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RESEARCH QUESTIONS AND METHODOLOGIES
For a Biodiversity and Development Research Agenda

February 2016

Research tests key assumptions and development hypotheses to enhance the evidence base of USAID's biodiversity and development programming.

I. DEVELOPING A RESEARCH QUESTION

A research question is a refinement of a research problem or idea generated from field experience, a review of the literature, or an existing theoretical framework.

A good research question identifies clearly what the research will explore. An *operationalizable* research question provides a link between the statement of a research problem and its translation into a study design. Operationalizing a good question also includes developing testable hypotheses.

FOUR QUALITIES OF GOOD RESEARCH QUESTIONS

1. Ethical – poses no risk or harm to the research subjects
2. Clear – yields outcome of interest to the intervention and other measurable factors of interest
3. Feasible – presents a study design and analysis that can be operationalized
4. Significant – answers the research question in a way that would make a meaningful contribution to the existing body of knowledge

HYPOTHESIS: A hypothesis addresses the research question and conveys an expectation about how two or more variables relate to each other. A well-written hypothesis should be specific and testable.

FOUR COMPONENTS OF GOOD RESEARCH QUESTIONS

1. Subject or population to be assessed
2. Variable or mechanism of interest
3. Intervention or treatment and other factors of interest
4. Expected correlation or causal pathway

Credit: Alena Stern

SAMPLE RESEARCH QUESTIONS

Example of a weak research question: *How do biodiverse ecosystems impact human health?*

- This question is vague and not readily operationalizable.

Example of a strong research question: *Are residents of communities near areas with a higher percentage of forest cover more likely to have a diverse diet compared to residents of communities near areas with a lower percentage of forest cover?*

- This question is strong because it is relevant, clear, focused, and operationalizable in its specification of both the environmental variable and human health indicator of interest. The question allows researchers to generate a testable hypothesis, design the study, and plan the analysis. An added strength is that it addresses an important gap in the empirical literature.

Example of a weak hypothesis: *Forest cover plays an important role in the dietary diversity of nearby communities.*

- This hypothesis lacks specificity in several aspects, including: What is the direction of the relationship? What is the mechanism through which forest cover and nutrition are related?

Example of a strong hypothesis: *Biodiverse environments (with higher-density forest cover) will have comparatively better capacity to provide humans with food-based ecosystem services compared to non-biodiverse environments (with lower-density forest cover), because people living in communities near the forests can access more food resources more efficiently.*

- This hypothesis highlights the direction of the relationship between forest cover and human nutrition, and it describes the pathway through which forest cover is expected to impact human nutrition.

II. RESEARCH METHODOLOGIES

A range of research methodologies can be used to support the Agency's evidence-based programming, including: **systematic reviews and meta-analyses, secondary data analyses, impact evaluations,** and **primary data collection.**

A. SYSTEMATIC REVIEWS AND META-ANALYSES

In the last 20 years, knowledge of conservation practices has grown significantly, as exemplified by the growing rate of publications in scientific peer-reviewed journals (Pullin et al., 2004). However, systematic testing of underlying assumptions and evaluation of the effectiveness of common conservation practices is lacking (Stewart et al., 2005).

A systematic assessment of conservation practices is required to identify which approaches work, which do not, and under what conditions (Pullin & Knight, 2001). This will support evidence-based conservation (Sutherland, 2000) and the effective allocation of resources (Groves, 2003).

Where a sufficient body of knowledge exists, literature reviews can help synthesize information. In such circumstances, rigorous research methodologies such as systematic reviews and meta-analyses can be implemented to assess the quality of the information, identify gaps, and empirically test common interventions in biodiversity conservation and development programming.

Protocols for the systematic identification of studies, assessment of methodological rigor, and scientific assessment of interventions have been pioneered by the medical and social sciences (Pullin et al., 2004). The Cochrane Reviews, considered the gold standard for evidence-based health care, are systematic reviews of research on health care and health care policy, testing the effectiveness of prevention, treatment, and rehabilitation practices (The Cochrane Collaboration, 2013b).

In the field of conservation, the Center for Evidence-Based Conservation at Bangor University, and the Collaboration for Environmental Evidence have adopted a similar approach to synthesizing and assessing information and evaluating the effectiveness of environmental management interventions and the impact of human activities on the environment.

SYSTEMATIC REVIEWS

- Data are compiled from published work (e.g., articles in peer-reviewed journals), unpublished reports, papers, and datasets through automated searches, followed by assessment of the methodological rigor of the sources based on a set of inclusion criteria (Stewart et al., 2005).
- Information is obtained through key informant interviews with stakeholders and program managers.
- Data are extracted and weighted by quality to assess the effectiveness of an intervention; results are disseminated to communities of practice and policy circles (Stewart et al., 2005).

META-ANALYSES

Meta-analyses and systematic reviews often are used interchangeably; however, they are different methodologies. A meta-analysis includes two stages:

1. Data are extracted from each study to calculate a summary statistic and confidence interval for that study.
2. An estimated weight of those results is formulated.

Some systematic reviews do not include a meta-analysis because the data are unavailable or not appropriate (Mulrow, 1994; The Cochrane Collaboration, 2013a).

Examples of the scientific evaluation of common practices and underlying assumptions in conservation programming include systematic reviews on:

- Gender and forest and fishery resources (Leisher et al., forthcoming)
- The impact of climate-related drivers of habitat loss (Mantyka-Pringle et al., 2012)
- The contributions of plant and animal biodiversity to human diets (Penafiel et al., 2011)
- The effects of land tenure on deforestation (Robinson et al., 2011)

B. SECONDARY DATA ANALYSES USING DATASETS THAT COVER LARGE GEOGRAPHIES

- U.S. Government investments in remotely sensed data, geospatial data, and other datasets can be leveraged for long-term biodiversity monitoring (Turner et al., 2003) and to conduct secondary data analyses that empirically test priority research questions in biodiversity conservation and development.
- Results of secondary data analyses can provide scientific evidence of the contributions of biodiversity conservation to other sectors and the impact of other sectors on biodiversity outcomes. Results of secondary data analyses can help make the case for integrated programming and point to target geographies and subgroups on which to focus conservation and development resources.
- Secondary data analyses that incorporate remotely sensed data provide information that is valid across different geographic and political contexts, and they are unaffected by sampling error (Carroll et al., 2013). These analyses, however, can be limited, depending on their spatial and spectral resolutions. (Turner et al., 2003).
- Remotely sensed data combined with other data such as household and agricultural surveys can help empirically test the contribution of biodiversity to development objectives in global health, food security, and global climate change.

Georeferenced population and health data from large-scale household surveys have been used with remotely sensed data to evaluate the linkages between protected areas and child health, nutrition, and food security (Aswani & Furusawa, 2007; Gjertsen, 2005; Johnson et al., 2013; Mascia et al., 2010).

Secondary analyses linking temperature and precipitation data to land-use data have been used to demonstrate the potential impact of climate change on the spread of malaria (Ermert et al., 2012).

C. IMPACT EVALUATIONS

- Impact evaluations test the extent that changes in biodiversity outcomes can be attributed to a given program or intervention after controlling for confounding factors (Baylis et al., 2015; USAID, 2012).
- Impact evaluations need to be planned at the project design stage and should aim to identify program impacts under different ecological and socioeconomic contexts and carry-over effects into non-program areas (Miteva et al., 2012).
- Impact evaluations of common biodiversity conservation strategic approaches, such as payment for ecosystem services, establishment of protected areas, and decentralized community-based natural resource management, remain limited.
- Impact evaluations can be implemented by using an experimental (e.g., randomization) or a quasi-experimental design (e.g., statistical matching, instrumental variable techniques, and difference in difference approaches) (Pattanayak, 2009). The latter is a more common approach in the biodiversity literature (Miteva et al., 2012).
- Empirical evaluations of program impacts are usually designed and implemented in one of two ways:
    a. Comparing program and non-program areas that share similar biophysical and socioeconomic and geopolitical characteristics that otherwise would influence the biodiversity outcome of interest; or
    b. Conducting a before-and-after analysis of an area where a biodiversity program was implemented, providing there was no selection bias in identification of the program area.
- Unbiased impact evaluations are challenging to design and implement because core assumptions of comparability across sites or through time are often violated (Miteva et al., 2012). For example, protected areas can be established in areas that are remote, less profitable, and less likely to be threatened (Joppa & Pfaff, 2010), thereby introducing selection bias.
- Results of impact evaluations can help support evidence-based programming. Impact evaluations can shed light on the circumstances under which a programmatic approach (e.g., direct payment for the protection of biodiversity) is effective – for which species and under what types of property regimes and governance (Clements et al., 2013) – thereby guiding the design and implementation of future programs.
- Results of impact evaluations can highlight positive and negative externalities of biodiversity programs, such as the alteration of social norms (Van Hecken & Johan, 2010). By illuminating the causal pathways in which programs impact biodiversity, the results of impact evaluations can guide future data monitoring and collection (Miteva et al., 2012).
- Results of impact evaluations can be supplemented with panel data estimates, interviews with program participants and program officers, and project document reviews (Vaessen & Todd, 2008; Woodhouse et al., 2015).

Credit: Daivde Matua

D. PRIMARY DATA COLLECTION

- Where no high-quality comprehensive reviews of the evidence around a particular topic exist, biophysical, environmental, and socioeconomic datasets can be used to test hypotheses if their spatial and temporal extents are sufficient.

- Where data are available, impact evaluations that rely on quasi-experimental design can help determine causal linkages.

- Some priority research questions require primary data collection such as field experiments. Depending on the research question, primary data collection may be small-scale and short-term, or it may require more long-term investments to monitor and collect data. The choice of research methodology depends on the research question, existing body of knowledge, availability and quality of existing data, and available resources.

- Various primary data collection methodologies support biodiversity conservation and development programming, such as habitat and household surveys, ethnographies, key informant interviews, community mapping, and species assessments (Hill & Upchurch, 1995; Russell & Harshbarger, 2003).

This publication was prepared for review by the United States Agency for International Development. It was prepared by Environmental Incentives, LLC, Foundations of Success, and ICF International.

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