

## Tradeoffs and Climate Change with Case Study

Now we're going to talk about trade-offs and optimization. How do you confront trade-offs in light of climate change? Well, you've already learned how to do multiple different ways of trade-offs, whether there's multiple objectives or single objectives. And you've learned about optimization or other techniques for doing a trade-off.

What if uncertainty is preventing the consideration trade-offs? The decision makers or the other participants may be hesitant to engage in a trade-offs assessment if there's still substantial uncertainty about the consequences of management actions.

What might be done? Well, the authors of Gregory, et al, they recommend two different situations. One is if the uncertainty is about facts, there are few different things you could do. The first, you can conduct a sensitivity analysis to clarify just how much various aspects of the performance might change under different assumptions about those uncertain qualities. Secondly, you can identify robust alternatives. We mentioned that before. So, if those haven't already been developed, you can consider adding those to the set of alternatives under consideration.

Third, you can develop adaptive alternatives. So those might bundle monitoring programs in with the management alternatives. So in that case, the participants would agree to potentially a preferred alternative based on an understanding that the key uncertainties could be monitored over time. And there would be timelines that are established that would trigger these institutional mechanisms for them to come back and have collaborative review of the monitoring data and reconsideration of the management decision. And we'll talk more about adaptive management in the next module, but there might also be decisions where you would want to develop an alternative that's explicitly experimental, where you're designing an alternative that increases your opportunities to learn over time.

And fourth, they recommend carving out a no-regret action that can be implemented immediately from a broader alternative, and then to find a plan for reducing uncertainty on the outstanding elements over time. So that's like saying, if there is one step that might be taken under multiple alternatives, or there's one step that you know that you could take that would not be dependent on reducing some uncertainty, you could go ahead and take that step, and say while we're doing that, we will monitor or reduce some of the other uncertainties. And then find out what it is to do branching out from there, whether to go in direction A or direction B, , or whether we need to rethink the strategy.

That in business circles is often referred to as the "keeping your foot in the game" strategy. You're still taking some initial option and action and you're not reducing your options, but you're keeping those open to where then you can follow through with the full action once you've reduced some of the uncertainty and you know how the system is responding to those actions.

So those are if the uncertainty is about the facts. Well, what if the uncertainty is about values and about how much weight should be placed on certain objectives? First, you could conduct a sensitivity analysis on the weights that are assigned to those measurable attributes and test

whether that changes the ranks of the alternatives. So, what would be the implication of changing the weight on this fundamental objective a little bit more than on that one, and with that change, the preferred alternative or not?

Second, you could conduct a critical-value analysis. Sometimes this is called a switch-over analysis. This analysis tests how high or how low an uncertain measurable attribute would have to go before your choice of preferred alternative would change. It works backwards from the decision. It asks, at what value, at what weight, would you have to place on this objective for it to actually switch the decision. Often, not always, but often, this will show you that additional predictive modeling is not necessary. It won't actually be useful, because it wouldn't actually switch the decision in this context.

So, those are few pointers about what you might want to do if there's still remaining uncertainty about values or facts that is an obstruction to participants and decision makers moving forward into the trade-offs phase. Then you can use the suite of tools that are available to you that you learned through the other videos with Mike [INAUDIBLE] and Sarah Converse. With climate change related decisions, you're often trading off a short-term benefit for a long-term benefit or the short-term benefit for long-term risk or something associated with that. So, it's important to make sure that your measurable attributes capture the time horizon that you're associating your decision with, and that you're able to determine the differences in benefit across the time that you care about.

Now let's go back to Southwest China. OK. So, we found out that [INAUDIBLE] is willing to spend a little extra time and money right now to see if he can improve yak health and to reduce the risk of certain diseases and parasites. So what did we learn from this? We learned that initially, there were lots of different alternatives. As we explored those further and we clarified the meaning around them, we found out that some either were not a feasible option, or they contained a risk that was too great to the decision maker, or they did not perform as well on achieving the objectives that were at hand; therefore, the short or the long-term benefit.

So, [INAUDIBLE] decided that he would like to pursue an adaptive approach, where he is spending a little bit of his time and money now to see if he can improve the health of his livestock. [INAUDIBLE] will work with the local vet and the other animal husbandry bureau officials to understand how to improve yak health. This may involve developing some techniques to monitor when they're getting sick, ways to tell their temperature and find out when they may be running risk of exposure to heat, or other indicators of yak sensitivity to environmental changes and physiological changes. [INAUDIBLE] was able to see more clearly the options that were available to him, to understand what he's really striving for both now and in the future, and find a new way to achieve those objectives.

Thank you for this time. These are some tough decisions, and it's helped me think about some options that I had not thought about before. But I'm willing to do what I can to help my family, so thank you.