3.8.0

SERIES 3
Building Resilience

MULTI-CRITERIA ANALYSIS

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Contents of Set

Multi-Criteria Analysis (MCA) is a simple yet systematic tool for prioritizing one option from among many when there are a number of different criteria influencing your selection. It provides a framework for assigning numerical values to both quantitative and qualitative actions with respect to how they address a list of specified criteria. Numerical scores assigned to actions via MCA can be useful when justifying selection of a particular action to a reviewer outside the selection process.

IN THIS SET YOU WILL:

- ✓ Be introduced to Multi-Criteria Analysis as a tool for prioritizing resilience actions;
- ✓ Design and use a simple multi-criteria analysis matrix to rank potential resilience project; and
- ✓ Articulate the limitations of the ranking and why selection of an option based on the ranking alone might not be a good idea.

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Overview

Multi-Criteria Analysis is a tool for selecting or ranking alternatives when there are multiple criteria influencing your selection. It is particularly useful in situations where a decision maker or decision group contemplates a choice of action in an uncertain environment. The decision making process often relies on information about multiple alternatives, and the information itself can range from scientifically-derived hard data to subjective interpretation, from certainty about decision outcomes to uncertain outcomes represented by probabilities. Comparing across alternative and evaluating one set of information relative to another becomes highly problematic when there is no clear basis for comparison—it becomes much like comparing apples to elephants.

Multi-Criteria Analysis avoids direct comparison by first establishing a "goal"; for the purposes of this training series, the goal is increasing citywide resilience. Within this, you might select a sub-goal, such as increasing the resilience of women headed households within a certain community. Then, for that goal, identify a set of criteria that can be used to assess whether different options achieve or contribute to that goal. The criteria must be measurable—even if the measurement is performed only at the nominal scale (yes/no; present/absent)—and a value for each criterion must be provided for every alternative. The values assigned to each criterion are called the "Criterion outcomes". For each alternative, the criterion outcomes are combined to provide the basis for comparison of alternatives and therefore determine the selection of one alternative over others.

In application, criterion outcomes for each alternative are collected in a table (See Table 3.8.1 on next page). The table columns represent the alternatives (e.g. one column for each proposed resilience actions or adaptation project); table rows represent criteria (e.g. resilience principles, statutory requirements, requirements posed by funders, cost, environmental impact, etc.). Values found at the intersection of each row and column in the table represents a criterion outcome—a measured, predicted or estimated assessment of how that alternative will perform with respect to that criterion. Structured in this way, the decision matrix compiles and presents the data for comparison of alternatives.

Table 3.8.1: Example multi-criteria analysis matrix from Surat, India.				
	Flood awareness raising, building safe-houses	Raising height of dikes by 0.3 meters	Relocating vulnerable community	City develops and enforces new limits on floodplain development
Inclusion of Vulnerable Groups in Process	4	2	1	2
Technical Feasibility	5	5	5	5
Cost known (1=high cost; 5= low cost)	4	1	3	5
City management and capacity	4	5	2	4
Generates New Knowledge (5=yes; 0=no)	5	0	5	5
Total Score	22	13	16	21

Index: 1-5, 1 = least desirable, 5 = most desirable

Table 3.8.1 provides an example matrix from Surat, India developed in 2010 as part of the ACCCRN initiative. The city's goal is to increase resilience by reducing the impacts of flooding. In this example, the city was evaluating which of the identified possible actions are best across a range of criteria. Criteria include whether the city has the management structures and capacity to implement proposed actions, whether the actions address the needs of vulnerable groups, and cost. Actions are scored from 1-5 for each criterion, with high numbers being more desirable than lower numbers. An overall low score, therefore, indicates a less desirable action. The low total score assigned to "Raising dike heights" might suggest it should be removed from the list of projects under active consideration, while the similar, higher scores assigned to the other three activities might be used to justify including all three in an 'Adaptation Activities to Address Flooding' proposal package.

DISCUSSION

Though the basic approach to decision matrices is straightforward, depending on the alternatives being evaluated and/or the criteria used for evaluation, there can be challenges in a systematic application. For example, if different criteria are contradictory or not easily comparable, it may be difficult to assign them numerical values. In this case, a yes/no scoring or a present/absent scoring may be needed.

Alternate scoring may also be desirable when one criterion is deemed more important than the others. In the example, criteria were scored from 1 to 5, with 1 being the least desirable and 5 being the most desirable. However, in broader application, it could be that technical feasibility will simply make a project viable or not, and should therefore be given more weight such that the difference between technically feasible and technically unfeasible projects is reflected more strongly in the scoring. There are a number of ways this could be done, such as by specifying a minimum value for the criterion e.g. 3 to 5, or by double-weighting the criterion ((1 to 5)*2), Both of these approaches have the advantage of preserving the 1 to 5 scoring scale, making it simpler to see what is being compared.

Determining when a criterion should be given extra weight and how that extra weight should be applied is, unfortunately, something that will depend on the issues surrounding the criterion. In general, the criterion weight should reflect how important it is to meeting the stated goal, how it impacts failure, political and/or social values, etc. However, as noted above, if a project is technically infeasible, ultimately it does not matter how strongly it is scored in other areas; it simply cannot be implemented.

Overall, the strength of Multi-Criteria Analysis for resilience planning work is that it supports the inclusion of subjective criteria in the evaluation and scoring of alternatives. Inclusion of criteria such as gender equality, for example, are of particular interest when designing projects that are to be truly sustainable and resilient. However, ranking these based on an associated quantitative measure, e.g. number of individuals impacted or average increase in annual wage for impacted individuals, can be difficult or impossible. By including a subjective score, which could be obtained for example by surveying the populations that would be impacted, we can assign a quantitative value to a non-quantitative activity.

Summary

Strengths of the Multi-Criteria Analysis approach to decision-making include:

- Provides a single number for each alternative by which alternatives can be compared.
- Makes alternative selection relatively transparent by providing a numerical "score" which can be pointed to in justifying selection.
- Provides a non-monetary basis for judging relative value of different activities.

Weaknesses of this methodology include:

- There may be compelling reasons why the highest scoring proposal should not be selected (e.g. politically unfeasible).
- Criteria weights and scores can be subjective. Different experts may have different opinions, and actual results may be different from the perceived outcomes.

For additional information on Multi-Criteria Analysis:

- The Center for International Forestry Research's Guidelines for Applying Multi-Criteria Analysis to the Assessment of Criteria and Indicators
- The Queensland Department of Natural Resources and Water Technical Document 10: Multi-criteria Analysis