LEARN HOW TO ANALYZE COST-BENEFITS OF EXTENSION PROGRAMMING

K. S. U. (Jay) Jayaratne, Ph.D.
Professor and State Leader for Extension Evaluation
North Carolina State University

Cost-Benefit Analysis of Extension Programming

North Carolina Cooperative Extension provides various educational programs and opportunities to help North Carolinians improve their social, environmental, and economic conditions. Demand for Extension programs is increasing, but resources are not. Meeting growing demands for Extension education with limited resources presents a challenge for North Carolina Cooperative Extension that can be met by increasing the cost-effectiveness of Extension programs. Cooperative Extension is increasingly focused on the cost-effectiveness of its programming. Cost-benefit analysis of Extension programs can help identify cost-effective programs and eliminate or revise ineffective programs. A careful examination of expenditures will determine whether the money spent for a particular Extension program is justified when compared to other available programs. Cost-benefit analysis is also helpful for us to communicate program results with Extension stakeholders.

What Does Cost-Benefit Analysis Mean?

Analyzing cost-benefit involves systematically comparing program benefits with the program costs to assess the relative value of each. Different methods are used. The following two methods can be used to assess the cost-benefit of Extension programs.

1. **Benefit-Cost Ratio (B-C Ratio):** This is the ratio between the value of benefits derived from the program to the total cost of an Extension program.

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Value of Benefits}}{\text{Total Costs}}$$

   For example, if the total value of the benefits of a conservation tillage Extension program is $250,000 and the total cost is $25,000, the benefit-cost ratio is (Total Benefits/Total Costs) = 250,000/25,000 = 10:1 This means that every dollar spent in the conservation tillage Extension program generates $10 in benefits to the society. The cost-benefit ratio generates a powerful message about the value of Extension programs to our stakeholders.

2. **Return-On-Investment (ROI):** This is the ratio of net benefits to the total costs of an Extension program. Normally, the ROI is expressed as a percentage.

$$\text{Return On Investment} = \frac{\text{Net Value of Benefits}}{\text{Total Program Cost}} \mathbf{X}\ 100$$

   In the above example, the ROI is calculated as follows:
   The value of total benefits of the conservation tillage extension program = $250,000
   The total cost of the conservation tillage Extension program = $25,000
   The value of net benefits of the Extension program = $(250,000-25,000)
   = $225,000
   Return-On-Investment = (Net Benefits/Total Cost) 100 = (225,000/25,000)100
   = 900%
   The ROI =900% means that every $100 invested or spent in this Extension program

generates $900 of net benefits.

Benefit-Cost ratio and return-on-investment values are helpful in communicating the value of Extension programs to society and key stakeholders. The ROI value is more powerful than the benefit-cost ratio because the ROI value shows the net return for a $100 investment. It implies the economic power of the Extension program in multiplying the initial investment. This example shows that the conservation tillage Extension program can multiply the initial investment nine times.

By comparing ROI values, or benefit-cost values of different Extension programs, you can separate cost-effective Extension programs from cost-ineffective programs.

Is Cost-Benefit Analysis Possible in Extension?

The answer is yes, you can conduct cost-benefit analysis in Extension. The cost-benefit analysis demands an excessive amount of planning, record keeping, and transforming data into monetary values. Cost-benefit analysis may be difficult to conduct with some of your programs due to a lack of data such as monetary values of social or environmental impacts. Therefore, it is advisable to start cost benefit analysis with comprehensive Extension programs and gradually expand it to other programs.

How to Conduct a Cost-Benefit Analysis

Careful planning and systematic data collection are essential steps in cost-benefit analysis. The following are guidelines for planning to conduct the cost-benefit analysis of an Extension program.

1. Determine the program that you plan to analyze.
2. Identify the possible outcomes and impacts of your Extension program.
3. Plan to document your program outcomes and impacts.
4. Identify outcomes and impacts that can be converted into monetary values
5. Collect outcome and impact data.
6. Make sure not to double count or exclude important impacts.
7. Convert outcome and impact data into monetary values. (Use research data and make assumptions. State the assumptions you made.)
8. Estimate the total value of the program’s outcomes and impacts. This is the total value of benefits or returns.
9. Estimate the total cost of your program.
10. Calculate the benefit-cost ratio and ROI.

1. How to Determine a Program for a Cost-Benefit Analysis

If your Extension program is comprehensive enough to generate a high level of impacts, then it will qualify for cost-benefit analysis. For example, if you are planning a county-wide Extension program to promote organic farming for niche markets, then your program has the potential to generate economic impacts such as increased income. Therefore, you will be able to conduct a cost-benefit analysis without much difficulty. At the beginning of the program, you should be able to conceptualize the possible outcomes and impacts of the Extension program for planning to collect necessary data.

If your program is a one-time, very short presentation or activity and lacks potential for measurable end results, then it is meaningless to spend your time conducting a cost benefit analysis.

2. How to Identify Possible Outcomes and Impacts of Your Program

The following diagram is helpful to identify possible outcomes and impacts of your Extension program. Think logically for predicting the potential results of your program.

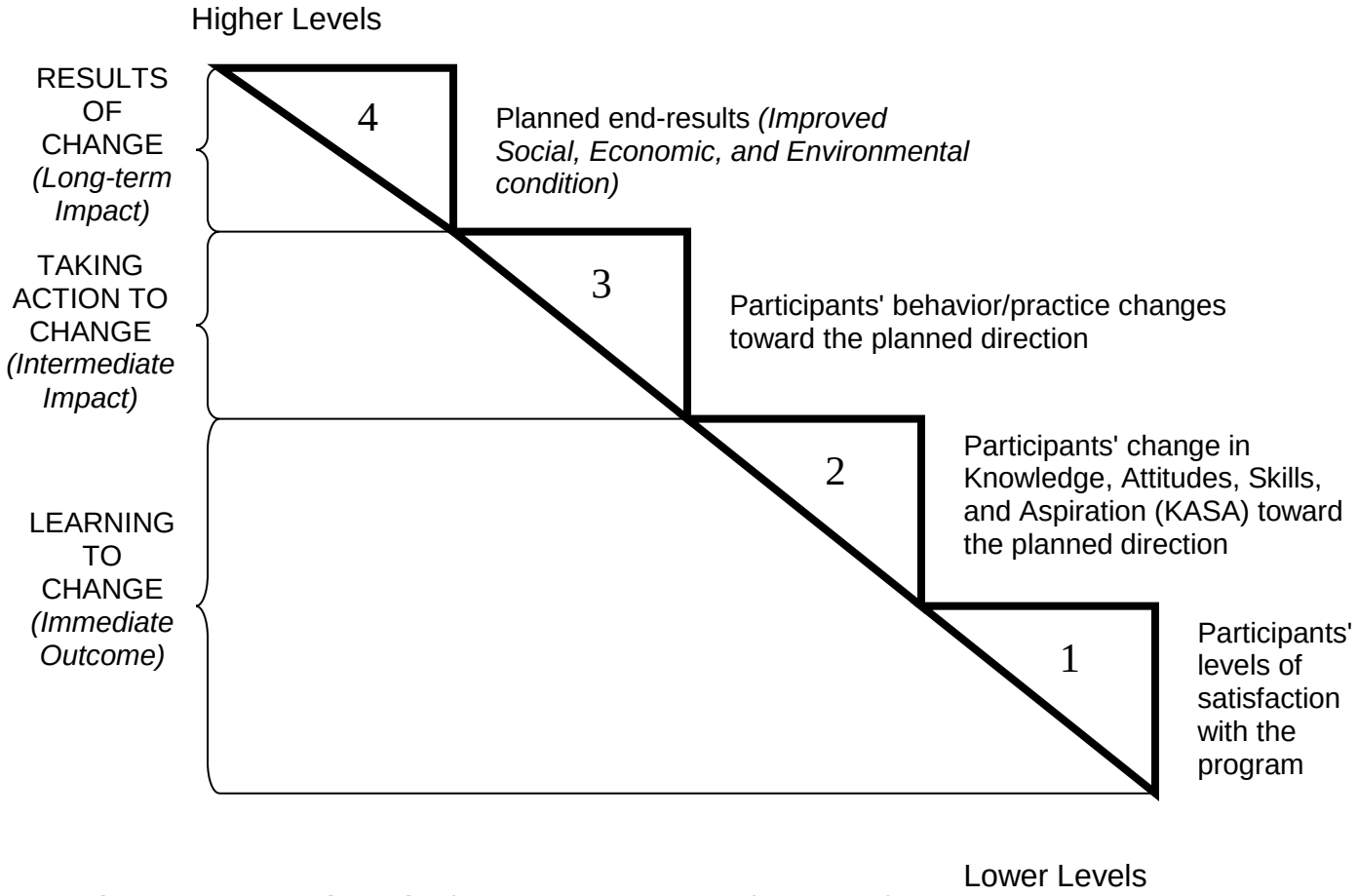

Figure 1. **Impact Hierarchy** (Jayaratne, Lyons, & Palmer, 2007)

The Significance of Impact Hierarchy

The impact hierarchy displays in Figure 1 helps you understand how the outcomes and impacts of an Extension program start to manifest. When an Extension program is presented, participants will come to the program. If the program is interesting and useful for the participants, then they will be satisfied with the program. This level of satisfaction with the program is the first measurable outcome of the program. Participants' satisfaction is mainly the result of their experience with the Extension program. Depending on their experience with the Extension program in terms of how well the program met their needs, participants may be satisfied, indifferent, or dissatisfied.

If participants are satisfied with the program, then there is a great potential for the program to help participants achieve their learning objectives. This is the next level of immediate outcomes of the Extension program. The learning outcomes include changing participants' knowledge, attitudes, skills, and aspirations (KASA). If the program is effective, participants will gain new knowledge, change their attitudes, develop skills, and aspire to practice what they learned. For example, if we presented a value-added agriculture Extension program to a group of farmers and the program was effective, then they will gain new knowledge about value addition, develop positive attitudes toward adding value to their farm products, develop skills needed to apply value addition in their operations and intend to apply value addition in their operations. These learning outcomes will manifest just before the end of the program. These learning outcomes are easy to measure and important to assess whether the Extension program is effective in helping participants achieve their learning objectives.

At the end of a successful Extension program, participants will leave with heightened aspirations to practice what they learned in their real life. If the environment is favorable for participants to apply what they learned, then their behavior or practice change will take place. For example, if the farmer who completed the value-added agriculture program and convinced about the benefits of adding value to his or her farm products found the needed capital for that change, then he or she will start practicing value addition in his or her operation. The degree of behavior or practice change of the participants varies with the nature of the change, type of participants, and their socio-economic environment. The participants' behavior change can take place over a period of time. The behavior-changing period varies from one month to few months after the program. Participants' behavior or practice change is needed to create end results. These behavior or practice changes are referred to as the intermediate impact of the program.

If participants changed their behavior or practices, then there is a great potential for achieving desired end results of the program. These end results include social, economic and/or environmental impacts. End results can vary with the program emphasis. For example, if a participant attended a value-added agriculture Extension program and changed his/her farm operation to add value, he or she would be able to increase the farm income. This is an economic impact. These end results are the long-term impacts of Extension programs. Evaluation of economic impacts is very useful in conducting the cost-benefits analysis.

When you identify your program outcomes and impacts, begin at the lower levels of outcomes and logically progress to the higher level of impacts in the hierarchy. Use Figure 1 to identify outcome and impact indicators for your program. You may select some of the following indicators:

a. Participants' changes in knowledge and skills, and heightened aspirations
b. Participants' behavior/practice changes.
c. End results – social, economic, and environmental improvements. Try to identify indicators that you will be able to convert into monitory values.

3. How to Document Program Outcomes and Impacts?

Think about the highest possible impacts that you can reasonably document with the available resources. Use the evaluation tools you learned to collect data, being careful to collect impact data that can be easily converted into monetary values. This is not an easy task with some Extension programs. For example, some youth development programs take years to manifest the end results. Therefore, it is advisable to start with a program that has easily recognized economic end results. When you convert impact data into monetary values, it is important to ensure that all impacts are counted. On the other hand, avoid double counting program impact when you convert impacts into monetary values. It is a good idea to be conservative to avoid the criticism of overestimation.

4. How to Convert Impact Data into Monetary Values for Estimating Benefits

You need to convert program benefits into monetary values. This is the most challenging step in cost-benefit analysis, especially in Extension. The following guidelines are helpful in estimating the value of program benefits.

a. List all the impact data of your Extension program and identify the data available for any of the following benefit categories.
   - Actual cost savings: This is the amount of money saved as a result of changing behaviors or adopting new practices. For example, if a farmer saved $9.50 per acre for seeds as a result of the practices learned from your training, then you can use this value as the actual cost saving.
   - Potential cost savings: In some instances, you will not be able to obtain the actual cost saving. What you can obtain is only the potential cost saving. For example, if you prevent diabetes among 10 people there is a value of preventing potential medical expenditures.
   - Value of minimized risk: This is the amount of money potentially saved as a result of minimizing risk. For example, replacing a stem borer susceptible corn variety with a stem borer resistant highbred corn. The value of the yield loss from stem borer is the value of the minimized risk of this new technology.
   - Opportunity cost savings: This is the cost that you would be able to obtain from a similar service or product. For example, if some farmers receive waste management consultant service and pay $200.00 per visit, your opportunity cost savings for a similar service will be $200.00.
   - Increased income: This is the amount of money received as a result of increased production or quality of product or service. For example, if growers increased their soybean yield by 1.5 bushels per acre on average, and the price of soybean is $6.00 per bushel, the value of increased production would be $9.00 per acre on average. This is the value of increased income per acre.
   - Potential income: This is not the actual income. It is the potential of income earning. For example, the potential income of a 4-year college graduate is

$45,000.00 per year on average. Another example is the potential income of a value-added farm product.

b. Identify the available monetary values of different impact data. For example, if minimum tillage is promoted under the conservation tillage program, and your impact data revealed that 60 farmers adopted minimum tillage practices in 50,000 acres this year, you can calculate the value of minimum tillage program by using the value of cost-saving of tillage per acre.

c. If monetary values are not available for your impact data, use estimates as the best alternative. For example, if you don't have the value of cost savings of reduced tillage per acre, you can work with a farmer to estimate the value of cost reduction and use that value for calculating the benefits of the program.

5. How to Estimate the Total Cost of Your Program

When you develop, deliver, and evaluate an Extension program you spend not only your time but also other people's time, as well as facilities and other resources of North Carolina Cooperative Extension. Calculating each and every single cost item of Extension programming is a cumbersome and time-consuming task. For the purpose of Extension evaluation, you can adopt the cost estimation method developed by Richardson in 1997. In this cost estimation method, there are two major cost items.

a. Your salary and benefits: This cost item is used to calculate the value of your time. Your total salary and benefits will be divided by annual work hours of 2000 to estimate the value of one hour of your time.
For example, if your salary is $40,000.00
The current benefit rate is about 25% of your salary
Therefore, the value of the agent's annual benefits = $(40,000.00)25/100 = 10,000.00
The total cost of hiring an agent = $40,000.00 + $10,000.00 = $50,000.00
The value of Agent's time alone = $50,000.00/2,000 = $25.00/hour
Your time is not the sole cost item in Extension programming. You are using many other supporting services and resources in the organization when you develop, deliver, and evaluate your program. The value of these other items is estimated under the following category.

b. All the organizational overhead expenditure: This includes your support staff time, specialists' time, administrators' time, buildings, equipment, traveling, printing, telephone, postage, etc. The calculation of the value of overhead expenditure by taking each of these cost components into account is extremely cumbersome and impractical. Therefore, Richardson's cost estimation method assumes the value of overhead expenditure associated with these cost items is almost equal to the value of an agent's time. For example, if the cost of an agent's time is $25.00/hour, then the value of organizational overhead would be $25.00/hour.

You need to add the above two values to estimate the total value of an hour spent in your program. For example, if the value of an agent's time is $25.00 per hour, then the total cost of one hour would be ($25.00+$25.00)=$50.

If you record the number of hours spent planning, developing, delivering, and evaluating

your program, you can use this hourly rate to estimate the total cost of your Extension program. For example, if the total time spent for program planning, development, delivery, and evaluation is 260 hours by the agent who is drawing a $40,000 annual salary, then the total cost of this program would be = ($50.00X260) = $13,000.00.

In addition to these two major cost items, there are some instances when you may have to include "extraordinary cost" as Richardson described. For example, if you provide participants meals and transport, and hire additional trainers such as consultants, these cost items are above your normal regular program cost. Therefore, if any of these "extraordinary cost" (John Richardson, 1997) items are involved in your program, then you need to include those values in your total cost. For example, if the cost of providing meals to 50 participants is $400, you need to add this when calculating your program cost.

Total program cost = $ 13,000+$400 =$13,400

6. How to Calculate the Benefit-Cost Ratio and ROI

Calculation of benefit-cost ratio or ROI is easy after calculating the total cost and benefits of your program. The following formulas can be used.

$$\text{Benefit-Cost Ratio} = \frac{\text{Value of Total Benefits}}{\text{Total Costs}}$$

For example, if the total value of benefits is $80,000 and the total cost of program is $13,400, then the benefit-cost ratio would be =($80,000/$13,400) = 5.97:1
That means every dollar spent in this program generates $5.97 in gross benefits.

$$\text{Return On Investment} = \frac{\text{Net value of Benefits}}{\text{Total Program Cost}} \mathbf{X}\ 100$$

Net value of benefits = value of total benefits – value of total cost
Net benefits for above example would be = $80,000 – 13,400 = $66,600

$$\text{ROI for above example would be} = \frac{\$66{,}600}{\$13{,}400} \mathbf{X}\ 100 = 497\%$$

That means every $100 invested in this program would generate $497 in net benefits.

Examples for Estimating the Benefit-Cost Ratio and ROI

Example for Agriculture Extension Programs

Soybean Population (Seed Rate) Reduction Program
This program teaches farmers to how to reduce the excessive use of seeds to achieve the optimum plant population in soybean cultivation.

Needed Data and Assumptions:

- Total acreage of soybeans planted and harvested with lower populations by the farmers who completed the program (If the soybean acreage is 20,000)
- Average reduction of seed used per acre (If the average reduction of seeds used is 17 pounds per acre)
- Average reduction of seed rate = (Average amount of seed used per acre before following the reduced seed rate – Average amount of seed used after following the reduced seed rate)
- Average price of soybean seeds (If the average price of soybean seed is $0.58/Pound)
- Average yield increase (If the average yield increase is 1.5 Bushels per acre)
- Average yield increase = (Average yield after following the reduced seed rate – Average yield before following the reduced seed rate)
- Average selling price of soybean (if the average selling price of soybean is $6.00/Bushel)
- Extension agent's annual salary (If your annual salary is $40,000, based on cost calculation described above, the value of your programming time would be $50.00/hour)
- Number of hours you spent planning, developing, delivering, and evaluating your program (If you spent 200 hours in this program, then the total cost would be = $50.00X200 = 10,000.00)

Cost Savings:

Impacts	Cost saving $/Acre	Value of Impacts $ (Cost savings per acre X Total extent)
Seed savings	(17X$0.58) = $9.86	($9.86X20,000) = $197,200.00
Total Cost Saving	$9.86	$197,200.00

Increased Income

Impacts	Income $/Acre	Value of Impacts $
Increased farm income	(1.5X$6.00) = $9.00	($9.00X20,000) = $180,000.00
Total Income	$9.00	$180,000.00

(Dumphy, 2007)

The value of total benefits of the program = (Total Cost Savings) + (Total Income)
= $197,200.00+ $180,000.00
= $377,200.00

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

Benefit-Cost Ratio of this program = $377,200.00/$10,000
= $37.72:$1

Benefit-cost ratio tells that every dollar spent in this program generates $37.72 gross benefit

to society.

$$\text{Return On Investment (ROI)} = \frac{\text{Net value of benefits}}{\text{Total Program Cost}} \textbf{ X } 100$$

Net value of benefits = (total benefits – total cost) = $377,200.00 - $10,000= $367,200.00
ROI = ($367,200/$10,000)100
= 3,672%
ROI tells that every $100 invested in this program generates $3,672 net benefit to society.

Tobacco Alternative Fertilization Program
This program teaches farmers how to use the liquid form of nitrogen fertilizer as a cost saving technique.

Needed Data and Assumptions:

- Total acreage of tobacco planted and harvested with alternative fertilization program (If the total extent of tobacco planted and harvested following this fertilization practice is 4,000 acres)
- Amount of nitrogen fertilizer needed per acre (If the needed nitrogen fertilizer is 50pounds per acre)
- Price of dry fertilizer mixtures (If the average price of dry fertilizer mixture is $1.40/Pound) (C. Fountain, personal communication, October 09, 2007)
- Price of liquid nitrogen fertilizer (If the average price of liquid nitrogen fertilizer is $0.33/Pound) (C. Fountain, personal communication, October 09, 2007)
- The cost of using dry fertilizer = (Price of dry fertilizer X amount of fertilizer needed per acre) = ($1.40X50) = $70.00
- The cost of using liquid fertilizer = (Price of liquid fertilizer X amount of fertilizer needed per acre) = ($0.33X50) = $16.50
- The average cost saving per acre = (Cost of using dry fertilizer – Cost of using liquid fertilizer) = ($70.00-$16.50) = $53.50
- Extension agent's annual salary (If your annual salary is $40,000, based on cost calculation described above, the value of your programming time would be $50.00/hour)
- Number of hours you spent planning, developing, delivering, and evaluating your program (If you spent 100 hours in this program, then the total cost would be = $50.00X100 = 5,000.00)

Cost Savings:

Impacts	Cost saving $/Acre	Value of Impacts $ (Cost savings per acre X Total extent)
Fertilizer cost savings	$53.50	($53.50X4,000) = $214,000.00
Total Cost Saving	$53.50	$214,000.00

The value of total benefits of the program = (Total Cost Savings)
= $214,000.00

The value of total benefits of the program = (Total Cost Savings)
= $214,000.00

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

Benefit-Cost Ratio of l4,000.00/$5,000.00
= $42.80 : $1

Benefit-cost ratio tells that every dollar spent in this program generates $42.8 gross benefit to the society.

$$\text{Return On Investment (ROI)} = \frac{\text{Net value of benefits}}{\text{Total Program Cost}} \textbf{ X } 100$$

Net value of benefits = (total benefits –total cost) = $214,000.00 - $5,000.00 = $209,000.00
ROI = ($209,000.00/$5,000.00)100
= 4,180%

ROI tells that every $100 invested in this program generates $4,180 in net benefits.

Swine Waste Management Education Program

Under the waste management program, farmers learn to use low flow techniques for reducing the amount of water waste as a cost-saving technique.

Needed Data and Assumptions(T. See, personal communication, October 08, 2007):

- Number of farmers adopted low flow watering techniques in their swine operations (If the total number of farmers adopted this technique is 15)
- Average size of swine operations (If the average size of swine operation is 1,000 breeder or topping animals per farmer)
- Average amount of annual waste per operation (Average amount of waste from an operation with 1,000 breeder or topping animals is nearly 90,027,000 gallons of the lagoon liquid per year.)
- Low flow technique reduces water waste by 10% (It will reduce 90,027,000X10/100 = 9,002,700 gallons of liquid waste annually from a farm with 1,000 breeder or topping animals)
- Average cost of managing swine waste (If the cost of managing swine waste is $0.03/ gallon of waste.)
- The amount of cost saving per 1,000 animal breeder or topping operation per year would be= (9,002,700X$0.03) = $270,081.00
- Amount of money saved by 15 farmers would be = $270,081.00 X15 = $4,051,215.00
- Extension agent's annual salary (If your annual salary is $40,000, based on cost calculation described earlier, the value of your programming time would be $50.00/hour)
- Number of hours you spent planning, developing, delivering, and evaluating your program (If you spent 200 hours in this program, then the total cost would be = $50.00X200 = 10,000.00)

Cost Savings:

Impacts	Cost saving $/1,000 animal breeder or topping operation	Value of Impacts $ (Cost savings per farm X number of farmers)
Waste management cost savings	$270,081.00	$270,081.00 X15 = $4,051,215.00
Total Cost Saving	$270,081.00	$4,051,215.00

The value of total benefits of the program = (Total Cost Savings)
= $4,051,215.00

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

Benefit-Cost Ratio of this program = $4,051,215.00/$10,000.00
= $405 : $1

Benefit-cost ratio tells that every dollar spent in this program generates $405 in gross benefits.

$$\text{Return On Investment (ROI)} = \frac{\text{Net value of benefits}}{\text{Total Program Cost}} \mathbf{X}\ 100$$

Net value of benefits = (total benefits –total cost) = $4,051,215.00-$10,000.00 = $4,041,215.00

ROI = ($4,041,215.00/$10,000.00)100
= 40,412%

ROI tells that every $100 invested in this program generates $40,412 in net benefits.

Example for Family and Consumer Sciences Extension Programs

Indoor Air Quality Education Program

This program shows participants how to prevent indoor air pollution and improve indoor air quality.

Needed Data and Assumptions:

- Number of participants improved their indoor air quality by cleaning carpets and avoiding smoking inside of their homes (If the total number of participants improved their indoor air quality by following recommended practices is 30)
- Healthy indoor air quality prevents and reduces asthma attacks. (If the total number of household members who have asthma among these 30 program participants is 3)
- The average cost of visiting the emergency room for an asthma attack (If the average expenditure for visiting the emergency room is $3,000.00/visit)

- The possible cost savings by preventing asthma attacks among 3 individuals would be at least $3,000.00 X 3 = $9,000.00
- Healthy indoor air quality reduces the potential for lung cancer and can increase the life expectancy of participants.
- According to the National Cancer Institute, the average medical cost per lung cancer patient in the first year following diagnosis is about $24,700 (2004 dollars)
- The potential for lung cancer is about 10% of people (Lung Cancer Alliance, n.d.)
- If improved indoor air quality reduces the potential for lung cancer by 50%
- Of the 30 participants who followed healthy indoor air quality guidelines, at least one individual (30 X 10/100 X 50/100 = 1.5) individuals will be able to prevent lung cancer.
- Potential cost savings by preventing one person from lung cancer would be = $24,700X1 = $24,700
- Extension agent's annual salary (If your annual salary is $40,000, based on cost calculation described earlier, the value of your programming time would be $50.00/hour)
- Number of hours you spent planning, developing, delivering, and evaluating your program (If you spent 100 hours in this program, then the total cost would be = $50.00X100 = 5,000.00)

Cost Savings:

Impacts	Cost saving $/Case	Value of Impacts $ (Cost savings)
Preventing emergency room visits	$3,000.00	$3,000.00 X 3 = $9,000.00
Preventing lung cancer	$24,700.00	$24,700.00
Total Cost Saving	$27,700.00	$33,700.00

The value of total benefits of the program = (Total Cost Savings)
= $33,700.00

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

Benefit-Cost Ratio of this program = $33,700/$5,000.00
= $6.74 : $1

Benefit-cost ratio shows that every dollar spent in this program generates $6.74 in gross benefits.

$$\text{Return On Investment (ROI)} = \frac{\text{Net value of benefits}}{\text{Total Program Cost}} \textbf{ X } 100$$

Net value of benefits = (total benefits –total cost) = $33,700.00-$5,000.00 = $28,700.00

ROI = ($28,700.00/$5,000.00)100
= 574%

ROI tells that every $100 invested in this program generates $574 in net benefits.

Healthy Lifestyle Education Program

This program teaches participants to practice a healthy lifestyle as a means of reducing the risk of chronic diseases such as diabetes and cardiovascular diseases.

Needed Data and Assumptions:

- Number of participants adopted a healthy lifestyle by changing their dietary and exercise habits. (If the total number of participants who improved their dietary and exercise habits is 40)
- Potential for getting diabetes among the population. (According to CDC, 8.2% of the population in NC have a chance of developing diabetes)
- Healthy lifestyle minimizes the potential for chronic diseases such as cardiovascular diseases and diabetes.
- A healthy lifestyle can decrease the development of diabetes among the high-risk groups by 71% (Net Wellness, 2006, para.4)
- Among the 40 participants, (40X 8.2/100 = 3.28) nearly 3 individuals have a chance of getting diabetes.
- As a result of adopting a healthy lifestyle, 71% of these three individuals (3 X 71/100 = 2) will be able to reduce the risk of diabetes. That means there is a great potential to prevent diabetes among 2 persons of the 40 people who adopted a healthylife style.
- According to the American Diabetics Association, "Per capita medical expenditures totaled $13,243 for people with diabetes and $2,560 for people without diabetes" (2003, para.3). That means a diabetic person would cost (13,243.00 - $2,560) = $10,683.00 additional amount of medical expenditure per year.
- The medical cost savings by preventing diabetes among 2 persons would be ($10,683.00 X 2) = $21,366.00/year.
- Average age of participants (If the average age of participants is 50 years)
- Life expectancy (If the life expectancy is 75 years)
- The potential medical cost savings by the two persons who prevented diabetes over 25 year period of their life would be ($21,366 X 25) = $ 534,150.00
- Extension agent's annual salary (If your annual salary is $40,000, based on cost calculation described earlier, the value of your programming time would be $50.00/hour)
- Number of hours you spent for planning, developing, delivering, and evaluating your program (If you spent 100 hours in this program, then the total cost would be = $50.00X100 = 5,000.00)

Cost Savings:

Impacts	Cost saving $/Person	Value of Impacts $ (Cost savings)
Potential per capita medical cost	$10,683.00	$10,683.00 X 2 = $21,366.00/year
Potential medical cost saving over the period of 25 years.		$21,366.00X25 = $534,150.00
Total Cost Saving	$27,700.00	$ 534,150.00

The value of total benefits of the program = (Total Cost Savings)
= $ 534,150.00

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

Benefit-Cost Ratio of this program = $ 534,150.00/$5,000.00
= $106.8 : $1

Benefit-cost ratio tells that every dollar spent in this program generates $106.8 gross benefit to society.

$$\text{Return On Investment (ROI)} = \frac{\text{Net value of benefits}}{\text{Total Program Cost}} \textbf{ X } 100$$

Net value of benefits = (total benefits –total cost) = $ 534,150.00-$5,000.00 = $529,150.00

ROI = ($529,150.00/$5,000.00)100
= $10,583 %

ROI tells that every $100 invested in this program generates $10,583 net benefit to society.

Example for 4-H Extension Programs

After school Program

This program teaches 4-H youths to develop their academic and social skills. Youths who participated in this program will be successful in their academic and social life.

Needed Data and Assumptions:

- A number of youths who participated in the program. (If the number of youths who participated in the 4-H program is 20)
- Annual high school dropout rate in North Carolina is 5% (NC State Board of Education, 2006, para. 1). That means there is a chance that 1 student (20 X5/100) out of every 20 students will drop out.
- The high school graduation rate of 4-H youths is 100% (University of Missouri, 2006, page 5)
- That means the 4-H after-school program helps prevent one student from dropping out of high school.

- "The average annual income for a high school dropout in 2004, according to the US Census Bureau, was more than $9,000 less than for a high school graduate (Docuticker, 2007, para 1).
- If the average age of entering into the labor market is 20 years, retiring at the age of 65 years, the economically active earning period is = 65-20years = 45years.
- The potential income saving by preventing one youth from dropping out over his or her economically active life period would be = $9,000.00 X 45 = $405,000.00
- Extension agent's annual salary (If your annual salary is $40,000, based on cost calculation described earlier, the value of your programming time would be $50.00/hour)
- Number of hours you spent for planning, development, delivering, and evaluating your program (If you have spent 100 hours in this program, then the total cost would be = $50.00X100 = 5,000.00)

Cost Savings:

Impacts	Income saving $/Person	Value of Impacts $ (Income savings)
Value of prevented potential income loss	$405,000.00	$405,000.00 X1= $405,000.00
Total Income Saving	$405,000.00	$405,000.00

The value of total benefits of the program = (Total Income Savings)
= $405,000.00

$$\text{Benefit-Cost Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

Benefit-Cost Ratio of this program = $405,000.00/$5,000.00
= $81 : $1

Benefit-cost ratio shows that every dollar spent in this program generates an $81 gross benefit to society.

$$\text{Return On Investment (ROI)} = \frac{\text{Net value of benefits}}{\text{Total Program Cost}} \mathbf{X}\ 100$$

Net value of benefits = (total benefits –total cost) = $405,000.00-$5,000.00 = $529,150.00

ROI = ($400,000.00/$5,000.00)100
= $8,000 %

ROI tells that every $100 invested in this program generates an $8,000 net benefit to society.

7. Is There Any Easy Way to Calculate Benefit-Cost Ratio and ROI?

The answer is yes. An Excel file (File name: Excel_Template_for_Cost_Benefit_Analysis) has been set up for you to calculate Cost-Benefit Ratio and ROI values. You need the following data for calculating the Cost-Benefit Ratio and ROI.

a. Your annual salary
b. Total hours you spent in planning, developing, delivering, and evaluating your program.
c. The value of program benefits. Your program may have benefits only for some of the listed categories above in this report.

You just need to insert your data into appropriate boxes in this Excel file. When you insert all the necessary data, this Excel file will calculate benefit-cost ratio and ROI for your program.

References

American Diabetics Association. (2003). *Economic costs of diabetes in the U.S. in 2002.* Retrieved October, 10, from http://care.diabetesjournals.org/cgi/content/full/26/3/917

Centers for Disease Control (CDC) (n.d.). *North Carolina - Total percentage of adults with diagnosed diabetes, 1994 – 2005.* Retrieved on October, 10, 2007 from http://apps.nccd.cdc.gov/DDTSTRS/Index.aspx?stateId=37&state=North%20Carolina&cat=prevalence&Data=data&view=TO&trend=prevalence&id=1

Docuticker, (2007). *The high cost of high school dropouts: What the nation pays for inadequate high schools.* Retrieved on October 15, 2007 from http://www.docuticker.com/?p=10489

Dumphy, J. (2007). *Impacts of work on soybean population.* Unpublished Power Point presentation. North Carolina State University in Raleigh.

Jayaratne, K. S. U., Lyons, A. C., & Palmer, L. (2007). *Financial education evaluation manual*. Greenwood Village, CO : National Endowment for Financial Education.

Lung cancer Alliance. (n.d.).*Lung cancer facts.* Retrieved on October, 10, 2007, from http://www.lungcanceralliance.org/facing/facts.html

NC State Board of Education. (2006). *NC dropout rate decreases in 2004-05.* Retrieved on October 15, 2007 from http://www.ncpublicschools.org/newsroom/news/2005-06/20060301

Net Wellness (2006). *Diabetics.* Retrieved on October, 10, 2007 from http://www.netwellness.org/healthtopics/diabetes/diabetesrisk.cfm

Phillips, J. J., & Phillips, P. P. (2002). ROI: *Providing a balanced viewpoint of program success.* Salt Lake City, UT: Jack Phillips Center for Research.

Richardson, J. G. (1997). *Extension program cost analysis AEE 97-03.* Retrieved on October, 7, 2007, from http://www.ces.ncsu.edu/AboutCES/Factsheets/progcost.html

The National Cancer Institute. (2005). *Cost of cancer.* Retrieved on October, 10, 2007, from http://progressreport.cancer.gov/doc_detail.asp?pid=1&did=2005&chid=25&coid=226&mid=

University of Missouri. (2006). *4-H youth future college within reach conference: 2006 Evaluation summary.* Retrieved on October 15, 2007 from http://4h.missouri.edu/programs/youthfutures/evaluation06.pdf