The net change in profits is the factor that determines whether the change can improve or hurt the current financial situation. In other words, if the application of the new technology improves or reduces the profits and increases or reduces the current variable costs. If the benefits are greater than the costs, the change will have a positive net benefit, and this led to the adoption of the new technology, given its profitability. Otherwise, if the variable costs related to a proposed change by adopting this technology are more significant than the benefits (negative valued net benefits), then the proposed change should not be considered or reconsidered, as it will cost more than it will return.

The benefit/cost ratio looks at the relative values of the benefits and costs when the profits from two considered alternatives (with and without technology) appear to be the same value. Using the benefit/cost ratio can help the farmer determine which option would produce better returns and, consequently, if it is worth adopting the new technology or improved farming practice. Both net change in profits and the benefit/cost ratio should be used to evaluate the results from a partial budget.

In many cases, the four partial budgeting components outlined in the above section will not apply to a specific situation. However, it is a good idea to evaluate all of the four possibilities to ensure that some variable or impact has not been ignored and reduce the chances that variables or impacts have been counted more than once. Finally, it is crucial to avoid making evaluations of these components (mainly costs and returns) that are not affected by adopting the new technology (i.e., proposed business change). A partial budget can be arranged into the following format:

Technology (Proposed Change – Adoption of new agricultural technology in the AP Region)	
Section I: Costs	Section II: Benefits
<p><b>A. Additional Costs</b> <i>(These will be the costs incurred as a result of adopting new technology or using a new practice)</i></p> <p><b>B. Reduced Returns</b> <i>(These will be the returns that are given up as a result of adopting this new technology by the farmer or practice being used)</i></p> <p><b>C. Total Costs (A + B)</b></p>	<p><b>D. Additional Returns</b> <i>(These will be the returns received as a result of adopting new technology or using a new practice)</i></p> <p><b>E. Reduced Costs</b> <i>(These will be the costs that will no longer be incurred as a result of no adopting the new technology or practice for a new one)</i></p> <p><b>F. Total Benefits (D + E)</b></p>
Section III. Analysis	
<p><b>G. Net Change in Profits: <math>NR = (F - C)</math></b></p> <p><b>H. Benefit/Cost Ratio: <math>BCR = (F \div C)</math></b></p> <p><b>I. Internal Rate of Return: <math>IRR = \{((D-A)-(B-E))/(B-E)\} \div \{(A-E)/E\}</math></b></p>	

## 5 Steps in Constructing a Partial Budget for Technology Evaluation


The financial and economic evaluation of technology is going through a logical process where the implementation of PB is one step within a full process that consider the following consecutive actions:


- **First:** Identify the technology (i.e., applying Integrated Protection and Protection Management -IPPM).
- **Second:** Describe the advantages of the technology (i.e., reduces pesticides, reduces costs).
- **Third:** Develop an explicit and transparent budget to assess its economic feasibility (Identify all costs and revenues by applying this technology and compare them with a control treatment – do nothing).
- **Fourth:** Identify constraints to adoption (i.e., know-how use of the technology, availability of biological pesticides, effective extension advisory services)
- **Fifth:** Estimate adoption rates (i.e., number of farmers' adopting this technology, number of planted areas under IPPM).

### Steps in Preparing a Partial Budget

The partial budget is ready to be developed after all appropriate data is produced and collected. It is recommended that only the costs and returns that change due to proceeding with the adoption of the new technology should be included in the partial budget. In working through a partial budget, the following steps can help a farmer assessing the profitability of new technology or improved production farming practice in a systematic way:



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1. Define the reason for adopting this new technology (i.e., reduce water, reduce the use of pesticides, improve yield, etc.). Rationalize the reason for adopting this new technology (i.e., what is this adoption's objective?).
  2. List all possible alternatives / technology options: List the potential available alternatives to obtain the desired objective (adopting the full package, adoption a part of the technological package, etc.).
  3. State the proposed alternatives/options: Develop a descriptive statement of the different available options for the technology. If more than one option exists, each option requires a separate budget format.
  4. Collect the relevant and required data to conduct the analysis: The data could be gathered through rapid rural appraisal (RRA) surveys, farmer's statistical books, household surveys, etc. The results obtained from a partial budget are only estimates and are only useful when the original data are validated and available. It is clear that if the data collected is inaccurate; results will also be inaccurate. Thus, it is always recommended and advisable to test several values for yields and prices to get an idea of what returns will or will not be received by adopting this new technology or new production farming practice.
  5. List the reduced costs induced by adopting this new technology: Adopting a new technology (or part of it) may cause a reduction in the variable costs (fuel, water, seeds, fertilizers, hired labour, etc.) and fixed expenses (in some cases such as depreciation, interest, unpaid labour).
  6. List of expected added returns induced by adopting this new technology (or part of it): The adoption of this new technology may increase the farm income (induced by an increase in the production level).
  7. List the added cost generated by adopting this new technology: The adoption of a new technology may cause an increase in the costs (variables and fixed) as implementing this innovation might require the use/purchase of additional or new inputs (i.e., fuels, seeds, etc.).
  8. List the reduced returns: profit may be reduced if adopting this new technology or farming practice reduces the production level.
  9. Calculate the change in net farm income: At this level, it is worth considering both advantages (reduced costs and added returns) and limitations (reduced returns and added costs) to calculate the net farm income or annual profit by subtracting the total limitations from advantages.
  10. Enumerate other considerations: Using partial budgeting to undertake an economic and financial evaluation of the technology may also include other considerations which were not included in the previous steps. An example of these considerations that could be major or minor includes acquiring a loan to adopt this technology if this new technology is labour-intensive (availability of labour), the time lag between the start of adoption and full action of the technology.

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11. The decision on whether to adopt or dis-adopt the technology: Once the economic benefits and the financial indicators (BCR and IRR) have been calculated and other issues have been considered, the decision is now with the farmer to adopt or not this technology.

## 6 Practical Examples Using Partial Budgeting

For analysis purposes, we will be comparing two proposed changes against our current business practice. This is by comparing the PB for two potential agricultural proven technologies. This will require two separate partial budgets for each case because, if we will recall, one of the limitations of partial budgeting is that we are restricted to evaluating only two alternatives per budget (i.e. for each example). Finally, an evaluation of the benefit/cost ratio result is provided to explain how to compare the partial budgets for the two proposed technologies.

An example of how to perform a partial budget follows. In the first example, we compare Sorghum's current production against Clitoria, a forage introduced by the project characterized by a high yield level and adapted to the AP climatic conditions. In the second example, we compare the current production of commercial tomato variety "*Isabella*" under the hydroponics production system in Net House against a proposed change in Cooled Green House.

**Example 1: Evaluating current production of Sorghum against a proposed change to produce Clitoria forage**

Technology: Sorghum vs. Clitoria (1 Ha)	
Section I: Costs	Section II: Benefits
<p><b>A. Additional Costs</b></p> <p><i>Clitoria forage</i></p> <ul style="list-style-type: none"> <li>Seed: \$ 60/ha</li> <li>Fertilizer: \$ 65/ha</li> <li>Chemicals: \$ 20/ha</li> <li>Labour: \$ 20/ha</li> <li>Other costs: \$ 25/ha</li> </ul> <p><b>B. Reduced Returns</b></p> <p><i>Sorghum forage</i></p> <ul style="list-style-type: none"> <li>8 tons of sorghum per hectare</li> <li>\$300/ton sorghum: \$2400</li> </ul> <p><b>C. Total Costs (A + B): \$2590</b></p>	<p><b>D. Additional Returns</b></p> <p><i>Clitoria forage</i></p> <ul style="list-style-type: none"> <li>85 tons of clitoria forage per hectare</li> <li>\$ 100/ton clitoria: \$8500</li> </ul> <p><b>E. Reduced Costs</b></p> <p><i>Sorghum forage</i></p> <ul style="list-style-type: none"> <li>Seed: \$ 30/ha</li> <li>Fertilizer: \$ 40/ha</li> <li>Chemicals: \$ 30/ha</li> <li>Labour: \$ 20/ha</li> <li>Other costs: \$ 30/ha</li> </ul> <p><b>F. Total Benefits (D + E): \$8650</b></p>
Section III. Analysis	
<p><b>G. Net Change in Profits: <math>NR = (F - C)</math>: \$6060</b></p> <p><b>H. Benefit/Cost Ratio: <math>BCR = (F \div C)</math>: 3.34</b></p> <p><b>I. Internal Rate of Return: <math>IRR = \{((D-A)-(B-E))/(B-E) \div ((A-E)/E)\}</math>: 10.1%</b></p>	

**Example 2: Evaluating current production of commercial tomato variety “Isabella” under hydroponics production system in Net House against a proposed change in Cooled Green House**

Technology: Tomato Variety “Isabella” under hydroponics production system in Net House vs Cooled Green House (m <sup>2</sup> )	
Section I: Costs	Section II: Benefits
<p><b>A. Additional Costs</b></p> <p><i>Tomato Variety “Isabella” under Cooled Green House</i></p> <ul style="list-style-type: none"> <li>• Seed: 0.26 US\$/m<sup>2</sup></li> <li>• Fertilizer: 0.89 US\$/m<sup>2</sup></li> <li>• Chemicals: 0.93 US\$/m<sup>2</sup></li> <li>• Labour: 3.81 US\$/m<sup>2</sup></li> <li>• Other costs for cooling system               <ul style="list-style-type: none"> <li>○ Electricity: 0.85 US\$/m<sup>2</sup></li> <li>○ Water: 0.2US\$/m<sup>2</sup></li> </ul> </li> </ul> <p>Total costs: 6.94US\$/m<sup>2</sup></p> <p><b>B. Reduced Returns</b></p> <p><i>Tomato Variety “Isabella” under Net House</i></p> <ul style="list-style-type: none"> <li>• 30.23 kg/m<sup>2</sup> of Isabella production in net house</li> <li>• 0.9 US\$/kg tomato “Isabella”: estimated tomato cost at the farm gate</li> <li>• Total income 27.21US\$/m<sup>2</sup></li> </ul> <p><b>C. Total Costs (A + B): 34.15US\$/m<sup>2</sup></b></p>	<p><b>D. Additional Returns</b></p> <p><i>Tomato Variety “Isabella” under Cooled Green House</i></p> <ul style="list-style-type: none"> <li>• 34.6 kg/m<sup>2</sup> of Isabella production in greenhouse</li> <li>• 0.9 US\$/kg tomato “Isabella”: estimated tomato cost at the farm gate</li> <li>• Total income 31.14 US\$/m<sup>2</sup></li> </ul> <p><b>E. Reduced Costs</b></p> <p><i>Tomato Variety “Isabella” under Net House</i></p> <ul style="list-style-type: none"> <li>• Seed: 0.26 US\$/ m<sup>2</sup></li> <li>• Fertilizer: 0.89 US\$/m<sup>2</sup></li> <li>• Chemicals: 0.93 US\$/m<sup>2</sup></li> <li>• Labour: 3.81 US\$/m<sup>2</sup></li> </ul> <p>Total costs: 5.89US\$/m<sup>2</sup></p> <p><b>F. Total Benefits (D + E): 37.03US\$/m<sup>2</sup></b></p>
Section III. Analysis	
<p><b>G. Net Change in Profits: NR = (F – C): 2.88US\$/m<sup>2</sup></b></p> <p><b>H. Benefit/Cost Ratio: BCR = (F ÷ C): 1.08</b></p> <p><b>I. Internal Rate of Return: IRR = {((D-A)-(B-E))/(B-E) ÷ ((A-E)/E)}: 0.75%</b></p>	

## 7 Determining Profitability

When assessing profitability of using new technology or practice based on partial budget results, it is usual crucial to remember that positive differences in the net effect indicate a potential increase in

net returns if the proposed technology (or practice) is adopted by the farmer, and negative differences are an indicator of a decrease in net returns where it is not recommended to adopt such technology.

## 8 Blank Partial Budget Forms for Replication

### Simplified Partial Budget Form


<b>Problem</b>	
<b>Section I: Costs</b>	<b>Section II: Benefits</b>
<b>A. Additional Costs</b>	<b>D. Additional Returns</b>
<b>B. Reduced Returns</b>	<b>E. Reduced Costs</b>
<b>C. Total Costs (A + B)</b>	<b>F. Total Benefits (D + E)</b>
<b>Section III. Analysis</b>	
<b>G. Net Change in Profits – NR = (F – C)</b>	
<b>H. Benefit/Cost Ratio – BCR = (F ÷ C)</b>	
<b>I. Internal Rate of Return: IRR = <math>\frac{(D-A)-(B-E)}{(B-E)} \div \frac{(A-E)}{E}</math></b>	

## Detailed Partial Budget From

Benefit-Cost Analysis of Technologies using Partial Budget Analysis								
Without Technology (Control)					With Technology Option			
1	Costs (C1)	A	B	C	Costs (C2)	D	E	F
2	Inputs	Quantity	Unit price	Total	Inputs	Quantity	Unit price	Total
3	Seeds				Seeds			
4	Fertilizers/pesticides				Fertilizers/pesticides			
5	Labor				Labor			
6	Machinery/fuel				Machinery/fuel			
7	Water				Water			
8	Other costs				Other Costs			
9	<b>Total Costs (TC1)</b>	XX	XX	XX	<b>Total Costs (TC2)</b>	XX	XX	XX
10								
11	<b>Revenues (R1)</b>				<b>Revenues (R2)</b>			
12	Main product				Main product			
13	Secondary product				Secondary product			
14	<b>Total Revenue (TR1)</b>	XX	XX	XX	<b>Total Revenue (TR2)</b>	XX	XX	XX
16	<b>Financial Indicators</b>							
17	Net Returns (NR)	C14-C9			F14-F9			
18	% Change in NR							(F17-C17)/C17
19	% Change in Total Costs (TC)							(F9-C9)/C9
20	Internal Rate of Return (IRR)							% Change in NR/% Change in TC
21	Benefit-cost ratio (BCR)	C14/C9			F14/F9			

## 9 Conclusion

Many changes proposed by a farmer or manager on a farm affect only part of the business. Partial budgeting is an excellent managerial tool to evaluate the financial considerations caused by a business change, such as adopting a new agricultural proven technology or improved farming system practice. This practical tool can be used to analyse many practical farm management problems, such as substituting crop and livestock enterprises, adopting new crop variety (i.e., tomatoes, strawberry, etc.), adopting new livestock breed, changing input levels or types of inputs (IPPM by chemical pesticides), changing the size of a farm in the business and buying new or used machinery (i.e., feed block machine). To be effective, it is essential to calculate the outcome induced by adopting this technology through accurate data. If not, results (economic and financial indicators) will be inaccurate.



Finally, this tool is considered powerful for analysing practical problems that face farmers and extension workers daily. However, the results obtained are only applicable for one specific situation i.e., it has to be reviewed when applying it to other farms, agro-ecological contexts, different farming systems, and market situations.

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## 10 Further reading

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### Useful Web – links

<https://extension.psu.edu/partial-budgeting-for-agricultural-businesses>

<https://www.msu.edu/user/betz/financialmgt/index.htm>