TRANSFORMATIONAL EVALUATION

FOR THE GLOBAL CRISES OF OUR TIMES

Rob D. van den Berg

Cristina Magro

Marie-Hélène Adrien

EDITORS

INTERNATIONAL DEVELOPMENT EVALUATION ASSOCIATION

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KNOWLEDGE CAPACITY DEVELOPMENT NETWORKING

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CHAPTER 15

Complex Systems, Development Trajectories and Theories of Change

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Abstract. This chapter presents a case study of the application of Complex Adaptive Systems thinking to the planning, monitoring and evaluation of transformational interventions. The chapter presents a methodology to develop a robust understanding of the dynamics of the system targeted by a development intervention and to understand the ways in and extent to which a development intervention interacts to modify the development trajectory of such a system. It also describes the lessons learned in the ongoing learning process seeking to develop transformational theories of change. It draws on mixed methods that include different conceptual frameworks, analytical tools and information-gathering techniques. The approach we adopted is different from other systems thinking–inspired theories-of-change approaches in two ways. First, instead of focusing on the transformation of a system, our approach focuses on how to steer a system development trajectory that is consistent with a set of long-term objectives that are typically broadly articulated. The second important difference is that, unlike other systems-based theories of change, which often focus on transformation pathways that identify likely sequences of developmental stages (or conditions), our approach focuses on affecting the most influential conditions to steer the system development trajectory in the direction of the stated objectives. Our approach also focuses on monitoring the most effectual conditions to continually assess the extent and direction to which change takes place.

Introduction

This chapter presents the lessons learned in the ongoing effort to develop theories of change to aid transformational interventions that was first reported in Zazueta, Le and Bahramalian (2021) in the *American Journal of Evaluation* (the AJE article). Although this chapter and the AJE article both concern the United Nations Industrial Development Organization (UNIDO) technical assistance programme to the fisheries and aquaculture sector in Indonesia and are funded by the government of Switzerland, the AJE article refers to the evaluation of the first phase of the programme, called SMART-Fish, whereas this chapter addresses the development of a theory of change that is being used in the design, implementation and evaluation of the programme's second phase, which is delivered within the framework of UNIDO's Global Quality and Standards Programme (GQSP). The evaluation and the development of the theory of change both draw on complex adaptive systems (CAS) for their theoretical framework. They both adopted an approach based on a robust understanding of the dynamics of the system targeted by a development intervention and on the way the development intervention interacts with such systems (Garcia and Zazueta 2015). Like the AJE article, this chapter documents an experience that used mixed methods, but the methodological tools used in the process discussed in this chapter are more diverse and reliable:

- The analytical methods used are different. A key aspect of the shared overall approach is a focus on the interaction of the different conditions that contribute to change. In the evaluation discussed in the AJE article, we based our analysis on identification of the causal link among conditions leading to system change, which we did jointly with the project manager. In the development of the second phase, as discussed in this chapter, we asked stakeholders (some 30 persons) to define the causal links but also to weigh the influence of each condition. Although both processes were consultative, the process documented in this chapter was much more participative.
- For the AJE article, we used network analysis to identify the conditions' causal links in the system. For this chapter, we used the Decision-Making Trial and Evaluation Laboratory (DEMATEL), a mathematical tool that traces links across the system to the *n* link. When combined with the ponderation of each of the causal links, this made for a much powerful and reliable method.

- In the experience presented in this chapter, by using influence mapping, we were also able to systematically assess the role of each condition in the system, going from highly causal – and critical to redirect the system trajectory – to highly effectual – an indicator that change is taking place.
- In this chapter, we also used the Knowledge, Aspirations, Skills and Attitude model of the Bennett Hierarchy (Rockwell and Bennett 2004) and the Unified Theory of Acceptance and Use of Technology Utility (UTAUT) for planning interventions that promote behavioural changes that contribute to the identified highly influential conditions (Venkatesh, Thong and Xu 2016).

During the development process of the second phase, the lockdown caused by the COVID-19 pandemic required the project preparation team to use a variety of techniques to gather information, which included stakeholder workshops and web-based focus group discussions using the application Mural[1] and web-based questionnaires. The project design team also used visualization, using diagrams to facilitate analysis and communication, and consulted the relevant scientific and technical literature. This mix of conceptual frameworks, analytical and planning tools and data gathering and communication techniques was selected to match the objectives of the different steps in the development of a comprehensive model to steer the system development trajectory to the intended long-term objectives.

The approach was applied to the preparation of a project aimed at increasing market access of Indonesian fisheries and aquaculture products by improving compliance capacity with international quality standards. This project is taking place within the context of the GQSP, which is a strategic cooperative effort of the Swiss State Secretariat for Economic Affairs and UNIDO. The GQSP programme aims at promoting trade and competitiveness by strengthening quality and standards compliance of enterprises. The GQSP programme in Indonesia builds on a previous project implemented by UNIDO – SMART-Fish, which is also funded by the Swiss State Secretariat for Economic Affairs to strengthen the trade capacity of the seaweed, pangasius and pole and line tuna value chains. The GQSP aims at supporting aquaculture farms and fish processing firms, as well as intermediary actors such as collectors along the pangasius, shrimp, milkfish, catfish and seaweed value chains to meet their market requirements in terms of

[1] Mural is a digital workspace for visual collaboration. See https://www.mural.co/.

quality and compliance with technical regulation and standards. The project also supports enhancement of the overall quality infrastructure system of the aquaculture sector, which includes standards and regulation, capacity building of institutions supporting upgrading of and compliance with market requirements and the services to verify such compliance (conformity assessment bodies). The project works with various stakeholder groups to promote Culture for Quality, which refers to overall awareness of and demand for quality products by markets and demand for quality-related services by enterprises.

Development of the theory of change (ToC) for the second phase of the Indonesia project was a collaborative effort that included project managers and evaluators. The intention was to develop a model that could be used as a tool for adaptive management of the project during implementation and for project evaluation. Strengthening of the national quality system requires involvement of multiple ministries, academia, business associations and other civil society organizations, as well as consideration of several domains, including policy, technology, institutional, scientific and financial. Changes must take place at various levels: national, provincial and local. It is expected that changes will be phased in over a time frame that extends beyond the duration of the project.

One important aspect of the approach is incorporation of stakeholder and technical perspectives at each step in the process. The original intention of the authors was to apply the methodology in Indonesia through face-to-face stakeholder workshops, focus groups and interviews. This was not possible because of the COVID-19 pandemic. Instead, most of the work was conducted remotely using virtual tools to interact with participating stakeholders. It provided an opportunity to assess the impact of a pandemic on development processes. To accomplish this, the authors obtained information pertaining to conditions before and in the early stages of the COVID-19 outbreak when developing the baseline for the most influential conditions affecting the development trajectory.

The chapter is developed in three sections. The first pertains to identification of key CAS concepts used as tools to delimit the boundaries of the system that the project addresses and that consist of a set of assumptions on the causal links between different elements of the system, helping explain its dynamics. The second outlines the steps followed in developing the ToC. The third presents conclusions and lessons learned from the experience.

CAS Conceptual Tools

Particularly crucial in ToCs is clarity as to how the different elements of a system interact to generate the desired outcomes (Davies 2018). A ToC is a theory of why and how an initiative works (Weiss 1997). It explains how short-term interventions contribute to long-term objectives. Thus, ToCs are useful in designing and assessing the extent to which interventions are likely to contribute to long-term goals such as the United Nations Sustainable Development Goals (Selomane et al. 2019).

Useful ToCs start with a good understanding of the system that interventions target for change. System-wide changes typically require attention to complex processes. Among the many approaches to complex systems thinking, the CAS proponents have developed a set of concepts to understand and model the interlinked elements of a social system. CAS are dynamic systems that result from the behaviour of autonomous agents who are adapting to behaviours of other agents. The interactions between agents permeate the aspects of the system and are the source of unpredictability in the system (Dooley 1996). CAS are adaptive because they can reorganize their parts and learn when facing internal or external drivers (Anderies, Janssen and Ostrom 2004; Dooley 1996). The concepts that CAS scholars propose present a framework on which to build models consisting of propositions that can guide a learning process to help understand and modify the factors enabling or hampering the agents' behaviours. Particularly useful concepts to construct ToCs of system-wide changes include the concepts of system boundaries, domains, scales, agents, adaptive behaviour, emergence and system development trajectory.

The notion that CAS are composed of nested and interconnected subsystems helps define the boundaries of a system or a subsystem based on the intensity of links among the parts (Ostrom 2009). Subsystems that are interconnected through multiple links help identify the aspects of the phenomena relevant to the policy or long-term objectives. The domains pertain to the broad areas of concern relating to a phenomenon.

Domains are areas of knowledge (fields of cognition) or activity characterized by a set of concepts, terminology and behaviours (Couture and Valcartier 2007). The policy and regulatory, economic, institutional, financial, technological and sociocultural domains are frequently relevant in development initiatives (Zazueta 2017). Domains provide frameworks to help identify the critical conditions that can enable or hamper behavioural change consistent with given development trajectory. Examples of such conditions include the presence of policies and regulations that provide incentives for behaviours consistent with the long-term policy goals, markets that recognize production processes and practices that contribute to the long-term policy goals and institutions capable of performing certain functions (UNIDO 2019). Domains are subsystems nested within the broader system that cut across scales; thus, identification of key domains pertaining to a given long-term objective is helpful in tracing the relevant system interactions and dynamics across different scales.

Scales represent levels across the system. Scales can be spatial or temporal and have quantitative and qualitative dimensions. For example, spatial scales go from local to national and global (in each case, there is an increase in the territory covered) and can pertain to different aspects of the phenomena, which could include administrative structures, ethnic boundaries, ecological boundaries and market systems (Gibson, Ostrom and Ahn 2000). Temporal scales can be short, medium or long term and can pertain to different phenomena such as frequency of occurrences across time and linearity or non-linearity in change. The links between scales make it possible for changes originating at one scale to trigger developments at other scales and across the system (Selomane et al. 2019).

The agents (or system components) and their behaviour underlie the phenomena that encompass the system. CAS scholars assume that systems operate through the actions and reactions of the agents (the agents' adaptive behaviour). Although agents command different resources, and the conditions in the various domains influence them differently, they are linked, directly or through other agents. The aggregated adaptive behaviour of the agents responding to each other and to other factors external to the system result in the emergence of system-level phenomena that are often different from the behaviours of the agents. The agents' adaptive behaviour can be in many forms, such as imitation, cooperation, conflict and coalitions, which feed back to influence other agents' reactions (Allen and Garmestani 2015; Holland 2006; Levin 2003).

The chain reaction of the adaptive behaviour of agents across scales and domains contributes to the complexity, non-linearity and unpredictability of the system (Holland 1995; 2006). Thus, in complex systems, outputs or results will not always correspond to inputs. Given these uncertainties, when dealing with complex systems, effective development interventions are those that mimic other agents in the system by adapting actions on the basis of information generated during the implementation process (Hartman and De Roo 2013). Adaptive management entails identification of long-term goals that can help guide the direction or trajectory of an intervention (Allen and Garmestani 2015). Adaptive management also requires identification of conditions that are likely to enable human behaviours across the system that are consistent with the desired trajectory. This requires clear understanding of how the different conditions interact and influence the development trajectory of the system. Considering the uncertainty and unpredictability inherent in complex systems, this step will require articulation of a set of hypotheses and specific objectives that can be tracked and monitored regularly to make necessary adjustments based on information generated during implementation. To measure changes, it will also be necessary to identify the starting point for each condition and to develop indicators to trace changes and developments during implementation.

Steps in Developing the ToC

We followed eight steps in developing the ToC:

1. Formation of an expert group that included representatives from the different stakeholders of the project
2. Articulation of the long-term objectives, with engagement of the technical working group
3. Identification of conditions that would enable a development trajectory consistent with the long-term objectives
4. Analysis of the chains of causality within the system and identification of the most influential conditions across domains
5. Establishment of baseline of conditions
6. Identification of indicators for the most influential conditions and of a baseline
7. Development of strategies to contribute to the most influential conditions affecting the development trajectory of the system
8. Building of hypotheses for evaluation of results and designing an appropriate impact evaluation strategy

Step 1: Expert Group

In the first step, project management identified a group of experts and informed actors from the different sectors that could bring in different perspectives to enrich the exercise. These included members of industry associations, technical staff at the Ministry of Maritime Affairs and Fisheries, researchers and university lecturers and individual experts in aquaculture value chains that the project targeted.

This expert group, consisting of 40 persons, was formalized as the ToC Working Group and tasked to act as an advisory group to the Project Steering Committee, which consists of representatives of the Indonesian government, the Swiss State Secretariat for Economic Affairs (the donor) and UNIDO. The functions of the ToC Working Group included:

- Support of the project management team in designing the ToC and project interventions
- Periodic review of and updates to the ToC
- Periodic review of project results and providing advice for adaptive management
- Support of the project mid-term evaluation by revisiting the ToC and evaluating the project's contribution to changes in key conditions
- Support of the final evaluation of the project by assessing the project's contribution to changes in key and targeted conditions and helping identify lessons learned

The functions of the ToC Working Group are stipulated in terms of reference. To ensure continuity and meaningful engagement of the experts in the working group, the project provided a certificate of membership and recognized contributions of the Working Group in the project reports, but the most important incentive was the opportunity to contribute to and eventually influence policy in the sector in which they are all involved and feel passionate about. ToC Working Group participants are also becoming familiar with the concept of ToC as a tool for project planning, monitoring and evaluation and may be able to apply it in their work.

Step 2: Long-Term System-Wide Objectives

This step aimed at reviewing key objectives and goals of the sector as articulated in the policies and strategies of the government of Indonesia, as well as aspirations of the industry. Before the workshop, the project preparation team reviewed such policies and objectives to expedite the review process.

During discussions of the ToC Working Group, it became clear that, in the case of the aquaculture sector in Indonesia, the objectives were quite diverse, covering social, economic and environmental aspects, in line with the Sustainable Development Goal framework. Therefore, rather than agreeing on a specific objective, the group reached a consensus on the overall direction of the desired development. This was stipulated in the three key words equity, wealth and sustainability, which also reflect key policy objectives of the government of Indonesia.

Step 3: Identifying Key Enabling Conditions and Domains of Change

The project preparation team presented a set of domains to the ToC Working Group as a starting point to help kick off a brainstorming session to identify key enabling conditions that would enable progress in the trajectory of the long-term goals identified in step 1. These domains were governance, knowledge and innovation, finance, production and markets.

This brainstorming was conducted in a face-to-face workshop in which ToC Working Group members were divided into subgroups and each group assigned two or three domains. Each group was then instructed to identify key conditions within the assigned domain that would steer behaviour in the trajectory identified in step 1. The subgroups were asked to limit each domain to five to six enabling conditions. Once breakout sessions were over, the whole group reconvened to review and validate key conditions that each subgroup identified. The review included removing duplicates, revising wording of conditions to ensure a consistent style of presenting conditions and adding new conditions if necessary; 27 enabling conditions were identified in the five domains (see annex for a detailed list of domains and conditions.)

The domain of production refers to a subsystem of activities that produce, transform and market aquaculture and seafood products. The expert groups identified six key conditions that constitute the positive contribution of this domain to the overall objectives of the sector. Unsurprisingly, awareness of sustainable development issues (P5) was selected as a key prerequisite for any progressive development towards sustainability, and any progressive change in the domain of production will ultimately depend on good practices, which will have a strong impact on sustainability of the sector if the actors along the value chain (input suppliers, farmers, processors and traders) adopt it at scale. Therefore, capacity to apply, for example, good aquaculture practices, good manufacturing practices, and good hygienic practices was defined as a key condition (P1). Moreover, capacity to meet market requirements and demand (P3), especially considering two other conditions in the domain of market (a growing and diversifying market for sustainable seafood (M5), market incentives along the value chain for quality, sustainability and equity (M4)), was identified as a key condition. Good production infrastructure (P4), suitable business models (P2) and access to suitable production inputs (P6) were other key conditions identified in this domain.

The domain of markets was defined as the subsystem that facilitates transactions along the aquaculture value chain to meet demand for aquaculture products – be it sales of raw material for processing, of fresh fish into local markets or of processed seafood for exports. In such a subsystem, the key conditions were therefore appropriate trade infrastructure and logistics (M1); symmetric information on demand (price, quality, quantity; M2); suitable value chain coordination models (M3); market incentives along the value chain for quality, sustainability and equity (M4) and a growing and diversifying market for sustainable seafood (M5).

The expert team was sensitized and aware of system-wide changes needed at the sector level to achieve stated long-term objectives and the various trends and mega-trends, such as rural-urban migration and growth of digital technologies used in the sector. In light of this, openness to new knowledge and innovation (K1) was selected as a key condition in the domain of knowledge and innovation. The expert group agreed that a set of three conditions; good, strong research and development and training institutions (K2); cooperation between university and research and development institutions, government and industry (K3) and a good incentive system for innovation (K4) together create the needed knowledge and support the necessary changes at the system level, which transfers the new knowledge to relevant actors and encourages application of new knowledge and skills. The ability and responsiveness of the aquaculture sector to adapt to changes in circumstances, new developments and external shocks and megatrends (K5) and the availability of evidence to support policy and decision-making (K6) were considered two other important conditions. Such conditions were considered to be closely connected to the domain referred to as knowledge and innovation.

The expert group recognized that any changes in behaviour and any undertaking would require investment in new practices, processes, skills and technologies and suitable financing options. Therefore, a subsystem of finance was defined to include all the interconnected conditions referring to availability and accessibility of financial resources, feasibility of investments and capabilities associated with new investments. These included bankable proposals for investment in sustainable aquaculture (F5), appropriate financial business models along the value chain (F2) and financial literacy of different actors (F3). Moreover, the expert group decided that two conditions (presence of financial institutions promoting investments with impact on sustainability (F1) and good coordination among different funding institutions (F4)) determine availability and accessibility of financial resources.

The expert group identified five conditions that referred to overall sector management capacity and governance towards a sustainable trajectory. Conducive regulation and standards for ease of doing sustainable business (G1) and a reward and punishment system for (un)sustainable practices (G4) underpin this capacity. Participatory approaches to governance and a strong and effective civil society (G2) was considered an important condition that enables interaction between the sector and the larger society. Recognizing the multiple streams of policy that affect the aquaculture sector, such as labour, agriculture, industry, trade and education, the expert group defined coherence and harmonized policies and capacity to implement policy (G5) and good coordination and cooperation among public and private institutions for implementation of policy (G3) as two other key conditions.

Step 4: Mapping Influence Between Conditions

4.1. Identifying Direct Influence Between Conditions

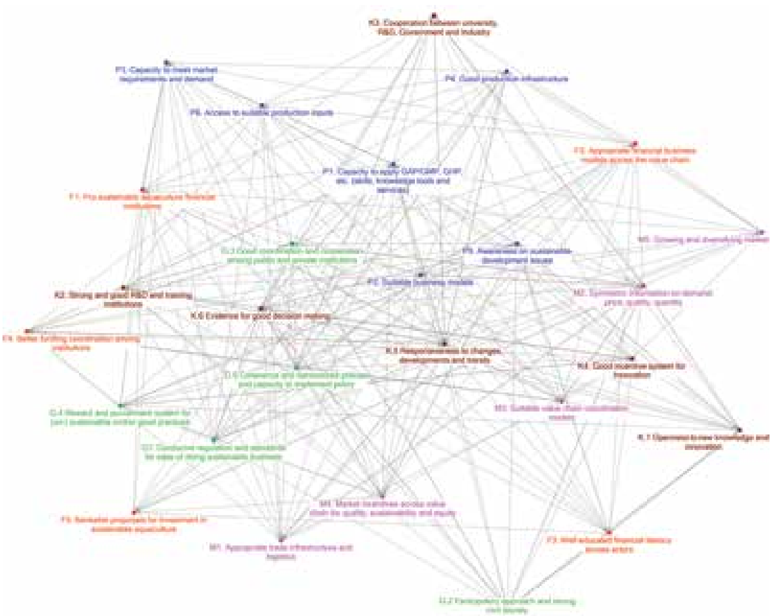
In the first stage, the whole group was engaged to identify direct influence links between conditions. To do so, the workshop facilitators went through every condition, domain by domain, and asked expert groups to identify the conditions that influence the selected condition the most[2], noting only direct influences between conditions (0 = no direct link, 1 = direct link); 247 direct links between the 27 conditions were identified. The result of substep 4.1 was subsequently diagrammed using NodeXL for network analysis and is presented in the network map in figure 15.1.

4.2. Evaluation of Strength of Direct Influence Between Conditions

Once the direct influences were mapped, the next substep was to evaluate the strength of each direct influence (0 = no influence (already identified in

[2] This question could have been posed the other way around as well, that is, picking a condition and asking the expert group to identify conditions that the selected condition influenced, but one can always assume some level of influence between all conditions in a system, and depending on the expert background, one may have exaggerated expectations of influence of a condition on the system. Therefore, it was deemed more accurate to ask about conditions that directly affect a selected condition.

Figure 15.1 Network of Key Conditions for Transforming Aquaculture Sector in Indonesia Towards Sustainability, Wealth and Equity



Source: 2020 data from the project team.

previous stage), 1 = weak, 2 = medium, 3 = strong, 4 = very strong). Substep 4.2 was conducted using an online survey. The definition of strength levels was considered subjective, meaning that each respondent could understand and use terms such as 'weak', 'medium', 'strong' and 'very strong' differently. Therefore, the facilitation team explained to the ToC Working Group that, in this substep, it was particularly important for each respondent to apply their own definition consistently to have consistent responses throughout the survey and not to worry about consistency of definitions across respondents. Twenty-four experts completed the survey, which took approximately three hours. The facilitation team was available and could reach out to respondents to address enquiries on the questions. In addition, a WhatsApp group was formed to share questions and answers with Working Group members. Subsequently, a two-hour webinar was organized to review the results of first phase and to explain the next steps, including the survey. The result of this substep was 24 matrices of influence between conditions of the ToC.

4.3. Identifying the Most Influential Conditions

In a complex system in which conditions influence each other, directly and indirectly (through other conditions), understanding the most influential conditions is crucial for programmes and projects that intend to influence the trajectory of the system towards the long-term objectives. Because the project does not have the resources to develop detailed strategies for the 24 enabling conditions, identifying the most influential conditions will allow the design team to pay more attention to development of robust strategies to pursue the conditions that are most likely to steer the system towards the long-term objectives. The most influential conditions (or factors, as referred to in operations research literature) in a complex system were identified using the DEMATEL technique, a structural modelling approach that translates the interdependency relationships between conditions of a complex system into cause-and-effect groups. As such, it determines whether a condition is a driver or cause of change or a result or effect of other conditions. In addition, DEMATEL identifies the most important conditions of a complex system with the help of an impact relation diagram by calculating the total routes (direct and indirect) through which a condition influences other conditions and the system as a whole (Shafiee, Lofti and Saleh 2014).

The project preparation team used classic DEMATEL[3] to analyse the strength of the causal links resulting from the survey responses obtained in substep 4.2. The individual direct influence matrices of substep 4.2 were collected into an aggregate direct influence matrix, and then a total influence matrix was elaborated by summing all direct and indirect influences between conditions.

The application of the DEMATEL method is summarized as follows.

Generate the individual direct-influence matrix (X). The following calculations used the data in the non-negative matrix attained from respondents after assessing the relationships between *n* conditions. The matrix captures the responses of *m* respondents who were asked to indicate the direct influence of condition *Ci* on condition *Cj* using an integer score of 0, 1, 2, 3 or 4, representing no influence, low influence, medium influence, high influence and very high influence, respectively.

[3] The project used the process that Si et al. (2018) described for a classic DEMATEL technique.

x_{ij} indicates the degree to which the respondent believes condition *i* affects condition *j*. For *i* = *j*, the diagonal elements are set to zero. For each respondent, an n-by-n non-negative matrix can be established as:

$$X^k = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nn} \end{bmatrix},$$

where *k* is the number of respondents with $1 \leq k \leq m$, and *n* is the number of conditions. Thus, X1, X2...X*m* are individual direct influence matrices from *m* respondents. Twenty-four experts ($m = 24$) assessed the strength of the relationship between 27 identified conditions ($n = 27$). In other words, 24 individual direct influence 27 × 27 matrices were developed in this stage.

Computation of group direct-influence matrix. To incorporate all opinions from all respondents, the average matrix is computed as:

$$x_{ij} = \frac{\sum_{k=1}^{n} x_{ij}^{k}}{m}$$

Computation of normalized direct influence matrix. Normalize direct-influence matrix D as follows:

$$D = X.S$$

Where

$$S = \frac{1}{\max\limits_{1 \leq i \leq n} \sum_{j=1}^{n} x_{ij}}$$

Computation of total-influence matrix. Total relation matrix (T) is defined as $T = D(I - D)^{-1}$, where I is the identity matrix.

Calculation of 'Prominence' and 'Relation' values. The total-influence matrix shows all the direct and indirect influences from each condition on all other conditions in the system. This will give us the essential elements to assess the importance and role of conditions in the system, referred to, respectively, as prominence and relation.

We first define R and C by $n \times 1$ and $1 \times n$ vectors representing the sum of rows and sum of columns, respectively, of the total relation matrix T. In other words, for each of the 27 conditions, R is the sum of all direct and indirect effects that a condition has on other conditions in the system (sum of rows of total influence matrix). Similarly, C is the sum of all direct and indirect effects on a condition of all other conditions in the system (sum of columns of the total relation matrix) (table 15.1).

'Prominence' shows the strength of influences that a condition gives and receives (out-degree plus in-degree). Prominence is calculated for each condition by adding its *R* and *C* values. The higher the ($R + C$) of a condition, the more central a role the condition plays in the system.

'Relation' shows the net effect that the condition contributes to the system, which can be cause or effect. Relation is calculated for each condition by deducting *C* from *R*. Specifically, if ($R - C$) of a condition is positive, it is a cause, whereas if ($R - C$) is negative, a condition is an effect.

Influential relation map. In this substep, an influential relation map plot was illustrated by mapping conditions based on their prominence ($R + C$) and relation ($R - C$) values on a scatter plot (figure 15.2).

Si et al. (2018) suggest the following classification of the conditions in a complex system according to their quadrant location in the influential relation map diagram:

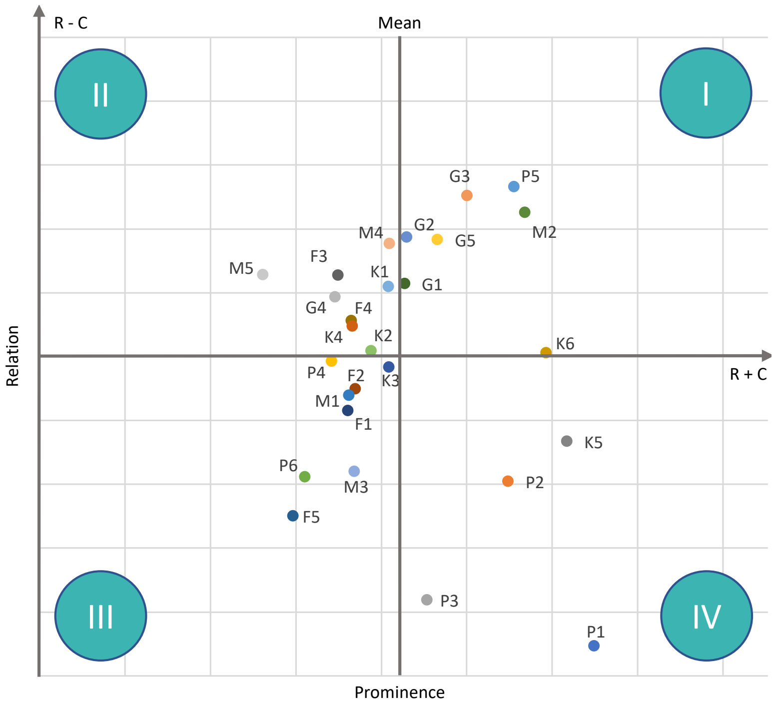
- Conditions in quadrant I are the most important conditions because they have high prominence and relation. For the purpose of the intervention design, these are conditions that the project should target to have the greatest influence on the trajectory of the system.
- Conditions in quadrant II are identified as autonomous driving conditions because they have low prominence but high relation. These conditions have a strong causal effect in the model. They are less connected in the system but have strong influence on the conditions they directly influence.
- Conditions in quadrant III are independent conditions that are relatively disconnected from the system because they have low prominence and low and negative relation. Although these conditions are relatively disconnected, they are relevant because they are considered necessary to achieve the long-term goal.
- Conditions in quadrant IV have high prominence but low and negative relation. These are referred to as impact factors. Other conditions strongly influence them. These conditions are indicators of the extent to which long-term impact is being achieved.

Table 15.1 Total Influence Matrix

	P1	P2	P3	P4	P5	P6	F1	F2	F3	F4	F5	G1	G2	G3	G4	G5	K1	K2	K3	K4	K5	K6	M1	M2	M3	M4	M5	R
P1	0.02	0.07	0.09	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.07	0.07	0.01	0.01	0.01	0.01	0.00	0.49
P2	0.10	0.02	0.09	0.01	0.01	0.02	0.02	0.08	0.01	0.07	0.09	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.07	0.08	0.08	0.01	0.00	0.88
P3	0.01	0.01	0.01	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.18
P4	0.10	0.08	0.10	0.01	0.00	0.07	0.02	0.02	0.00	0.01	0.08	0.01	0.00	0.00	0.01	0.06	0.00	0.01	0.02	0.01	0.09	0.02	0.01	0.01	0.02	0.01	0.06	0.84
P5	0.17	0.12	0.14	0.03	0.03	0.05	0.05	0.09	0.07	0.08	0.05	0.09	0.03	0.08	0.08	0.02	0.09	0.10	0.10	0.08	0.13	0.11	0.04	0.03	0.10	0.08	0.01	2.05
P6	0.07	0.01	0.08	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.06	0.01	0.01	0.00	0.01	0.00	0.00	0.31
F1	0.10	0.08	0.10	0.07	0.00	0.08	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.07	0.01	0.07	0.00	0.00	0.69
F2	0.04	0.09	0.09	0.07	0.01	0.07	0.02	0.01	0.00	0.01	0.09	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.07	0.01	0.02	0.01	0.07	0.06	0.00	0.80
F3	0.11	0.10	0.05	0.02	0.07	0.02	0.09	0.09	0.01	0.02	0.10	0.02	0.06	0.01	0.01	0.01	0.07	0.02	0.02	0.02	0.09	0.08	0.03	0.02	0.03	0.02	0.00	1.19
F4	0.11	0.03	0.04	0.01	0.01	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.07	0.06	0.01	0.02	0.07	0.08	0.07	0.09	0.03	0.08	0.02	0.09	0.01	0.01	1.05
F5	0.01	0.01	0.01	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.12
G1	0.13	0.11	0.12	0.07	0.02	0.09	0.09	0.03	0.01	0.01	0.04	0.01	0.07	0.01	0.06	0.02	0.01	0.07	0.02	0.02	0.05	0.09	0.08	0.02	0.03	0.01	0.07	1.36
G2	0.08	0.11	0.06	0.03	0.08	0.03	0.03	0.04	0.08	0.03	0.04	0.04	0.03	0.08	0.02	0.09	0.08	0.09	0.04	0.07	0.11	0.11	0.03	0.08	0.05	0.02	0.01	1.54
G3	0.15	0.11	0.13	0.03	0.02	0.10	0.03	0.09	0.07	0.09	0.05	0.09	0.08	0.02	0.02	0.09	0.02	0.08	0.09	0.03	0.07	0.11	0.09	0.08	0.10	0.02	0.01	1.88
G4	0.12	0.10	0.11	0.01	0.07	0.02	0.08	0.02	0.01	0.01	0.03	0.01	0.01	0.01	0.02	0.01	0.07	0.02	0.02	0.07	0.04	0.03	0.02	0.02	0.03	0.07	0.06	1.10
G5	0.14	0.05	0.12	0.08	0.02	0.09	0.03	0.07	0.01	0.08	0.04	0.08	0.01	0.01	0.09	0.02	0.02	0.03	0.09	0.09	0.11	0.09	0.03	0.02	0.09	0.08	0.02	1.62
K1	0.13	0.05	0.05	0.02	0.08	0.02	0.07	0.03	0.07	0.02	0.03	0.03	0.07	0.02	0.01	0.02	0.02	0.08	0.03	0.02	0.11	0.10	0.03	0.08	0.08	0.01	0.00	1.30
K2	0.11	0.09	0.10	0.06	0.01	0.07	0.02	0.02	0.06	0.02	0.03	0.02	0.01	0.05	0.00	0.01	0.01	0.01	0.02	0.01	0.10	0.09	0.02	0.01	0.02	0.01	0.01	0.99
K3	0.12	0.03	0.04	0.02	0.02	0.07	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.08	0.08	0.02	0.02	0.01	0.10	0.10	0.02	0.07	0.03	0.01	0.00	0.98
K4	0.12	0.09	0.04	0.01	0.02	0.07	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.07	0.01	0.08	0.08	0.08	0.01	0.04	0.09	0.02	0.02	0.07	0.01	0.01	1.04
K5	0.12	0.10	0.11	0.07	0.00	0.03	0.08	0.02	0.01	0.07	0.08	0.07	0.01	0.01	0.01	0.01	0.01	0.07	0.07	0.01	0.04	0.03	0.08	0.02	0.09	0.00	0.01	1.21
K6	0.13	0.05	0.06	0.03	0.07	0.04	0.03	0.08	0.01	0.02	0.10	0.09	0.06	0.02	0.03	0.08	0.02	0.03	0.09	0.08	0.11	0.04	0.07	0.02	0.04	0.07	0.01	1.50
M1	0.09	0.02	0.10	0.01	0.01	0.08	0.01	0.06	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.07	0.01	0.01	0.07	0.08	0.01	0.00	0.75
M2	0.16	0.13	0.07	0.08	0.08	0.05	0.04	0.11	0.08	0.03	0.11	0.09	0.08	0.08	0.02	0.09	0.08	0.03	0.09	0.03	0.07	0.12	0.09	0.04	0.11	0.03	0.01	1.99
M3	0.08	0.01	0.02	0.01	0.01	0.06	0.00	0.01	0.01	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.07	0.01	0.00	0.00	0.47
M4	0.13	0.11	0.12	0.07	0.07	0.03	0.09	0.03	0.01	0.02	0.09	0.02	0.01	0.07	0.08	0.01	0.02	0.07	0.03	0.08	0.10	0.03	0.08	0.02	0.04	0.01	0.01	1.47
M5	0.11	0.09	0.04	0.02	0.01	0.02	0.08	0.08	0.00	0.01	0.09	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.08	0.07	0.08	0.07	0.02	0.01	0.03	0.01	0.00	0.97
C	2.75	1.86	2.08	0.87	0.72	1.24	1.11	1.05	0.55	0.77	1.36	0.78	0.60	0.62	0.63	0.70	0.74	0.95	1.06	0.79	1.87	1.46	1.05	0.85	1.37	0.58	0.33	

Source: Calculations by author based on 2020 survey data from the project team.

Figure 15.2 Influential Relation Map



Source: 2020 survey data from the project team.

The ToC Working Group concurred with the results of the analysis and identified the conditions in each of the four quadrants (table 15.2). Various conditions were identified in quadrant I to design project intervention strategies. P5[4] (awareness of sustainable development issues), M2 (symmetric information on demand: price, quality and quantity) and G3 (good coordination and cooperation among public and private institutions) were identified as the most important factors driving change in the system because of their high prominence and high and positive relation. Conditions in this group also include G5 (coherence and harmonized policies and capacity to implement policy), G2 (participatory approach and strong civil society), G1 (conducive regulation and standards for ease of doing sustainable business) and K6 (evidence for good decision-making). These conditions

[4] Working Group members were convinced of the importance of sustainability awareness (P5) and the need to promote knowledge in this regard.

Table 15.2 Classification of Conditions

Q-II Autonomous driving conditions	Q-I Most important conditions
M4 Market incentives across value chain for quality, sustainability and equity K1 Openness to new knowledge and innovation F3 Well-educated financial literacy across actors M5 Growing and diversifying market G4 Reward and punishment system for (un)sustainable and/or good practices F4 Better funding coordination among institutions K4 Good incentive system for Innovation K2 Good, strong research and development and training institutions	P5 Awareness of sustainable development issues M2 Symmetric information on demand: price, quality, quantity G3 Good coordination and cooperation among public and private institutions G5 Coherence and harmonized policies and capacity to implement policy G2 Participatory approach and strong civil society G1 Conducive regulation and standards for ease of doing sustainable business K6 Evidence for good decision-making
Q-III Independent conditions	**Q-IV Impact conditions**
K3 Cooperation between academia, research and development, government and Industry F2 Appropriate financial business models along the value chain P4 Good production infrastructure M1 Appropriate trade infrastructure and logistics F1 Pro-sustainable aquaculture financial institutions M3 Suitable value chain coordination models P6 Access to suitable production inputs F5 Bankable proposals for investment in sustainable aquaculture	P1 Capacity to apply good practices P2 Suitable business models P3 Capacity to meet market requirements and demand K5 Responsiveness to changes, developments and trends

Source: 2020 survey data by project team.

were identified as the key conditions driving the aquaculture sector towards competitiveness, equity and sustainability.

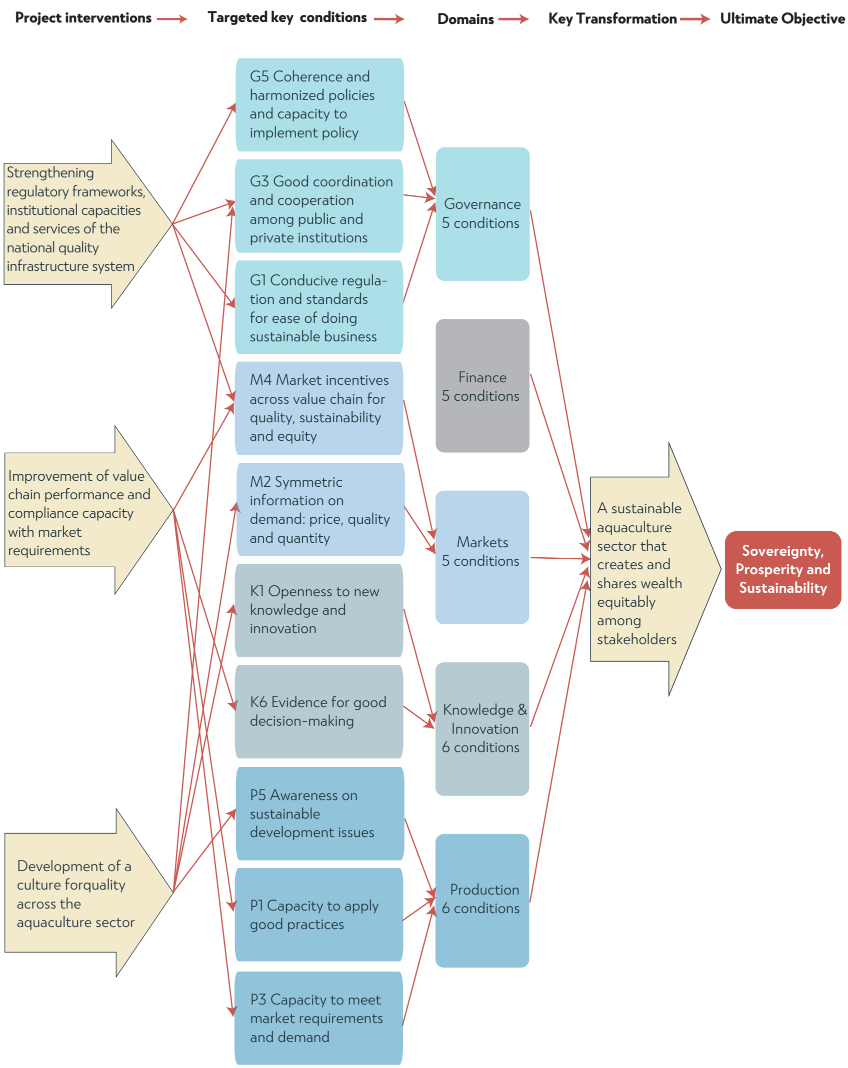
The ToC Working Group also selected conditions belonging to quadrant II that have a positive relation (R − C) but less than average prominence (R + C). These include M4 (market incentives across value chain for quality, sustainability, and equity), which had high positive relation, meaning that it is an important cause factor driving change in the sector. Similarly, K1 (openness to new knowledge and innovation), F3 (well-educated financial literacy across actors) and M5 (growing and diversifying market) were cause factors that played less prominent roles in the system.

Conditions in quadrant IV are prominent and important conditions for achieving the long-term objectives. Although other conditions influence them strongly, they have less impact on the other conditions in the system. For example, condition P1 (capacity to apply good practices) is where real change takes place when industry actors start applying business practices that, if adopted at scale, will achieve long-term objectives. The project therefore selected this condition too, to develop a targeted strategy of interventions that would lead to adoption of good practices along value chains (see step 7 for further details).

Step 4 was critical in this process because it identified 10 of the 27 initially identified key conditions on which the project could concentrate its resources to support the desired development trajectory. This does not mean that other conditions were not important, because they are also necessary to steer the system in the direction of the desired long-term objectives. It does mean that, if the causality assumptions in step 4 are correct, the 10 conditions could play a role in driving change in the other conditions, particularly conditions in quadrants II and IV.

Figure 15.3 illustrates the project's ToC and maps its interventions against the most important conditions identified in step 4. At the extreme right of figure 15.3 are the government of Indonesia's guiding principles of property, sovereignty and sustainability, which help guide the national development trajectory. The project seeks to support this development trajectory by contributing to the conditions that are conducive to a sustainable aquaculture sector that creates and shares wealth equitably. Although the ToC formulation process identified 27 conditions there, the project is focusing on 10 (in five domains) that were identified as the most influential conditions across the system (quadrant I) or that can be use as indicators of system-wide change (quadrant IV). At the extreme right are the project interventions, which include three sets of activities related to regulatory changes and capacity development, improvement of value chain

Figure 15.3 **Global Quality and Standards Programme Theory of Change**



Source: Authors.

performance and improvement of a culture for quality across aquaculture. Although figure 15.3 indicates a unidirectional chain of causality, the interplay of interactions among conditions is much more complex, with causality moving in different relations, as indicated in figure 15.2. Two key assumptions of the ToC are that the 10 selected conditions have a high level of influence and representation of change across the 27 conditions in the system and that progress in these 10 conditions is highly likely to steer the system in the desired development trajectory.

Step 5: Baseline Assessment

In this step, the ToC Working Group assessed the current status of each of the 27 conditions in the aquaculture sector in Indonesia with regard to the long-term objectives of creating wealth, equitable distribution of value across the industry and environmental sustainability. Information was collected using an online survey. Participants were asked to rate the state of each condition by selecting 0 = very bad, 1 = bad, 2 = medium, 3 = good or 4 = very good. The result of this assessment is the baseline against which changes in the state of conditions and the overall changes of the system can be measured.

Respondents were also asked to rate the state of each condition before and after the COVID-19 outbreak[5]. The recent global pandemic has affected aquaculture in Indonesia, as well as the global markets on which it depends. The question was intended to:

- better understand the impact of COVID-19 on the sector and key conditions
- test the robustness of the developed ToC
- potentially identify key areas of immediate policy intervention to counter negative impacts of the pandemic

Table 15.3 presents average expert scores for each condition before and after the COVID-19 pandemic outbreak and indicates whether each condition's score is below or above the average.

As indicated in table 15.3 and illustrated in figure 15.4, most conditions (20) that the ToC Working Group assessed have significantly worsened during the COVID-19 pandemic. Only in six conditions did the ToC Working

[5] The survey was conducted in June 2020, only three months into the pandemic; therefore, the full short-term effects may not have been apparent and reflected in responses.

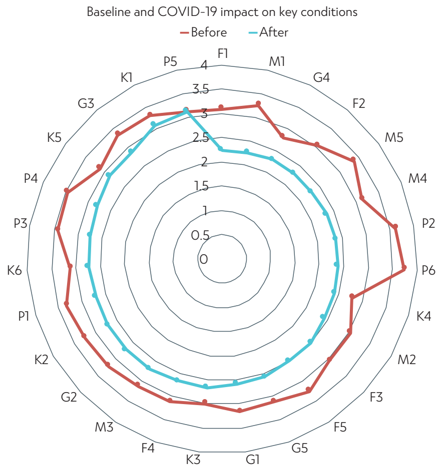
Table 15.3 Expert Group Assessment of Baselines

Quadrant	Condition	Description	Before COVID-19			After COVID-19		
			Score	Rank	State	Score	Rank	State
II	G4	Reward and punishment system for (un)sustainable and/or good practices	2.79	26	Below	2.29	23	Below
II	K4	Good incentive system for Innovation	2.79	26	Below	2.42	18	Below
III	K3	Cooperation between academia, research and development, government and Industry	3.00	25	Below	2.67	12	Above
III	F2	Appropriate financial business models along the value chain	3.04	22	Below	2.29	23	Below
I	**M2**	**Symmetric information on demand: price, quality, quantity**	3.04	22	Below	2.42	18	Below
II	**F3**	**Well-educated financial literacy across actors**	3.04	22	Below	2.50	16	Below
III	F1	Pro-sustainable aquaculture financial institutions	3.08	21	Below	2.25	26	Below
II	**M4**	**Market incentives along value chain for quality, sustainability and equity**	3.13	14	Below	2.33	22	Below
I	**G5**	**Coherence and harmonized policies and capacity to implement policy**	3.13	14	Below	2.58	14	Below
II	F4	Better funding coordination among institutions	3.13	14	Below	2.67	12	Above
III	M3	Suitable value chain coordination models	3.13	14	Below	2.71	8	Above
I	**K6**	**Evidence of good decision-making**	3.13	14	Below	2.75	6	Above
IV	K5	Responsiveness to changes, developments and trends	3.13	14	Below	2.88	3	Above
I	**P5**	**Awareness of sustainable development issues**	3.13	14	Below	3.13	1	Above
I	**G1**	**Conducive regulation and standards for ease of doing sustainable business**	3.17	13	Below	2.58	14	Below
I	**G2**	**Participatory approach and strong civil society**	3.21	12	Above	2.71	8	Above
III	M1	Appropriate trade infrastructure and logistics	3.25	9	Above	2.25	26	Below
III	F5	Bankable proposals for investment in sustainable aquaculture	3.25	9	Above	2.50	16	Below
II	K2	Good, strong research and development and training institutions	3.25	9	Above	2.71	8	Above
II	**K1**	**Openness to new knowledge and innovation**	3.29	8	Above	3.08	2	Above
IV	P1	Capacity to apply good agricultural/manufacturing/hygienic/etc. practices, skills, knowledge tools and services)	3.33	6	Above	2.71	8	Above
I	**G3**	**Good coordination and cooperation among public and private institutions**	3.33	6	Above	2.88	3	Above
II	**M5**	**Growing and diversifying market**	3.38	5	Above	2.29	23	Below
IV	P3	Capacity to meet market requirements and demand	3.42	4	Above	2.75	6	Above
III	P4	Good production infrastructure	3.46	3	Above	2.79	5	Above
IV	P2	Suitable business models	3.63	2	Above	2.38	20	Below
III	P6	Access to suitable production inputs	3.75	1	Above	2.38	20	Below
		Average	3.20			2.59		

Source: 2020 survey data by project team.

Group assessment show a small difference (P5, K3, K4, K5, K6, M3). Four conditions had larger declines than others (a mean difference of one or more between the before and after COVID-19 assessments). The most vulnerable conditions and those that the pandemic has most affected include:

Figure 15.4 State of Conditions Before and After COVID-19



Source: 2020 survey data by project team.

1. P6 (adequate access to production inputs). It is understandable that, during the pandemic, the government applied full and partial lockdown policies in some districts, including regions that supply inputs. Condition P6 fell in quadrant III, the quadrant in which conditions are more autonomous than the other conditions affecting the system. Nevertheless, this condition remains important because, without production inputs, the production process is halted, and the value chain is interrupted.
2. P2 (suitable business model). During the pandemic, the business environment changed and disrupted existing business models. Shocks to the supply chain were observed in supply and demand.
3. M5 (growing and diversified market). The pandemic led to a decline in global demand.
4. M1 (adequate trade infrastructure and logistics). During the pandemic and under the lockdown policies, transportation activities on some roads and at some airports and ports were strictly limited. This directly affected logistics services, on which export of seafood relies heavily.

Step 6: Indicators for Monitoring Changes at System Level

The expert assessment of the baseline by the ToC Working Group should be examined on the basis of evidence from other sources. It is highly likely that, for some of the conditions, suitable and standard quantitative indicators are available and accessible. For example, condition M5 refers to a growing and diversifying market that can be measured using national and international trade data, but for most of the conditions, such indicators are not readily available, and their production would require significant effort. To this end, three possibilities can be pursed in parallel:

- Consulting relevant literature to identify suitable indicators related to each condition
- Focused discussion with key stakeholders related to the specific condition
- Substantiation of the baseline scoring by providing examples and reasons

Step 7: Building Strategy

The next step was to develop specific strategies to target each of the 10 conditions identified as having the most influence in the system development trajectory. Whereas transformation at the aquaculture sector level was considered a complex adaptive process, changes in individual conditions were assumed to follow a less-complex process. Small groups (five to six persons) that had the relevant expertise on topics related to each of the 10 conditions completed this stage. The online tool Mural was used to facilitate the process.

The strategy-building process included three substeps: identifying influence pathways that drive the targeted condition, stakeholder analysis relevant to the condition and constructing a hypothesis for monitoring and evaluation of outcomes of the strategy to influence the condition. We provide one example of such a strategy-building process for improving condition P1: capacity to apply good aquaculture practices, good manufacturing practices, and good hygienic practices (skills, knowledge tools and services). This strategy involves UNIDO as an external agent and other national public and private stakeholders.

In general, a standard design process was followed, including:

7.1. Mapping Influence Pathways

Using the influential relation matrix (table 15.1), the project preparation team mapped the direct and indirect influencers separately from the other 26 conditions that were mapped. The top seven influencing conditions on P1 are listed in table 15.4. These conditions were considered when analysing the specific problems affecting the capacity of value chain operators to adopt good practices.

Table 15.4 Most Influential Conditions on P1 (Capacity to Apply Good Practices)

P5	Awareness of sustainable development issues
M2	Symmetric information on demand: price, quality, quantity
G3	Good coordination and cooperation among public and private institutions
G5	Coherence and harmonized policies and capacity to implement policy
M4	Market incentives along value chain for quality, sustainability and equity
K6	Evidence of good decision-making
G1	Conducive regulation and standards for ease of doing sustainable business

Source: Project preparation team (2020).

7.2. Stakeholder Analysis

Changes in each condition are causally linked to the behaviour of key stakeholders. The small group of experts conducted a stakeholder analysis for each of the conditions by asking participants to identify stakeholders at various levels of the administrative scale (city, province, country) and to identify motivators of each stakeholder. To facilitate the process, five predefined categories were used to identify the stakeholders: research and education, industry and private sector, government, non-governmental organizations, and sector organizations and professional bodies.

7.3. Strategy for Change

The process of achieving desired behavioural change was mapped based on the Knowledge, Aspirations, Skills and Attitude model of the Bennett Hierarchy (Rockwell and Bennett 2004). In this substep, the small group of experts was asked about the current activities and role of each stakeholder in promoting good aquaculture practices. In other words, the expert group identified activities of key stakeholders aimed at reaching out to farmers (discover), providing information and raising awareness of farmers (inform), building capacity of farmers and improving their skills (training) and supporting farmers in implementing good aquaculture practices and applying newly obtained skills (implementation).

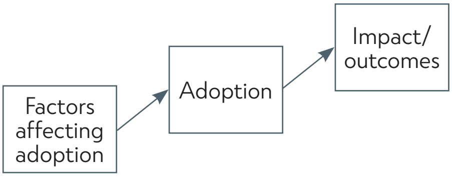
Once stakeholder activities were mapped against the behavioural change process, gaps were identified that key stakeholders did not target systematically. The small working group was then asked to brainstorm on possible responses to the identified gaps, and a list of interventions was created that each stakeholder could undertake and that could eventually contribute to improvement of the overall state of the key condition in question.

Step 8: Developing Hypothesis to Measure Outcomes and Impact

8.1. Conceptual Framework

The example that is described in step 7 refers to adoption of good practices by value chain actors (e.g. farmers). Therefore, the conceptual framework to measure success of the strategy requires identification of factors that affect adoption of good practices, the extent of adoption of good aquaculture practices by value chain actors and the extent to which good aquaculture practices contribute to desired outcomes consistent with long-term objectives in the aquaculture sector. The long-term objectives in question are related to creation of value and equitable distribution of wealth along the value chain while minimizing the environmental impact of farming activities. This conceptual framework is depicted in figure 15.5.

Figure 15.5 Conceptual Framework for Impact Evaluation



Source: Authors.

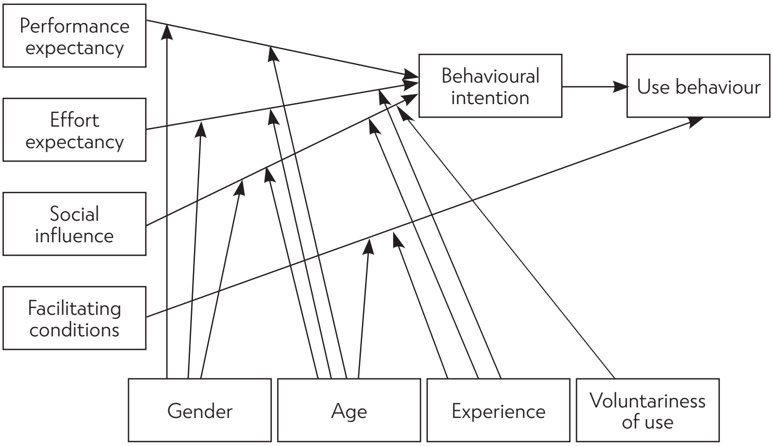
Adoption of good practices is considered a dynamic process and is influenced by multiple factors. The UTAUT utility (figure 15.6) provides a model to explain behavioural intention towards adoption of a technology[6]. The UTAUT provides a framework to analyse the factors that lead to user adoption of a practice by focusing on four constructs: performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC) (Williams, Rana and Dwivedi 2015).

Using UTAUT, the project establishes two hypotheses:

- The knowledge transfer strategy that key stakeholders develop and implement will result in farmers adopting good aquaculture practices.
- Adoption of good aquaculture practices contributes to desired impacts: improvement of farmer's livelihood, environmental sustainability and more balanced distribution of value created.

[6] Technology in the general meaning of the word, including practices.

Figure 15.6 Unified Theory of Acceptance and Use of Technology

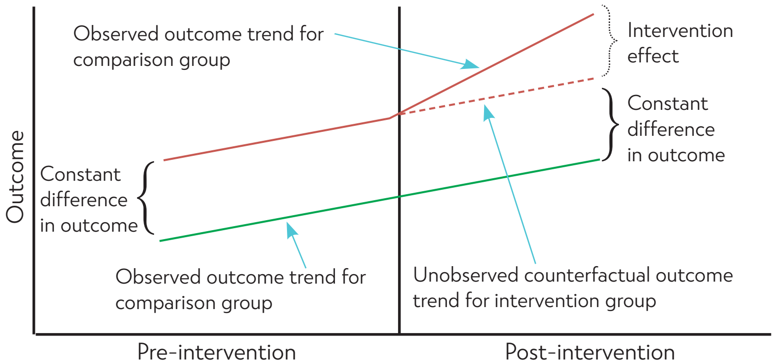


Source: Venkatesh et al. (2003).

8.2. Design of Evaluation Studies

Impact evaluation of the strategy is approached by comparing before and after project implementation. The evaluation design will apply a difference-in-differences (DID) model, which is used to estimate a causal effect using longitudinal data from treatment and control groups to obtain an appropriate counterfactual (figure 15.7). Three assumptions need to be

Figure 15.7 Difference-in-Difference Estimation, Graphical Explanation



Source: Columbia University Mailman School of Public Health (2019) (https://tinyurl.com/ydm8t7v5).

held: exchangeability, positivity and Stable Unit Treatment Value Assumption. The model also requires that:

- The intervention be unrelated to outcome at baseline (outcome did not determine allocation of intervention)
- Treatment or intervention and control group have parallel trends in outcome
- Composition of intervention and comparison groups be stable for repeated cross-sectional design
- There be no spill-over effects

DID will be implemented as an interaction term between time and treatment group dummy variables in a regression model:

$$Y = \beta 0 + \beta 1*[Time] + \beta 2*[Intervention] + \beta 3*[Time*Intervention] + \beta 4*[Covariates] + \varepsilon$$

Where:

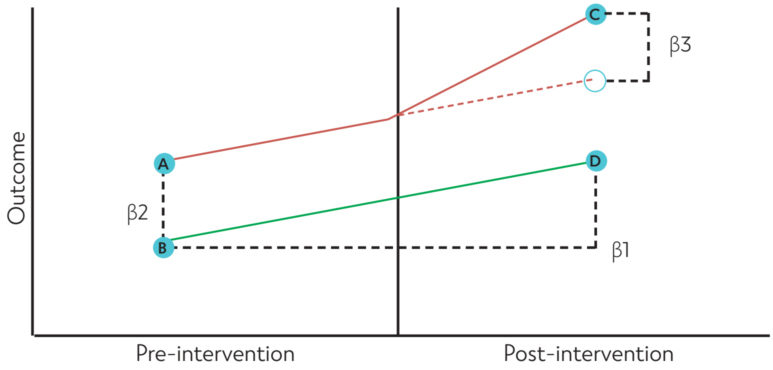
Y: Outcome
β0: Baseline average
β1: Time trend in control group
β2: Pre-intervention difference between two groups
β3: Differences in changes over time

The model can be explained through a graphical explanation (figure 15.8).

The benefit of adopting good practices will be assessed at two levels: group and individual. It is important to differentiate the impact of good practices of groups from that of individuals because the good practice may work only at the aggregate level and not at the individual, which adoption rates of individual farmers can affect. Therefore, assessing individual and group levels can reduce bias or overestimated impact. The benefit of the good practice is assumed to consist of production, quality, financial, social and environment aspects.

Data will be collected through a survey using structured questions and in focus group discussions. The survey will be conducted to collect quantitative data, whereas focus groups are required to capture qualitative opinions of farmers at the group level.

Figure 15.8 Model for Evaluating Benefits of Adoption of Good Practices



Source: Columbia University Mailman School of Public Health (2019) (https://tinyurl.com/ydm8t7v5)

Conclusions

Transformational development interventions confront major challenges stemming from highly unpredictable social systems due to the interaction of multiple and confounding factors and the emergence of conditions that are difficult to predict. Structural change is also likely to take place in time scales that go beyond the duration of the intervention. In this chapter, we presented an approach to help model the interactions among the key components of the system and to identify the conditions that are most likely to drive change towards a given development trajectory. We combined the use of CAS conceptual tools, network analysis and DEMATEL to model the interactions of the components of the system and to identify the most promising inflection points to steer the system development trajectory towards the desired long-term objective. This combined approach reduced drawbacks from using a single tool. CAS encourage deep observation of the system by identifying domains and help identify the conditions likely to contribute to the desired changes. Thus, CAS provided a comprehensive view of the system and of the extent of its complexity, although CAS are of limited utility for planning because it is not realistic that a project can directly target the multiple conditions and interactions of conditions across the system. Network analysis helped delineate the extent to which conditions influence each other. DEMATEL, by quantifying the effect of each condition, allowed us to identify cause factors, effect factors and the most prominent factor. Combining CAS, network analysis and DEMATEL helped developed a ToC composed of a set of robust hypotheses of the most influential conditions affecting the system development trajectory. The approach followed also used a variety of techniques to gather information, ensuring that the perspectives of the key stakeholders and the appropriate technical knowledge were incorporated at every stage of the process. Stakeholder participation and sound interdisciplinary scientific and technical knowledge were particularly important when developing strategies to intervene in the most influential conditions.

The approach we presented combines CAS-inspired ToCs with the use of qualitative and quantitative tools to map and track change system inflection points that can help steer a system's development trajectories towards long-term transformational objectives, also allowing a more meaningful and robust evaluation than if only theory-based or quantitative approaches were used. The approach we have presented is different from other ToC approaches inspired by systems thinking in two ways. First, instead of focusing on the transformation of a system, our approach focuses on *how to steer a system development trajectory that is consistent with a set of long-term objectives that are typically broadly articulated*. The second important difference is that, unlike other systems-based ToCs, which often focus on transformation pathways that identify likely sequences of developmental stages (or conditions), our approach focuses on affecting the *most influential conditions* to steer the system development trajectory in the direction of the stated objectives.

We have developed the ToC; mapped the interactions across conditions and identified causal factors, effect factors and most prominent factors as part of the inception phase of project implementation. At the time of writing this chapter, the project team was in the process of using the UTAUT model to design specific strategies to affect most influential conditions. The project implementation team will develop indicators for each of the most influential conditions in the system to assess progress made in redirecting the development trajectory at the system level. The project implementation team is also developing UTAUT model indicators to help assess the extent of stakeholder behavioural change that is consistent with the desired development trajectory and to provide timely information for adaptive management. Whenever feasible, the project implementation team is using SMART-C (Specific, Measurable. Accountable, Realistic, Time bound and Challenging) key performance indicators to measure change in the key system conditions. Key performance indicators combined with the recurrent annual ToC Working Group reviews will function as an early-warning system and learning mechanism to assist in adaptive management of the project during implementation.

On the practical side, the process of constructing a comprehensive ToC (which identifies conditions to steer the system in the desired trajectory, links between the conditions and the most influential conditions) is likely to take two to three months. A robust ToC requires in-depth understanding of the target system and its dynamics. To this end, it is necessary to build a common understanding among stakeholders through consultation, in-depth studies and review and discussion of the technical literature, but the project identification stage is often short and limited in resources, which does not allow for a full range of activities leading to development of a comprehensive model. In this example, the ToC was developed during the inception stage of the implementation phase. This can be a practical formula for similar projects, whereby the process can start in the project identification stage and continue to the inception stage. That said, establishing a ToC at any point in the life cycle of a project is useful, mainly because periodic revisiting of the ToC is necessary, especially considering the need for adaptive management. Although establishing a ToC at the outset should result in better strategic choices, doing so during the implementation phase can help project activities achieving better results.

The approach presented provides a framework particularly well suited to designing, managing and evaluating transformational interventions because it is based on a holistic understanding of the system an intervention seeks to influence. Other approaches seek to simplify complexity or design projects around specific development pathways. The model presented here helps identify a manageable number of conditions for intervention by embracing complexity by mapping the extent to which the key conditions interact and influence one another. We present an approach to provoke cause-and-effect cascades across the system that have a high likelihood of redirecting the system trajectory. The structure of the process is similar to that of a neural network, in which inputs provoke multiple interactions among system components, which are difficult to trace but result in a discernible set of outcomes (Shi 2019). A further comparison with neural networks is warranted. The approach we present engages technical and non-technical stakeholders from inception and throughout the project or programme cycle (including planning, monitoring and evaluation); this approach is likely to increase effectiveness and contribute to sustainability of the new trajectory by building stakeholder ownership of technically sound strategies and outcomes. Also, when incorporating multiple agents of development cooperation and sectoral ministries, the process helps improve communication between agencies and identifies opportunities for coordination and collaboration. The ToC also provides a framework for periodic review of project accomplishments and development of performance and impact indicators to inform the adaptive management of the process.

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Annex: Domains and Conditions

Production

P1. Capacity to apply good aquaculture practices, good manufacturing practices and good hygienic practices (skills, knowledge tools and services)
P2. Suitable business models
P3. Capacity to meet market requirements and demand
P4: Good production infrastructure
P5: Awareness of sustainable development issues
P6: Access to suitable production inputs

Market

M1. Appropriate trade infrastructure and logistics
M2. Symmetric information on demand: price, quality, quantity
M3: Suitable value chain coordination models
M4: Market incentives along value chain for quality, sustainability and equity
M5: Growing and diversifying market for sustainable seafood

Finance

F1. Pro–sustainable aquaculture financial institutions
F2. Appropriate financial business models along the value chain
F3: Well-educated financial literacy across actors
F4: Good coordination among funding institutions
F5: Bankable proposals for investment in sustainable aquaculture

Governance

G1. Conducive regulation and standards for ease of doing sustainable business
G2. Participatory approach and strong civil society
G3: Good coordination and cooperation among public and private institutions
G4: Reward and punishment system for (un)sustainable and good practices
G5: Coherence and harmonized policies and capacity to implement policy

Knowledge and Innovation

K1. Openness to new knowledge and innovation
K2: Good, strong research and development and training institutions
K3: Cooperation between academia, research and development, government and industry
K4: Good incentive system for Innovation
K5: Responsiveness to changes, developments and trends
K6: Evidence for good decision-making

The COVID-19 pandemic has demonstrated the enormous challenges humanity is facing. It has been facilitated by other crises as climate change, biodiversity loss, economic exploitation, and increased inequity and inequality. The UN Agenda 2030 and the Paris Agreement on climate change call for transformational change of our societies, our economies and our interaction with the environment. Evaluation is tasked to bring rigorous evidence to support transformation at all levels, from local to global. This book explores how the future of the evaluation profession can take shape in 18 chapters from authors from all over the world, from North and South, East and West, and from Indigenous and Decolonized voices to integrative perspectives for a truly sustainable future. It builds on what was discussed at the IDEAS Global Assembly in October 2019 in Prague and follows through by opening trajectories towards supporting transformation aimed at solving the global crises of our times.

By combining practical experiences with perspectives drawn from new initiatives, this book offers invaluable insights into how evaluation can be transformed to support transformational change on the global stage.

Indran A. Naidoo, Director of the Office of Independent Evaluation of IFAD

Across continents, educational systems, and historical complexities, this book builds up the language we all should speak about our field. A mandatory read for all young evaluators.

Weronika Felcis, Board member of EES and Secretary of IOCE

After reading these chapters you will have a sharper look at what is relevant when managing or doing an evaluation, and you will notice that 'business as usual' will no longer be an option.

Janett Salvador, Co-founder of ACEVAL, Former Treasurer of ReLAC

This book offers original, visionary discourse and critical perspectives on the challenges evaluation is facing in the post COVID-19 pandemic era.

Doha Abdelhamid, Member of the Egyptian Academy of Scientific Research and Technology

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