Knowledge Broker Support Program

Volume 2 – Knowledge Broker Tools – Causal Loop Analysis module

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Cover photo: Knowledge broker in action. Photo by Tom Greenwood, 2017. Photo below by Seona Meharg.

Causal Loop Analysis

This module will explore the following:

1. **What causal loop analysis is and its strength in helping to understand the dynamics of complicated and complex systems**
2. **Why use causal loop analysis to understand systems dynamics**
3. **How to use causal loop analysis to assess the impacts of drivers of change, including climate on systems**

What is causal loop analysis?

Causal loop analysis is a strong tool to help understand the dynamics of complicated and complex systems.

Causal loop analysis allows you to assess qualitatively any complicated or complex systems within defined boundaries. The key strength of this tool is that it brings together stakeholders with different values, worldviews, and priorities and takes a systems view of the problems that they are aiming to address (Butler, J.R.A., 2017; Department of Home Affairs, 2019).

> A system is defined as 'a set of interdependent parts, connected through causal relationships, which together express a structured function or purpose'.
>
> – (Groundstroem, F., & Juhola, S., 2021)

As you have seen in the Systems Thinking Module, the complexity of problems faced depends on:

Content Complexity

- The decisions to be made are complex. The problems are 'multidimensional'. They are interrelated and have feedback mechanisms, in which an event or issue is related to another in a way that the more the first changes the more the other one becomes acute or improves. Vermaak, H. (2016)
- It allows you to better identify and address problems affecting your system of interest

Process Complexity

- Many stakeholders are involved in the problem, and they have different viewpoints, values and objectives. Stakeholders often struggle to collaborate to co-create solutions. Vermaak, H. (2016)
- It allows stakeholders involved in the process to increase their understanding of the system, its components and feedback thus increasing their systems thinking competencies.

Photo by Tom Greenwood

MANGROVE EXAMPLE

An example where content and process complexity play out is mangrove clearance. This provides income for harvesters and building material for homes but destroys nursery for marine species reducing income for fishermen and results in coastal erosion potentially damaging / destroying infrastructure (content complexity). Without alternative building materials or incomes for people harvesting mangroves, stakeholder will struggle to develop solutions (process complexity).

To really understand the system of interest (e.g. a particular value chain or a fisheries system), you have to understand it as a whole, and then examine the connections between the different parts and how these perform, and the complexity of the networks connecting them.

Example: In systems such as value chains, which include very diverse actors and which can be geographically and temporally distant, climate change impacts can couple with several other drivers of change in the system and have cascading effects throughout the network. Think of the recent COVID-19 pandemic and how several of our much-loved items on the supermarket shelves are now missing since the producers in far countries have not been able to go fishing, or work in the farm, while the truck driver could not deliver the product to the ship, and so on.

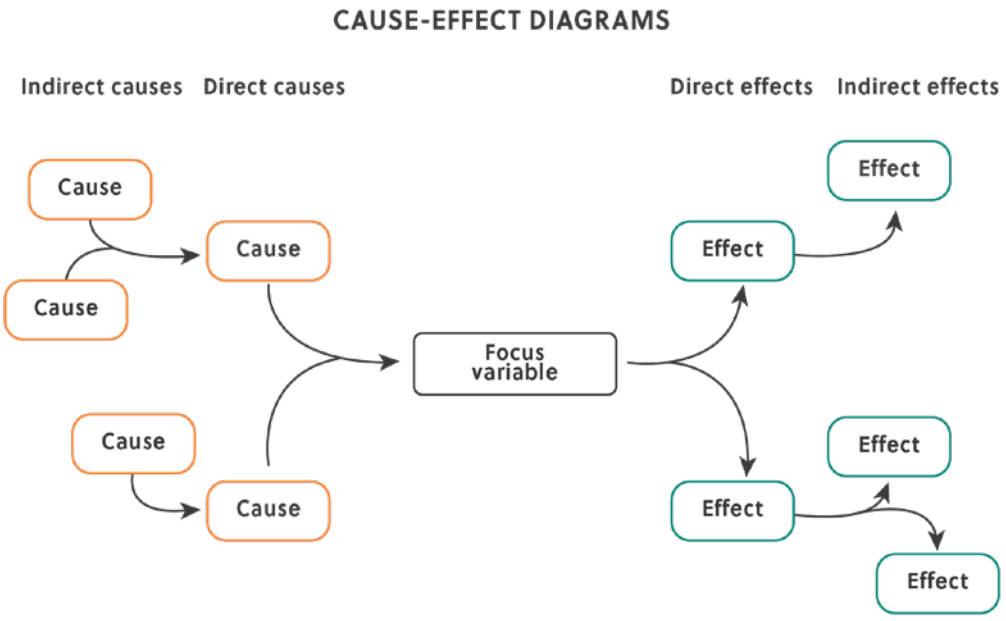

Figure 52 Causal loop – cause-effect diagrams. Source: Australian Government, Department of Home Affairs. 2019. Climate and Disaster Risk: What they are, why they matter and how to consider them in decision making. 3 Guidance on Vulnerability CC-BY-4.0

Why use casual loop analysis to study systems' dynamics?

As outlined in the module on Systems Thinking, the world is changing faster than ever before and uncertainties about the systems we live in are growing. Causal loop analysis is a strong participatory yet easy to use tool which is used to:

- take a systems approach to describe and assess the complex systems you live and work in
- identify key interventions points
- build the capacity of participants in system thinking

Causal loop analysis can support decision-making in your projects at both content and process levels.

Causal loop analysis is a very effective tool that allows you to:

- consider the complexity of the examined system
- study it systematically and interactively
- find feedback mechanisms and explain why some issues tend to persist despite efforts to address them
- identify points in the systems where a solution can be applied with a higher likelihood of success

How to undertake causal loop analysis

In a causal loop analysis, participants break down a problem from a systems perspective. This powerful tool has four key steps, including identifying (i) an issue, (ii) the direct and indirect impacts, (iii) the root causes (direct and indirect) of the issue, (iv) feedback loops (positive and negative), and (v) key intervention points needed to change the system (Butler, J.R.A. 2017)

Step 1: Identify the key issues and their impacts

Before starting the causal loop analysis, participants at the workshop identify key issues that are barriers to the sustainable functioning of the system and decrease its resilience to drivers of change.

Usually participants are then divided in groups. Each group is given an issue.

Each group then considers the direct and indirect impacts of the issue and their linkages.

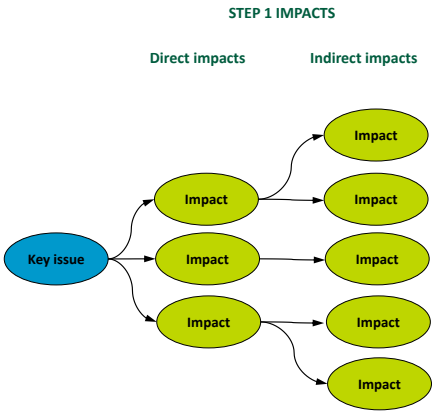

Figure 53 Template for considering the direct and indirect impacts of an issue and their linkages

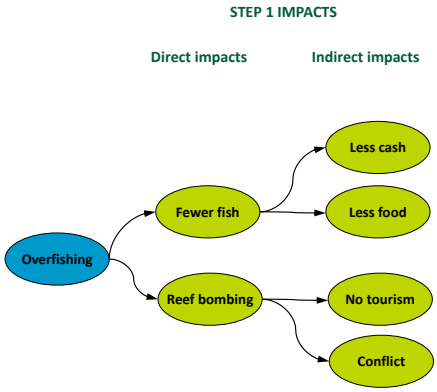

Figure 54 An example of overfishing as an issue in a system of small-scale fisheries

Step 2: Identify their causes

In the second step, each group investigates the direct and indirect causes, and their linkages. The causes of a key issue are also called controlling variables. The controlling variables influence the system. By identifying and targeting the controlling variables you can create change in the system.

You may not always be able to change the controlling variables, but you can look for opportunities to intervene that reduce the effect of controlling variables.

Without understanding the issues and their root causes – both their direct and indirect causes – you can often design activities that don't address the issue.

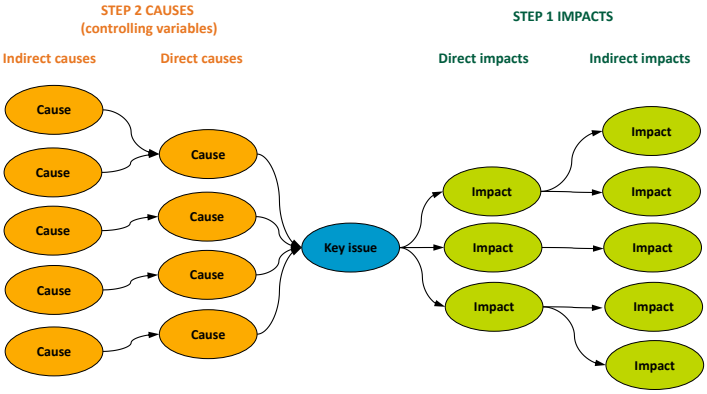

Figure 55 Template for considering the direct and indirect issues and causes of an issue and their linkages

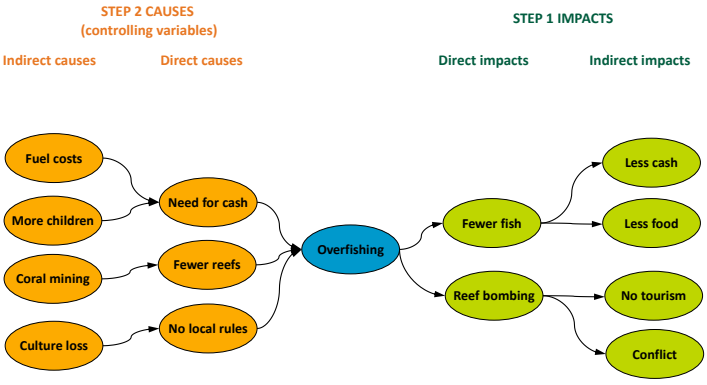

Figure 56 An example of overfishing as an issue in a system of small-scale fisheries

Step 3: Identify feedback loops

In the third step, each group considers feedback loops between impacts and causes. A feedback loop is a chain of cause and effect forming a loop that can either amplify or dampen the effects of change. For example, poverty can be reinforced by feedback loops – poverty leads to poor health, which leads to unemployment, which leads to greater poverty.

- Positive feedback loops amplify the cause or impact
- Negative feedback loops dampen the cause or impact

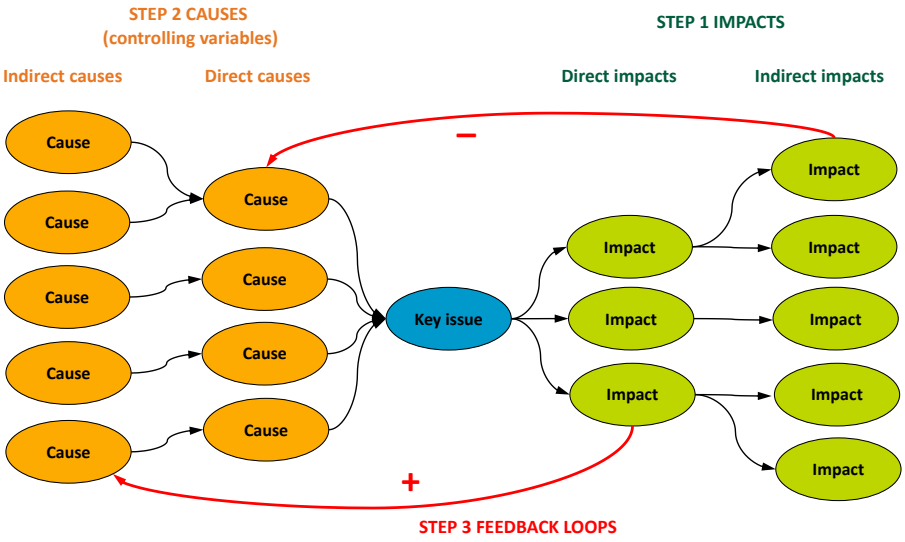

Figure 57 Template for considering the positive and negative feedback loops

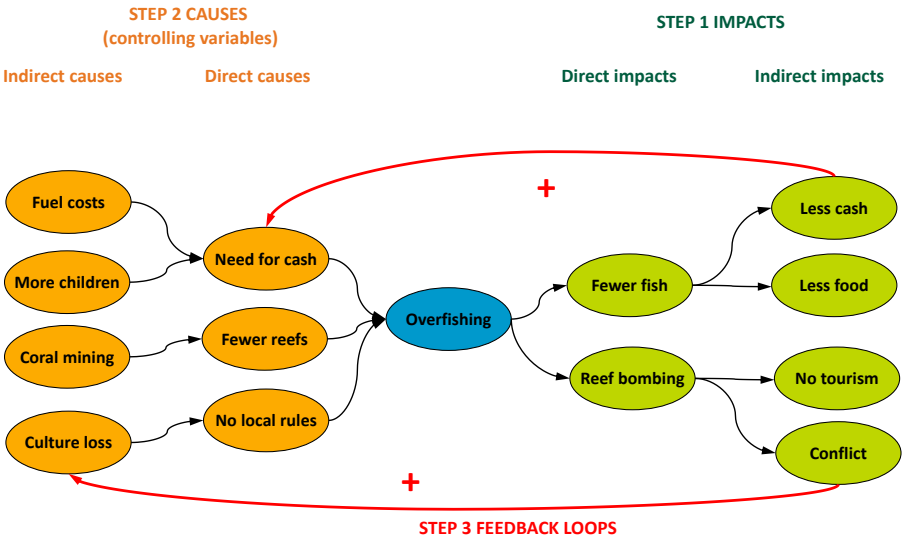

Figure 58 An example of overfishing as an issue in a system of small-scale fisheries

Step 4: Identify interventions

In the fourth step, each group designs interventions to intervene in the 'positive and negative cycles' created by the feedback loops. An intervention is any action that is planned or that is made in a system.

Interventions can be made that target the direct causes. However, to really address the key issues, we often need to find interventions that target the indirect causes. This often requires work with and partnering with a diversity of organisations.

In the fisheries example interventions include:

- Introducing local management of fisheries,
- Restoring culture, and
- Family planning.

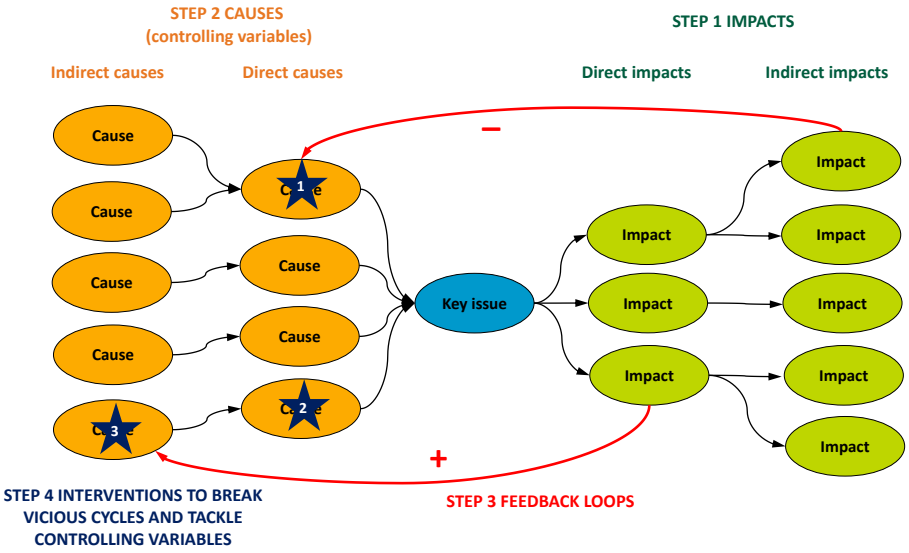

Figure 59 Template for considering interventions

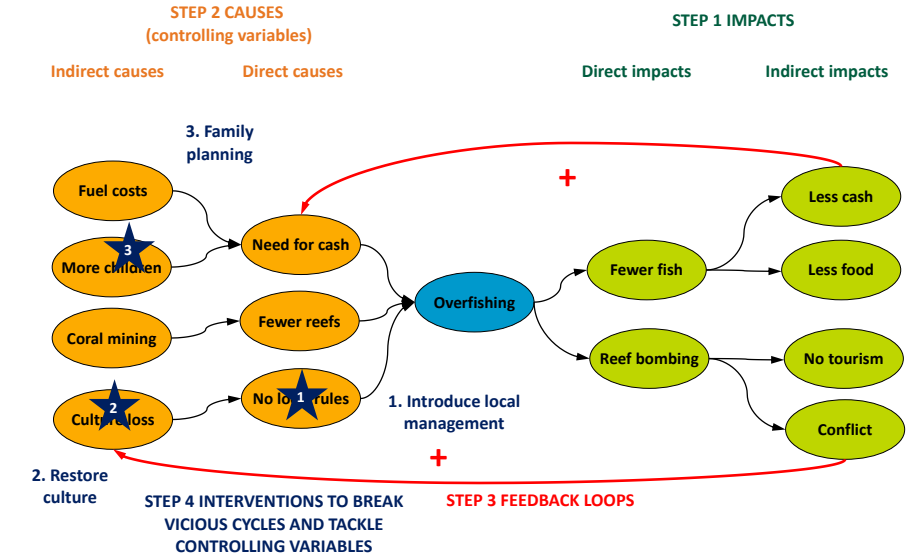

Figure 60 Fisheries example

An action plan can then be developed for each specific intervention. Below is an example of an action plan for introducing local management of fisheries.

ACTION	RESPONSIBILITY (WHO)?	WHEN?
1. Review current management arrangements	• Government • NGO • Researchers etc	Date and who?
2. Develop and fund locally appropriate management plan	• Government • Donor • Local leaders • NGO • Researchers	Date and who?

Figure 61 example action plan

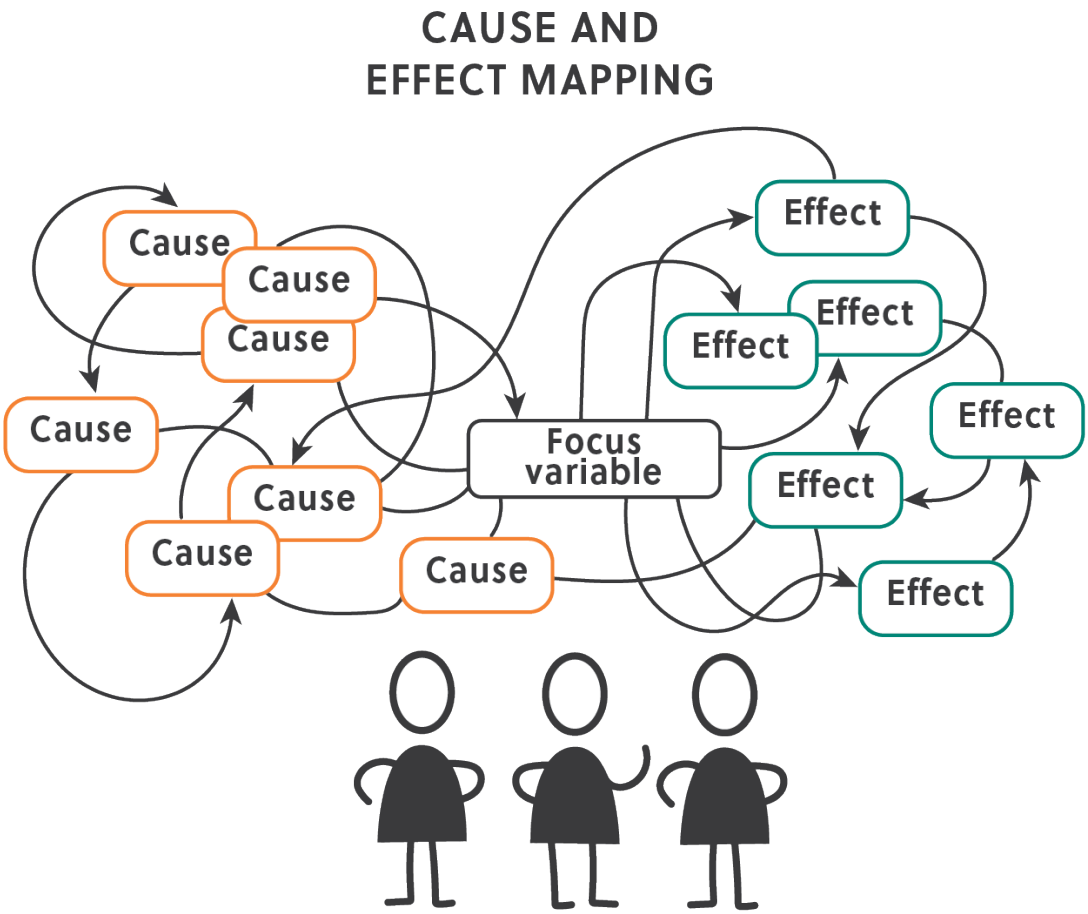

Figure 62 Causal loop – cause and effect mapping. Source: Australian Government, Department of Home Affairs. 2019. Climate and Disaster Risk: What they are, why they matter and how to consider them in decision making. 3 Guidance on Vulnerability CC-BY-4.0

References and additional resources

If you would like to watch a YouTube video on this module, please see: https://www.youtube.com/playlist?list=PLa3eWR75XNLxlRG-XYzLb8VHcGCBCrdOX

Resources

If you are interested in conducting a causal loop analysis in your study of a system you can access:

YouTube video on causal loop
https://www.youtube.com/watch?v=u-MPKeE_CC8

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Acknowledgements

This module was developed by:

Seona Meharg (CSIRO): an integration scientist focused on the capacities and competencies needed for systemic change, and with experience in research evaluation and project management for transdisciplinary projects.

Sara Busilacchi (Independent research scientist): research scientist with a background in fisheries science with a focus on social-ecological systems thinking for the sustainability of small-scale fisheries in a changing world using collaborative and participatory approaches.

Michaela Cosijn (CSIRO): an innovation broker who works in international development programmes solving complex problems and enhancing livelihoods, with her work focused on agri-food innovation systems, gender integration, and climate adaptation.

James Butler (CSIRO): a sustainability scientist with a background in agricultural economics, terrestrial, freshwater and marine ecology gained in southern Africa, Europe and Australia.

Your notes

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