## Video Script: Cost-Benefit Analysis

Let's start digging into the methodology for the strategic assessment of banana research priorities. We are using Cost-Benefit Analysis as an overall framework to evaluate if it is worthwhile to invest in different banana research options. In general, Cost-Benefit Analysis, or in short CBA, is defined as a systematic process for calculating and comparing the costs of a project to the estimated benefits it will create. In the assessment all costs and benefits are expressed in monetary terms (in our case dollars) and are adjusted for the time when they occur - economists call this discounting.

The results of a CBA can be used in two different ways: first, they help us determine if an investment in a certain banana research line is financially sound. This means that we need to justify the investment of scarce research funds by showing that the value of benefits created sufficiently exceeds the costs incurred. Second, the results of the CBA serve as a basis for comparing two or more different banana research options to ensure money is invested in the best way. In order to rank different investment options we need to define the indicators to be used. The two most important indicators produced by a CBA are the Net Present Value and the Internal Rate of Return. The Net Present Value (or short NPV) represents today's value of the net benefit of an investment while the Internal Rate of Return (or short IRR) is the interest rate earned on the research investment.

The Net Present Value is calculated by deducting the estimated costs from the anticipated benefits for a certain time into the future - in our case the assessment period is 25 years. The result is a net benefit stream, which is negative initially since research and extension costs typically occur at the beginning of the project and before benefits arise. In order to compute the NPV, net benefits are then adjusted for the time when they occur. That is, in economic terms, they are discounted to a present value and then added up. If the Net Present Value of a banana research option is positive, it is a financially viable and profitable investment.

But why is it crucial to adjust costs and benefits for the time when they occur? Time affects economic values and a dollar available now is more valuable than a dollar available in the future. This is because we are impatient and will always value having something right now higher than having the same thing later - assuming it is something with a positive value, like this Minion who is excited about eating a banana rather sooner than later. The reverse holds true for costs - we would rather delay paying a bill. Another way to explain this is that we have the option to either spend a \$ we have today or "earn" money through investing it for example by depositing it in a bank account (or loaning it to somebody) and being compensated by receiving interest. As a result, we will have more than the initial amount after some time has passed. How much more we will have after for example a year's time, depends on the interest rate, the rate that is paid or charged for the use of money. For instance, if we deposit $\$ 100$ in a bank account today at $5 \%$ annual interest - we will have $\$ 105$ next year (our initial $\$ 100$ plus $\$ 5$ of interest earned). This is why $\$ 100$ available in the future is less valuable than $\$ 100$ today. This means that the further in the future benefits from our banana research arise, the lower their equivalent present value and the less they are valued in our assessment. These present values of future benefits are lower the higher the interest rate is.



Let's explore how this adjustment for time influences the Net Present Value of a project in practice. Imagine three banana research investments: let's call them projects A, B, and C. Even though all three projects incur different absolute amounts of costs and benefits, their Net Present Values are the same. How can that be? The costs of project A accrue at the beginning of the assessment period while benefits are only realised far in the future. This is typical for example for investments in banana breeding which takes a long time. In contrast, project B yields fewer benefits but they occur earlier while costs are the same and follow the same pattern than for project A. For instance, this could be the case for a project that focuses on multiplying and disseminating existing improved genetic material. For project C, finally, costs are equally spread over the entire assessment period while benefits occur at the same time than those in investment A. This can be a typical pattern for improved crop or pest management research, which requires on-going investment in extension services to disseminate the knowledge to a large number of small-scale banana producers to realize benefits. As you can see, the absolute amounts of costs and benefits of all three projects differ, but the net present values are the same, due to the timing of costs and benefits. This example illustrates that benefits and costs that occur later in the assessment period have lower present values and thus carry less weight when computing NPVs than benefits or costs occurring earlier.

The second important CBA outcome variable is the Internal Rate of Return, or IRR. It is defined as the discount rate at which the Net Present Value equals zero meaning that the present value of costs of our research would exactly equal the present value of the resulting research benefits. Thus, it is the discount rate at which the research investment breaks even that is to say all costs are covered. How can we use the IRR as an indicator to assess projects? Basically, the IRR is the interest rate earned on the research investment and can be compared to other interest rates such as the returns earned in other investments or the interest earned when depositing money in a bank account. Hence, the research project is a good investment if the IRR exceeds these other interest rates. In general, the higher the Internal Rate of Return of a banana research project, the more desirable it is to undertake this project.

Now that we have described the methodological framework for assessing banana research priorities, let's continue with a more detailed look at the steps we carried out to estimate benefits and costs of each of the banana research options included in our assessment.


## Cost-Benefit Analysis



Cost-Benefit Analysis (CBA)


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## Internal Rate of Return (IRR)

'Discount rate at which the Net Present Value equals zero'

'Discount rate at which all costs are covered'



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