

Using theory to understand how policy change happens: Insights from agricultural research for development

Boru Douthwaite ^{1,2,*}, Claudio Proietti ³, Vivian Polar², Graham Thiele²

¹Selkie Consulting Ltd., Cushalogurt, Kilmeena, Westport, Co. Mayo, Ireland

²CGIAR Research Program on Roots, Tubers and Bananas (RTB), led by the International Potato Center (CIP), Av. La Molina 1895, Distrito de La Molina, Lima 12, Peru

³Center for International Cooperation in Agricultural Research for Development (CIRAD), Bâtiment 1, 389 Av. Agropolis, 34980 Montpellier-sur-Lez, France

*Corresponding author. Email: bdouthwaite@gmail.com.

Abstract

Influencing policy is an important scaling mechanism. However, if a program is to plausibly claim that it has or can influence policy, it needs to explain how. This is not straightforward because of the complex nature of policy change. Scholars suggest the use of theory to help answer the 'how' question. In this article, we show how, in practice, a middle-range policy change theory—Kingdon's Policy Window theory—helped us model the workings of four outcome trajectories that produced agricultural policy outcomes in four cases. By providing a common framework, the middle-range theory helped accumulate learning from one evaluation to the next, generating specific and generalizable insights in the process. Accumulation learning in this way can help organizations become more convincing in the proposals they write to donors, more accountable and better able to identify and deliver on their goals.

Keywords: biofortification; seed certification; middle-range theory; realist evaluation; theory of change

1. Introduction

Much public-sector-funded food and agricultural research for development is carried out through projects and programs. Donors and implementers increasingly expect that their investments and interventions make a meaningful difference to the Sustainable Development Goals (SDGs) of which there are 20, set at a global scale. For example, the Global Alliance for Improved Nutrition is working in nine countries to end malnutrition in all its forms by 2030 (SDG2), with an annual budget of US\$45 million.¹ At a larger scale, the CGIAR intends to contribute to five so-called SDG-focused Impact Areas: (1) nutrition, health, and food security; (2) poverty reduction, livelihoods, and jobs; (3) gender equality, youth, and social inclusion; (4) climate adaptation and mitigation; and (5) environmental health and biodiversity, and in so doing contribute to impact targets in 13 out of 20 SDGs. The CGIAR calls itself the world's largest global innovation network with an annual budget in 2019 of US\$830 million.² To put the budget into perspective, it represents just 0.54%³ of official development assistance provided by OECD countries in the same year.

Given the comparatively small budget allocation, if agricultural research for development projects and programs are to make a meaningful contribution to SDG targets, they will need to show how they will achieve leverage, i.e. show how relatively small investments can realistically be expected to trigger change at national or regional scale. One such lever is influencing policy change. Research, carried out at relatively little cost, can provide evidence that contributes to highly-impactful policies being implemented. For example, research investment of around US\$1 million, carried out by the CGIAR, has contributed to the design of US\$50 billion Indian

government program to support solar irrigation pumping. Part of the KUSUM program, as it is known, will connect over a million farmers to the electricity grid so that they can sell excess power and be motivated to pump less ground water. This will have far reaching impacts with respect to farmer income, reduction in emission of greenhouse gases (most of the electricity currently used for pumping is generated by coal-fired power stations), and reduction in over pumping of ground water (Verma, Durga and Shah 2019; Douthwaite and Shepherd 2020).

Another example of research influencing policy leading to impact is provided by the orange-fleshed sweetpotato outcome trajectory in Africa. By 2019, 6.2 million households in 15 countries in Africa had been reached by a CGIAR-led biofortification initiative to introduce orange-fleshed sweetpotato rich in pro-vitamin A (Low and Thiele 2020). Vitamin A deficiency in children has been linked to problems with vision, higher risks of infection, and mortality and stunting and is estimated to affect 48% of children in Africa in 2013 (Stevens et al. 2015). The level of reach was achieved in part through research that provided convincing evidence to the global nutrition community that biofortification was highly cost-effective, worked at scale (de Brauw et al. 2018), and therefore resources should be brought to bear to work on the outcome trajectory. Reallocation of resources is a policy-related outcome (Renkow 2018).

If a program is to plausibly claim that it has or can influence policy, it needs to explain how. This is not straightforward because policy making is influenced by a complex set of factors that change from context to context (Mueller 2020) involving a number of steps that can take a long time (Whelan 2008). As a result, scholars suggest the use of

theory-driven evaluation in which previous experience, distilled out into theories about how behaviors change, is used to help unpick what has happened, is happening, or likely to happen in the future.

Luckily, a number of theories exist as to how policy change occurs. Sabatier (2007) edited the book ‘Theories of the Policy Process’ that identified six theoretical frameworks that passed a number of criteria, including that: they must do a reasonable job of meeting the criteria of a scientific theory; and, that they must apply to most of the policy process in a variety of political systems (Sabatier 2007: 8). These can be understood as middle-range theories because they are positioned between universal social theories on one hand, and more location- and context-specific program theory/theory of change (ToC) on the other (Pawson 2010, 2013).

The context-specific nature of policy change suggests that to be useful, middle-range theories need to be adapted and specified to the policy change envisaged and the institutional and political environment in which the program is working. It also suggests that there will be benefit in accumulating learning on how specific contexts influence generative mechanisms and outcomes from one evaluation to the next.

Accordingly, this article seeks to answer two questions:

- Q1: How can middle-range policy change theories be used to accumulate and synthesize learning and insight from one policy evaluation to the next?
- Q2: How can middle-range theories be adapted and specified to help understand how families of similar policy change programs work?

In answering the questions, our overall objective is to demonstrate how evaluation can help programs become more convincing in the proposals they write to donors, more accountable, and better able to deliver on their goals.

2. Conceptual framework

We assume a theory-driven Realist-informed perspective, similar to that described in Douthwaite et al. (2017).

Despite scholars recommending the use of theory to help understand programs that set out to change people’s behavior, using published theory in the evaluations of such projects is not common as it should be (Whelan 2008; Arensman, Van Waegeningh and Van Wessel 2018). Rather, standard practice for evaluations carried out by UN organizations, and others that follow OECD guidelines (OECD 2021), is to evaluate whether programs were faithful to the program theory developed during program proposal development. Typically, these theories take the form of diagrams that link program activities to outputs to short-term behavior changes and then to longer-term impact. Links are drawn as arrows between boxes. Rarely are the causal assumptions implied by the arrows, explained. Typical evaluations are not informed by, or contribute to, any accumulation of learning from one evaluation to the next.

We adopt the Realist position that an appropriate middle-range theory can help in the construction of program theory for a set of similar programs, while at the same time serve as a reusable conceptual platform to help in the accumulation of learning from the evaluation of one similar program to the next (Pawson 2013).

Another concept important to this article is that of an outcome trajectory. Outcomes that programs report are rarely, if ever, one-off events but rather emerge over time as the result of interacting and co-evolving systems of actors, knowledge, technology, and institutions, as described by Axelrod and Cohen (2000) and similarly Douthwaite et al. (2002). We define an outcome trajectory as the interacting and co-evolving system of actors, knowledge, technology, and institutions that produce, sustain, and sometimes scale a coherent set of outcomes over time. The term builds on Paz-Ybarnegaray and Douthwaite (2017) who developed Outcome Evidencing, a method to understand and assess the contributions of a program as part of a broader outcome trajectory. Programs achieve their outcomes through contributing to outcome trajectories. Trajectory actors include, but are not limited to, the set of program actors.

From a realist perspective, outcome trajectories can be understood as middle-range generative mechanisms that are influenced by the socioeconomic, institutional, and agroecological context in which they operate. While there are different views as to what, exactly, is a generative mechanism, we assume a definition based on Lacouture et al. (2015: 1). A mechanism is what influences the reasoning and reactions of actors in regard to the resources available in a given context, including program resources. Program interventions trigger mechanisms that can become weaker or stronger over time, within a social system of relationships.

In the outcome trajectory approach presented in this article (described in Douthwaite et al. *in press*), our starting point is a claimed-program-outcome and the assumption of an outcome trajectory has generated it. We then use a selected middle-range theory to help develop a ToC to describe the workings of the outcome trajectory, over time. Next, we use the ToC to help explain the contribution of the program being evaluated to the outcome trajectory. This is different to other approaches to program evaluation that seek to attribute outcomes directly to program intervention, without acknowledging the existing processes and dynamics that characterize the system to which the program brings its contributions. One of the limitations of putting program theories, instead of outcome trajectories, at the center of the inquiry is that these theories may underplay the contribution of other actors and initiatives to the causal package responsible for program outcomes (Mayne 2012). Also, as noted by Schmitt and Beach (2015), program theories in theory-based evaluation often do not investigate the causal links and treat them simply as assumptions that remain unstudied empirically. In our experience, this comes with the risk of overestimating the causal power of the program by being partially blind to, and thus underestimating, the contributions made by other actors and initiatives.

In summary, an outcome trajectory approach builds ToC to model the workings of the outcome trajectory and then describes the program’s contribution to that trajectory. This is different to program theory evaluations that put the program at the center of the theory.

3. Materials and methods

To achieve the article’s objectives, we took advantage of an independent evaluation conducted by the CGIAR Research Program on Roots, Tubers and Bananas (RTB) together with a sister program on Agriculture for Health and Nutrition (A4NH). Leadership in both programs wanted to better understand and document their respective contributions to

Table 1. Four policy change cases considered in the evaluation (adapted with permission)

Case title	Main outcomes achieved
1. Mainstreaming of biofortification ^a in the African Union (AU)	A continental declaration has been drafted by the AU Commission (AUC) that endorses regional- and country-level operationalization of biofortification as a strategic step in accelerating the scale-up and adoption of biofortified crops and products.
2. Development of a cassava seed certification system in Tanzania	A cassava seed certification system is being increasingly put into place to control cassava mosaic disease (CMD) and cassava brown streak disease (CBSD) based on seed standards that have been passed into law to provide a regulatory framework
3. Development of a cassava seed certification system in Rwanda	The same as Tanzania, but in less time, having benefited from experience from Tanzania
4. Control of potato purple top (Purple Top—Spanish acronym) in Ecuador	Establishment of a national-level technical committee who have drafted a coordinated national control strategy.

^aBiofortification is a process of increasing the density of vitamins and minerals in a crop through plant breeding or agronomic practices so that the biofortified crops, when consumed regularly, will generate measurable improvement in vitamin and mineral nutritional status.

policy change, in part to account to their investors for funds provided, and in part to learn and become more effective at influencing policy in the future. The first author was commissioned to carry out the work, in close collaboration with the co-authors who managed the evaluations on behalf of RTB and A4NH and subsequently contributed to cross-case analysis and writing this article.

RTB and A4NH chose the cases to be assessed (Table 1) as part of developing the terms of reference for the evaluations. Cases represent a sub-set of significant policy changes reported by program teams as plausibly linked to CGIAR contributions. Selected cases were the ones for which some information supporting plausible links was available and where the respective teams wanted their cases to be documented and analyzed.

We evaluated the four cases sequentially following the same approach, described in detail in Douthwaite et al. (in press). In summary, the steps were as follows:

- 1) Select the middle-range theory to be used across all four evaluations (Figure 1);
- 2) For each case, identify and describe the outcome trajectory that produced the policy outcomes with an annotated timeline;
- 3) Use the selected middle-range theory as the basis for a case-specific ToC that explains the workings of the respective outcome trajectory, i.e. how the strategies used by the trajectory actors contributed to a chosen policy outcome;
- 4) Validate the outcome trajectory timeline and the case-specific ToC with key trajectory actors;
- 5) Use the validated timeline and ToC to answer the evaluation questions and write the respective evaluation reports;
- 6) Subject each of the four draft reports for fact and inference with key trajectory actors;
- 7) Accumulate learning and generate insights by comparing and contrasting between the four cases, and specifying a ToC that works for all four cases (Figure 3).

Under Step 1, we searched the policy change literature for middle-range theories relevant to the cases to be evaluated. We identified a brief by Stachowiak (2013) that chose three of the six theoretical frameworks described in Sabatier's book. She simplified and explained them such that they could be more easily understood by evaluators and program implementers without a political science background. She considered two other theories that were not considered by Sabatier (2007)—'power politics' and 'regime.' The five middle-range

theories are summarized in Table 2. We sent Stachowiak's brief to the key individuals involved in the first case we evaluated so that they could understand and chose the theory that best fitted their experiences.

We chose biofortification as the first case because it was the case where participants had worked more explicitly and for longer on influencing policy at scale. The key individuals chose the Policy Window theory (see Figure 1) as best describing their experiences. We then used the theory for the other three cases so as to test whether using the same analytical framework would help in practice to generate cross-case sights and learning. In doing so, we were reassured that Policy Window theory, originally developed by Kingdon (1995) and also known as the multiple-streams framework, has been found to be the most widely applicable to a variety of policy arenas (Sabatier 2007). We also considered whether elements of the other theories might better explain phenomenon we came across, and found that Coalition Theory did with respect to identifying coalition formation as a generative mechanism.

The Policy Window theory proposes that policy changes during *windows of opportunity*, which help champions successfully connect two or more components of the policy process. The components are: the way a *problem* is defined; the *policy solution* to the problem; and, the *politics* surrounding the issue (Zahariadis 2007; Stachowiak 2013). Windows of opportunity are moments when progress can be made. They can be created by natural events such as pandemics, droughts, or earthquakes. They can also be changes in government, budget cycles, or landmark meetings and summits held as part of ongoing sub-national, national, regional, and global processes. Policy windows are often short in duration and may or may not be predictable.

As part of Step 3, we developed a case-specific version of the generic theory to help identify and explain in which contexts and through which mechanisms the strategies used by the trajectory actors contributed to policy outcomes. We validated each of the four ToCs with key actors involved in the respective outcome trajectories and then used them to help answer the same evaluation questions for each case.

Each of the four case evaluations were reviewed by a subset of key trajectory actors, before being published by the CGIAR (Douthwaite 2020a,b,c,d).

4. Findings

In this section, we address our overall objective by carrying out cross-case analysis to answer the two questions described

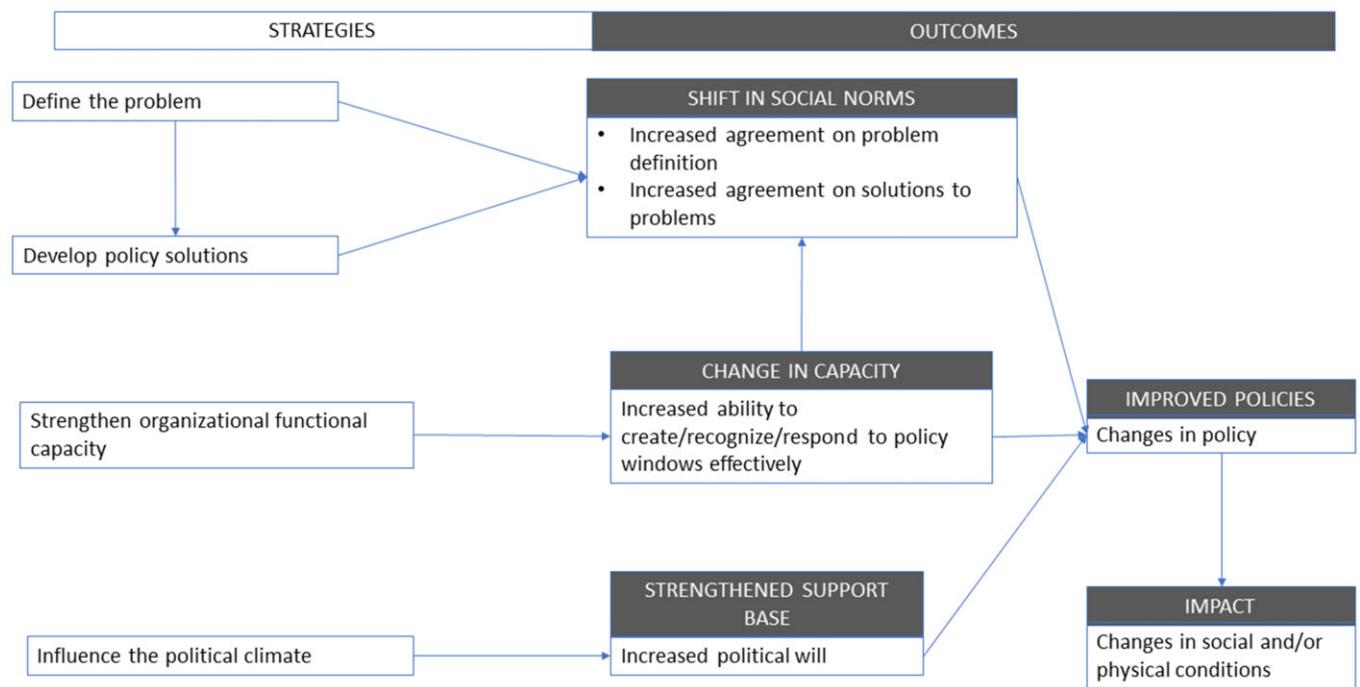


Figure 1. Policy Window theory chosen to describe how CGIAR interventions contributed to policy change in four cases (adapted from Stachowiak 2013: 8). Adapted with permission.

Table 2. Five middle-range theories that describe how policy change happens (from Stachowiak 2013: 3)

Middle-range theory	Description
Large Leaps	Like seismic evolutionary shifts, significant changes in policy and institutions can occur when the right conditions are in place
Policy Window	Policy can be changed during a window of opportunity when advocates can successfully connect two or more components of the policy process (i.e. the way a problem is defined, the policy solution to the problem, and/or the political climate around the issue)
Coalition	Policy change happens through coordinated activity among a range of individuals with the same core policy beliefs
Power Politics	Policy change is made by working directly with those with power to make decisions or influence decision making
Regime	Policy change happens through the support and empowerment of policy makers by a close-knit body of influential individuals

in the Section ‘Introduction’. The four cases are summarized in Table 3. It shows that the potential number of beneficiaries of the four trajectories range by orders of magnitude from millions of farmers and consumers to tens of thousands of farmers, as did the level of investment made. In three cases, outcomes related to the development, agreement, and adoption of policies. In the fourth trajectory (Purple Top), which has progressed least far, the outcome related to the establishment of a national-level technical committee to develop policy. All trajectories were framed and driven forward by groups of actors that included: the policy owner—the organization with responsibility to pass any required legislation and to follow-up on implementation; research actors responsible

for providing much of the implementation and drive; and the donors who provided financial and other support.

The biofortification outcome trajectory had the broadest geographical scope working at a pan-Africa scale as compared to the others that worked at a national scale. It is also the trajectory where the largest investment was mobilized as part of a larger body of work realized to develop and promote biofortified crops and their value chains, globally. In contrast, two orders of magnitude less was spent on the Purple Top trajectory because the trajectory was relatively young and with a much narrower geographical scope and potential impact in terms of total number of beneficiaries.

More was spent on the Tanzania trajectory than the Rwanda one, in part because it started earlier. Rwanda was able to learn from Tanzania such that International Institute for Tropical Agriculture (IITA)/RTB was able to support the development and approval of cassava seed standards in 1 year, compared to 5 years in Tanzania.

Table 3 shows a spread in the dates when the trajectories took shape. For biofortification, this was when the idea of a continental declaration was first considered by the African Union (AU) Commission. For the cassava seed system trajectory in Tanzania, it was when a project began to develop cassava seed systems in the region. For Purple Top, it was when the International Potato Center (CIP, Spanish acronym) undertook a Purple Top risk assessment as a strategy to build support for the trajectory. The trajectory timelines in the four published evaluations (Douthwaite 2020a,b,c,d) show the eventual actors in the respective outcome trajectories had been working together on the respective topics for some time. Work on biofortification in Africa began 14 years previously, in 2001, when CIP launched the Vitamin A for Africa Partnership to combat vitamin A deficiency in Sub-Saharan Africa through increased use of orange-fleshed sweetpotato. A quality management protocol for cassava seed was first

Table 3. Characteristics of the four policy outcome trajectories, achievements to date, and potential for impact

	Biofortification declaration at continental-level	Cassava seed certification in Tanzania	Cassava seed certification in Rwanda	Control of Purple Top in Ecuador
Policy change sought	Continental declaration by the African Union in support of biofortification	Cassava seed certification system implemented by a national government	Cassava seed certification system implemented by a national government	Coordinated national-level response to control Purple Top
Main outcome achieved to date	Continental declaration drafted and awaiting ratification	Standards published; TOSCI 5-Year action plan for Cassava Seed Certification approved	Standards published	National technical committee established; control strategy drafted
Further work required	Advocating to include biofortification in National Agricultural Investment Plans	Develop a market-led cassava seed system that takes standards into account	Develop a market-led cassava seed system that takes standards into account	National technical committee to show strong leadership and be adequately funded
Key trajectory actors	Policy owner: AUC-DREA Research: CGIAR, AUDA, FARA, Donor: BMGF, DFID	Policy Owner: TOSCI Research: CGIAR, TARI, MEDA Donor: BMGF	Policy owner: RSB Research: CGIAR, RAB, RALIS, INAGBO Donor: IFAD	Policy owner: MAG Research: INIAP, Agrocalidad, CGIAR, FAO, Central University Donor: AECID, CIP
Year trajectory took shape	2015	2012	2017	2018
Estimated investment in the policy trajectory (US\$)	Millions	Hundreds of thousands	Hundreds of thousands	Tens of thousands
Potential number of beneficiaries	Millions of women and young children in Africa consuming biofortified foods and millions of farmers growing biofortified varieties	Millions of cassava farmers in Tanzania	Hundreds of thousands of farmers in Rwanda	Tens of thousands of farmers in Ecuador; potential spillover benefits for hundreds of thousands of farmers in the Andes

AECID: Spanish Agency for International Development Cooperation; Agrocalidad: Agency responsible for phytosanitary and zoonosanitary regulation and control in Ecuador; AUC-DREA: African Union Commission-Department of Rural Economy and Agriculture; AUDA: African Union Development Agency; BMGF: Bill & Melinda Gates Foundation; CIP: International Potato Center; DFID: Department for International Development; FAO: Food and Agriculture Organization of the United Nations; FARA: Forum for Agriculture Research for Africa; IFAD: International Fund for Agricultural Development; INAGBO: Rwanda Farmers' Trade Union; INIAP: National Institute of Agricultural Research (Ecuador); MAG: Ministry of Agriculture and Livestock; MEDA: Mennonite Economic Development Associates; RAB: Rwanda Agricultural Board; RALIS: Rwanda Agriculture and Livestock Inspection Services; RSB: Rwanda Standards Board; TARI: Tanzania Agricultural Research Institute; TOSCI: Tanzania Official Seed Certification Institute.

developed in 1997 by a project in which IITA participated, 15 years before a version of it was finally approved in Tanzania as the basis of seed certification regulations.

4.1 Q1: How can middle-range theory be used to accumulate and synthesize learning and insight from one evaluation to the next?

We answer this question by doing what the question asks—trying in practice to accumulate and synthesize learning and insight by using the Policy Window theory (Figure 1) as a reusable conceptual framework across the four published cases. We do so by addressing sub questions (SQs) corresponding to elements of the middle-range theory, case by case. The first three SQs unpack how the three main outcomes—shift in social norms, change in capacity, and strengthened support base—shown in the Policy Window theory were generated in each case by strategies implemented by trajectory actors. The fourth SQ explores how useful the Policy Window ToC and a realist perspective were in understanding how trajectory actors contributed to policy change in the four cases.

4.1.1 SQ1: How did the 'shift in social norms' outcome manifest itself in the four cases?

The outcome 'influence social norms' took on specific meaning in the four cases. In each case, the outcome was increasing shared agreement by actors within and outside the respective

outcome trajectories as to the nature and severity of the problem on one hand, and the potential and practicality of the proposed solution on the other.

Table 4 shows the strategies used by key actors in the four respective outcome trajectories to bring about a 'shift in social norms.' Analysis of the cases found that the actors used three types of strategies—framing the problem, framing the solution, and communication.

4.1.1.1 Framing the problem

In three of the trajectories, the problem to be addressed was relatively well understood which allowed for most of the effort to shift social norms to focus on developing, proving, framing, and communicating the respective policy solutions. The exception was the Ecuador case where Purple Top was a new disease that needed to be better understood before a set of control measures could be identified and agreed upon. The disease, which first arrived in Ecuador in 2012, proved to be difficult to diagnose. In contrast, cassava mosaic disease (CMD) and cassava brown streak disease (CBSD) have been present in Tanzania and Rwanda for at least 85 and 110 years, respectively, and the problem they pose is relatively well understood, albeit both viruses have become more virulent in the last 25 years. The CBSD and CMD problem was framed by research published in 2006⁴ that estimated the diseases threatened income security for over 30 million African

Table 4. Strategies identified in the four cases that brought about a 'shift in social norms'

Type of strategy	Specific strategies used	Cases that used it
Framing the problem	Research to identify vectors and causal agents of Purple Top	Purple Top
	Research to document impact of Purple Top	Purple Top
	Bringing in outside experts to help understand Purple Top	Purple Top
Framing the solution	'Gold standard' research showing biofortification can significantly reduce the main types of micronutrient malnutrition	Biofortification
	Demonstrating that biofortified crops can be grown at scale in Africa	Biofortification
	Work to establish biofortification as a solution that can be defined and measured in National Agricultural Implementation Plans (NAIPs)	Biofortification
	Formation of a technical committee to develop seed standards	Tanzania and Rwanda
	Development and piloting of business models	Tanzania and Rwanda
	Formation of platforms, committees, and groups to tackle Purple Top	Purple Top
	Development of effective Purple Top control measures	Purple Top
Communicating the problem or solution	Maintaining a clear and consistent message	Biofortification
	Framing of solution as complementary to other ways of reducing micronutrient malnutrition	Biofortification
	Issuing press releases	Biofortification, Tanzania and Rwanda
	Communication of the problem and/or solution in academic conferences	Purple Top

farmers costing more than US\$1 billion a year. As of 2020, the extent of losses to Purple Top in Ecuador were yet to be properly estimated.

The problem of micronutrient malnutrition, addressed by the biofortification case, is well researched given the high priority of nutrition globally. According to [FAO \(2013\)](#), micronutrient deficiencies afflict more than 2 billion individuals, or one in three people, globally. This number has been broadly publicized by the nutrition community.

4.1.1.2 Framing the solution

Actors in all four trajectories worked on developing and demonstrating their respective solutions. In the three national-level trajectories, the key actors formed technical committees to develop workable policies. In the Tanzania and Rwanda cases, the responsible seed certification institution hosted an inclusive technical committee to develop and consult on cassava seed standards. In Ecuador, the Ministry for Agriculture and Livestock called for a national-level technical committee that then drafted a Purple Top control strategy, aspects of which can be expected to become policy in the future.

In the biofortification case, trajectory actors worked to successfully write biofortification into National Agricultural Implementation Plans as well as into the AU's business plan to implement the CAADP-Malabo Declaration 2017–21.⁵ The latter provided a signal to AU member states to grow more biofortified crops. Time was also invested in developing nutrition indicators to motivate adoption, e.g. that consumption of biofortified food counts toward a country achieving its targets for improving dietary diversity.

The relative observability and trialability of solutions affected the strategies required to effectively frame them. The relatively visible and immediate solution of clean seed certification to help control cassava viral diseases was an easier sell

than the less visible and less immediate solution of biofortified crops to tackle hidden hunger. To frame biofortification as a solution to micronutrient malnutrition, a CGIAR-led project carried out a randomized control effectiveness trial costing US\$6 million over 3 years in Mozambique and Uganda. The trial was designed to test whether biofortified sweetpotato, provided to farmers, resulted in a reduction in vitamin A deficiency in their families. This level of evidence was also thought necessary to influence policy decisions at the highest level, as randomized control trials are widely viewed as the 'gold standard' with respect to proving causation. No randomized control trial has been carried out in the other three trajectories.

As already discussed, the CGIAR has been able to show that by 2019, 6.2 million households in 15 countries in Africa had been introduced to orange-fleshed sweetpotato rich in pro-vitamin A ([Low and Thiele 2020](#)), demonstrating that the solution is implementable at scale. The other three trajectories have not yet achieved similar reach, although providing clean cassava planting material has the potential to benefit millions.

Uptake of seed certification standards for cassava in Tanzania and Rwanda was helped by projects that developed business models to demonstrate that rural entrepreneurs could run viable businesses producing and selling certified cassava planting material.

4.1.1.3 Communication

Biofortification trajectory actors placed particular emphasis on communicating that biofortification was complementary to other ways of tackling micronutrient malnutrition, so as to attach the solution to a broader effort being undertaken on improving nutrition in Africa. Biofortification actors also focused on maintaining a clear and consistent message. In Rwanda and Tanzania, actors sought press coverage by

putting out press releases. In the Rwanda case, their impact benefited from a heightened concern about CBSD following a very large outbreak. This led to a number of news stories being published, in particular by the New Times newspaper. These stories were particularly effective because they confirmed what politicians were hearing from their constituents in cassava growing areas. In contrast, communication on Purple Top control was largely limited to presentations at conferences by INIAP, Agrocalidad, and the Central University, due to lack of project funding.

4.1.1.4 Evolving strategies and interaction

The three strategies just considered overlap and co-evolved together, as shown in Figure 2. Framing the problem clearly is an important first step that leads to framing the solution. Communication can combine elements of the problem and the solution to foster shifts in social norms. This comes through clearly in the Purple Top case where communication was linked closely with the framing of the problem through presentations at conferences and stakeholder events. Similarly, the Rwanda case showed how newspaper communication during a large outbreak linked the problem of CBSD with the solution provided by seed system regulation.

4.1.2 SQ 2: How did the ‘change in capacity’ outcome manifest itself in the four cases?

Table 5 shows the strategies used by key actors in the four respective outcome trajectories to bring about ‘changes in capacity.’ It shows there is a difference in whether trajectory actors invested in formal advocacy, informal advocacy, or both, where formal advocacy is carried out by acknowledged champions and informal advocacy is carried out as part of professional discourse without the advocate necessarily being aware that they are playing that role.

4.1.2.1 Increasing capacity to carry out formal advocacy

Actors in biofortification and cassava seed system trajectories were explicit that they carried out advocacy to bring about desired policy changes. In the former, Bill & Melinda Gates Foundation (BMGF) funded two consecutive CGIAR- and FARA-led projects to train national and regional networks of ‘champions’ to advocate for biofortification in Africa over a

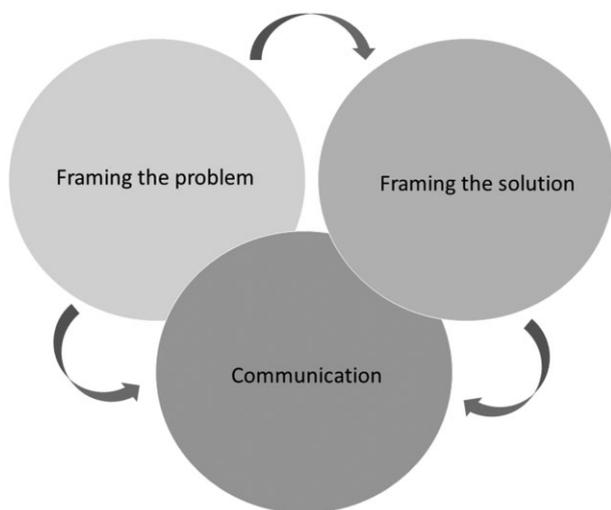


Figure 2. Sequence and interaction between strategies used to prompt shifts in social norms.

period of 6 years. Capacity development included showing participants how to link biofortification into broader nutrition policy processes, in particular through holding side events at high-level meetings on nutrition. Champions were crucial in creating bridges to communicate with higher level decision makers.

In Tanzania, a CGIAR-led component of a project recruited and supported District-level champions to advocate for the use of government funding allocated to Districts to promote cassava as a cash crop. The thinking was that the seed certification system would only be viable if farmers earn enough to pay for certified planting material.

4.1.2.2 Increasing capacity to carry out informal advocacy

The evaluations found that in Tanzania and Rwanda advocacy messages traveled ‘informally’ through the professional links that existed between CGIAR staff and their counterparts working in the respective national agricultural research and extension systems. National staff shared ownership of the seed certification work with CGIAR staff. They also had links to policy makers and had sufficient agency to help push the policy process forward. What worked in practice was the combination of broad, consultive workshops to frame the problem and solution, the formation of an inclusive technical working group in each country to develop the standards and one-on-one meetings between informal champions and key decision-makers. Funding to support this work came from CGIAR- and NGO-led projects that built on previous projects in support of the respective outcome trajectories.

These empirical findings suggest that informal advocacy is possible when individuals pushing for a policy change have strong working relationships with colleagues who themselves are close in network terms to the pivotal decision-makers. When the network distance⁶ is greater, e.g. when working at a continental scale as with the AU, or at District level in Tanzania, then champions need to be enlisted through a more formal and explicit process so as to bridge the network gap.

4.1.2.3 Increasing capacity to implement the solutions

In the two cassava seed trajectories, capacity development of farmers, seed producers, seed inspectors, and laboratory staff were important for seed certification to happen, in part by convincing key decision-makers that cassava seed certification was implementable and worthwhile. In Tanzania, trajectory actors trained cassava food processors in how to use cassava flour to replace more expensive imports of wheat flour, and in so doing take advantage of a market opportunity.

Capacity development was also important to help farmers know how to control Purple Top, even though there was no consensus on how best to do so. The evaluations found some indication that lack of public-sector support to the trajectory allowed agri-chemical suppliers to promote greater use of insecticides than public sector bodies would recommend.

4.1.3 SQ 3: How does the ‘strengthened support base’ outcome manifest itself in the four cases?

In all four cases, a ‘strengthened support base’ manifested itself as a more enabling political and financial environment for the four respective policy changes (Table 1).

Table 6 shows the strategies used by key actors in the four respective outcome trajectories to bring about a ‘strengthened support base.’ Analysis of the cases found that that the actors

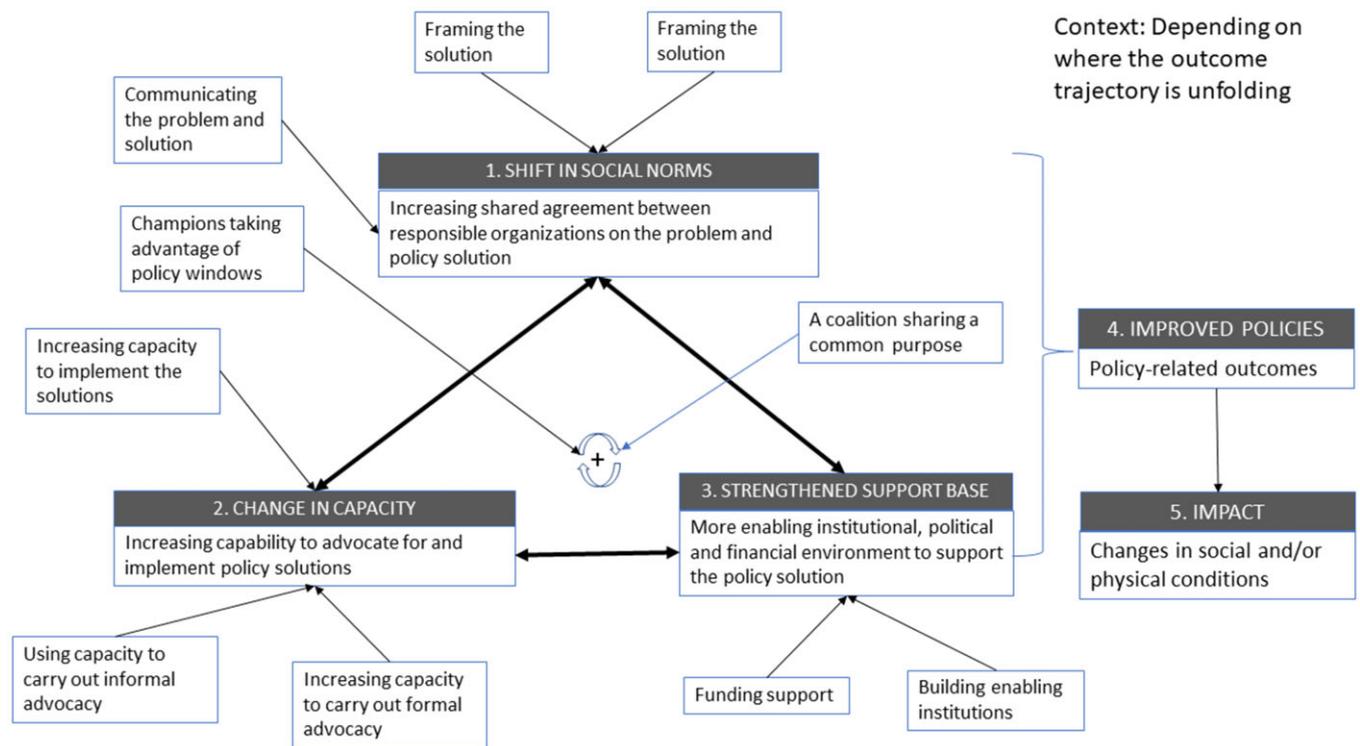


Figure 3. Policy window theory adapted and specified to better model how policy change happens in tropical agriculture.

Table 5. Strategies identified in the four cases to bring about changes in capacity

Type of strategy	Specific strategies used	Cases that used it
Increasing capacity to carry out formal advocacy	Building the capacity of biofortification champions to advocate	Biofortification
	New scientific evidence regularly provided to champions	Biofortification
	Building the capacity of a network of district-level champions promoting cassava production, processing, and commercialization	Tanzania
Increasing capacity to carry out informal advocacy	Building on existing professional networks to carry out advocacy informally	Tanzania, Rwanda, and Purple Top
Increasing capacity to implement the solution	Training TARI staff in basic seed production	Tanzania
	Training TOSCI staff in seed certification scheme implementation including upgrading lab skills	Tanzania
	Training provided to seed entrepreneurs and inspectors	Tanzania
	Training of seed inspectors and seed producers	Rwanda
	‘Learning by using’ of QDS protocol by RAB staff	Rwanda
	Training of technicians and farmers in the control of Purple Top	Purple Top

used two strategies—finding funding support and building enabling institutions.

4.1.3.1 Funding support

Availability of funding was one of the most important enablers for all four of the policy trajectories. A valued competency of the CGIAR by other trajectory actors was CGIAR ability to propose and win multi-partner projects. The CGIAR in Tanzania and Rwanda had more success than in

Ecuador. The Tanzania trajectory benefited from consistent support from BMGF from 2007 and was set to continue until 2024. IFAD provided consistent support to the Rwanda trajectory from 2017. In Ecuador, CGIAR championed and supported the carrying out of a risk assessment as a strategy to bring more funding to bear on the threat posed by Purple Top. The AU biofortification trajectory had consistent funding from BMGF and Department for International Development (DFID).

Table 6. Strategies identified in the four cases that strengthened the support base in the respective outcome trajectories

Type of strategy	Specific strategies used	Cases that used it
Funding support	CGIAR proposing and winning two projects to build a network of regional biofortification champions	Biofortification
	CGIAR proposing and winning projects to: (1) provide clean cassava seed in response to CBSD and CMD outbreaks; and (2) strengthen the cassava value chain	Tanzania and Rwanda
	CGIAR proposing and winning projects to tackle Purple Top Risk assessment carried out as a pre-requisite for a declaration of emergency and release of funding	Ecuador Ecuador
Building enabling institutions	Explicitly establishing and supporting a network of champions	Biofortification and Tanzania
	Two main biofortification donors (BMGF and DFID) forming and supporting high level panels of African leaders who championed biofortification	Biofortification
	Establishment of and support to a seed growers association	Tanzania
	Launch of a regional initiative to prevent the spread of Purple Top	Purple Top
	Government measures to expand the market for cassava, e.g. establishment of cassava mill	Tanzania and Rwanda
	Coalition-building: implicitly creating and strengthening of linkages between trajectory actors, e.g. setting up and supporting national-level technical working groups	Tanzania, Rwanda & Purple Top
Engagement in an RTB-coordinated community of practice working on improving seed systems for vegetatively-propagated crops	Tanzania, Rwanda & Purple Top	

4.1.3.2 Building enabling institutions

The evaluations found that trajectory actors employed and benefited from a number of strategies to build enabling institutions at different scales. BMGF and DFID provided support to high-level panels of African leaders, including the Global Panel on Agriculture and Food Systems for Nutrition (the Global Panel) and the African Leaders for Nutrition Initiative. These panels actively supported biofortification as part of a package of measures to combat micronutrient malnutrition. This helped biofortification be seen as complementary to other strategies to tackle micronutrient malnutrition, including fortification, dietary diversity, and supplementation.

Two back-to-back projects established a network of regional- and national-level biofortification champions that proved key to the success of the Africa-wide trajectory. In Tanzania, a project supported a network of champions advocating for Districts to grow cassava as a cash crop.

In Tanzania, Rwanda, and Ecuador, the main enabling institution was a national-level technical working group led by the respective policy owners, supported by CGIAR. The evaluation found that the working groups helped build a coalition of key people supporting and championing the trajectory, to which CGIAR contribution was necessary but not sufficient.

In Tanzania, a multi-partner project established a seed growers' association that supported the establishment and commercial viability of seed entrepreneurs. For example, the association helped schedule certification inspections so as to keep the cost down for individual entrepreneurs.

In Tanzania and Rwanda, CGIAR supported the respective governments and private sectors to expand the market and increase the value of cassava as a cash crop. The logic is that a more market-driven cassava value chain is necessary if farmers are going to pay for certified planting material and if seed producers are going to make it available.

Also, in Tanzania and Rwanda, researchers said they benefited from being part of a global CGIAR-coordinated community of practice, which might also be called a coalition, working on improving seed systems for vegetatively-

propagated crops. This allowed them to learn from experiences tackling similar problems in other countries and with other crops.

4.1.4 SQ4: What aspects of the Policy Window theory of change were useful in understanding how trajectory actors contributed to policy change in the four cases?

The Policy Window ToC suggests that respective outcome trajectory actors contributed to policy change by iteratively and interactively generating three outcomes—shift in social norms; change in capacity; and, strengthened support base—driven by participants' ability to generate and make use of policy windows.

The 'shift in social norms' outcome helped with understanding that framing the problem is important in establishing an outcome trajectory in the first place and needs to come before framing the solution, when clear and simple communication also becomes important.

The 'capacity building' outcome highlighted the need to build the capacity of champions to create, recognize, and respond to policy windows. It helped to understand that the capacity to advocate informally may already exist in CGIAR staff and their national counterparts that have been working together on an outcome trajectory for some time. The outcome also included building the capacity to implement a proposed solution, to demonstrate to key decision makers that the solution is viable in practice.

The idea that a strengthened support base is important, helped underline the importance of efforts to strengthening the market for cassava to drive the demand for seed certification in Tanzania and Rwanda. In the biofortification case, the idea helped understand the importance of donors and their support to high level think tanks.

The idea of policy windows helped in understanding that windows of opportunity do open and close and whether they do lead to policy shifts is context specific. For example, disease outbreaks in Tanzania and Rwanda helped to drive progress on cassava seed certification. In contrast, there was no

concerted national response to outbreaks of Purple Top in Ecuador because of competition for limited resources from an economically more important plant disease. In the biofortification trajectory, the policy windows most frequently used were regional- and global-level conferences and workshops relating to nutrition. CGIAR supported biofortification champions to attend well over 20 such meetings to explicitly advocate for including biofortification as part of the package of viable solutions to nutrient malnutrition. The strategy succeeded in linking biofortification to the broader nutrition trajectory, which is a high-level global priority.

4.2 Q2: How can a middle-range theory be adapted and specified to help understand how families of similar policy change programs work?

We adapted the generic Policy Window theory (Figure 1), based on the answers to the first three SQs, above. We adapted the description of the three main outcomes—shift in norms, change in capacity, strengthened support base—to reflect how the outcomes appeared in the four cases. We changed and added to the strategies (white boxes) to reflect those used in the four cases to bring about the main outcomes (Figure 3). The specific strategies that map onto these strategies are shown in Tables 4–6 and are described in the answers to the three sub-questions above. The diagram can be understood to reflect a Realist context-mechanism-outcome construct in which the generative mechanism is the respective outcome trajectories, the outcome is as described in the second row of Table 3 and the context is determined by the different countries and regions in which the outcome trajectories are unfolding.

The main structural change to the generic theory is to show the empirical finding that the three main outcomes, numbered 1–3, work together in an iterative and self-reinforcing manner denoted in Figure 3 as double-ended arrows linking the main outcomes and two circular arrows and plus sign at the center. Policy-related outcomes emerge from this dynamic, denoted by the bracket. The dynamic is driven by ‘champions taking advantage of policy windows,’ and by ‘a coalition of trajectory actors sharing a common purpose.’ We borrowed the latter dynamic from coalition theory (see Table 2) as a good description of what happened in three out of the four cases. The dynamic is that coalitions of stakeholders coalesce around broad, shared agendas. Members bring resources to the table, including strategic knowledge, capacity to act on that knowledge, relationships with other allies, and constituencies and control of financial and other resources (Stachowiak 2013: 13). We found that the coalition dynamic described well how the trajectory actors worked, or attempted to work, in the three disease-related trajectories. The dynamic was less evident in the biofortification trajectory, probably because of the size of the gap in network terms between researchers working on the solution and the policy makers who needed to develop and approve the declaration. This gap was bridged by working with regional-level champions.

5. Discussion

5.1 Addressing Question 1 on accumulating learning and insight

The findings show that a middle-range theory and a realist perspective can be used to accumulate and synthesize learning

and insight across the four published cases. We did so in practice by using the elements of the Policy Window theory and the concept of generative mechanisms to carry out a cross-case synthesis. This section pulls together the insights and tentative conclusions that we were able to derive that may have applicability beyond the four cases.

5.1.1 Insights relating to strategies to ‘shift in social norms’

All things being equal, policy solutions that are less easy to test, less observable, and are to be implemented at a larger scale (e.g. biofortification as a solution to hidden hunger across Africa) will be harder to advocate for and may take a greater investment in their framing, than policy solutions that are more immediate, observable, and local (e.g. seed certification to help control CBSD in cassava at country level). This is consistent with the finding in the seminal book *Diffusion of Innovations* (Rogers 2010) that adoption of an innovation (including a policy innovation) is affected by trailability⁷ and observability together with relative advantage, compatibility, and complexity.

The three components that shift social norms—framing the problem, framing the solution, and communication—overlap and work together as the trajectory evolves, implying that all three should be worked on at the same time.

5.1.2 Insights relating to strategies to ‘change in capacity’

The capacity for advocacy among champions played a crucial role in all four cases, and is likely to do so in other policy outcome trajectories. The cases showed that there are two types of advocacy to consider—formal and informal.

The ability to carry out informal advocacy came from the innate good partnering practices of national-level researchers and their CGIAR colleagues, built up over years of working together at country level. As such, informal advocacy did not require separate, formal training. It worked where the degree of separation between CGIAR staff and national-level colleagues on one hand, and key decision-makers on the other, was small, as was the case in the three trajectories involving national-level policy change. In contrast, formal advocacy was required to reach decision-makers which the degree of separation was greater, as was the case in the biofortification trajectory, and in attempts to influence District-level decision making in Tanzania.

The outcome trajectory in Rwanda was able to develop and approve cassava seed standards in 1 year compared to 5 years in Tanzania because the actors were able to learn from Tanzania. This showed the value of learning from one case to the next.

5.1.3 Insights relating strategies achieve a ‘strengthened support base’

A strengthened institutional support base gave impetus to the four trajectories through funding support and through creating an enabling environment for the trajectories. CGIAR Centers and CRPs were particularly valued by other trajectory actors for their ability to develop and fund multi-partner projects. Donors also played an important role, particularly those that provided funding over several project cycles, allowing for momentum to be built and maintained.

Support from enabling institutions took different forms at different scales, including:

- Support to researchers from a global community of practice of researchers working on controlling vegetatively-propagated diseases;
- Panels of African leaders championing biofortification at a continental scale;
- national-level technical working groups developing and owning cassava seed standards;
- Strengthening the cassava value chain.

5.1.4 Insights relating to policy windows

Two types of policy window in particular helped drive the respective trajectories forward:

- Regional- and global-level conferences provided opportunities for biofortification champions to link biofortification to the broader and well-supported nutrition trajectory;
- Disease outbreaks were the most important policy windows for the three disease-related trajectories.

5.1.5 Generative mechanisms and context

The cases support the idea that policy outcomes emerged over time from outcome trajectories, understood to be high-level generative mechanisms. An outcome trajectory is a patterned and co-evolving system made up of actors, knowledge, technology, and institutions to which a program contributes to achieve outcomes. Working with this idea is likely to be useful in helping programs put more emphasis on understanding context, and thinking about how best to be coherent with ongoing processes.⁸

The following are the main generative mechanisms that appeared to be driving the four outcome trajectories, through the coalition dynamic and action of champions (Figure 3):

- Knowledge of solid and broadly available evidence explaining problems and corroborating solutions reinforce trajectory actors' capability and motivation in agreeing on shared understanding of problems and solutions;
- Advocacy activities carried out by skilled individuals and groups recognized for their social/professional commitment and providing solid supporting evidence for their ideas reinforce trajectory actors' motivation in taking them and their ideas into consideration and eventually support the interventions they propose;
- Perception that legal, regulatory, and funding environments are already or may become supportive toward the implementation of policy solutions creates opportunities for more trajectory actors, in particular decision makers, funders, to join forces and support the proposed solutions;
- Perception that trajectory actors are part of a collective effort to which they provide a useful contribution while increasing their professional recognition and network in the process.

The idea that outcome trajectories are driven by a common set of dynamics and generative mechanisms is also likely to be useful in thinking about how a program might best make a contribution to an outcome trajectory, and in how completed programs are evaluated.

5.1.6 Most significant insights

Overall, the use of middle-range theory allowed the evaluation team to develop a meaningful framework applicable to

different cases and facilitating cross-case learning. Also, it allowed for the identification of key insights presented below.

The first significant insight is that effective advocacy strategies depend upon the proximity in network terms between researchers on one hand, and the policy decision-makers on the other. When the degree of separation is large, then it was necessary to engage in 'formal' advocacy practices such as explicitly recruiting and training policy champions to bridge the gap. When the degree of separation is small, 'informal' advocacy can take place in which a coalition of CGIAR and national-level researchers are able to directly engage with and influence key decision-makers. This is important because informal advocacy is not widely recognized as a scaling mechanism in the CGIAR. Coalitions, such as those that were evident in the three plant disease cases, are generally not recognized or valued.

The second significant insight came through better understanding the ways in which donors contribute to policy outcome trajectories, specifically through better appreciating:

- The importance of continued financial support across several project cycles that allowed momentum to build, including through the formation and growth of coalitions.
- That donors can influence the enabling environment at the highest levels by funding global movements and think tanks, e.g. BMGF's support to Scaling Up Nutrition and DFID's support to the Global Panel on Agriculture and Food Systems for Nutrition (the Global Panel). Both had an important influence on the biofortification case.
- That deeply invested donors such as BMGF and DFID, have a broader view of outcome trajectories than the actors they fund. This gives them an opportunity to play a stronger integrating role that would reduce some of the less-than-productive competition for funding from them that was apparent in one of the cases.

Our third significant insight was finding evidence that learning from one case to the next can bring significant savings in time and resources. By learning from colleagues in Tanzania, Rwanda trajectory actors were able to develop and approve of cassava seed standards in 1 year rather than 5.

5.2 Addressing Question 2 on how theory can help learn across cases

Using the same Policy Window theory across the four cases allowed us to develop a specified and adapted version of it (Figure 3). We specified the theory by classifying and detailing the strategies used in each case to achieve the three main outcomes. We found that the concept of a coalition, borrowed from coalition theory (see Table 2), matched well with a common strategy in three of the trajectories, so we included it. This modified version of the Policy Window theory should be of value to anyone planning future initiatives to influence agricultural policy, specifically policy changes similar in classification to those attempted in the four cases. According to FAO policy categories (FAO 2015), all four policy outcomes are producer-orientated, covering production support and market management (Biofortification); seed technology and quality assurance systems (Tanzania and Rwanda); and, genetic resources and sanitary measures. The biofortification case is also consumer-oriented, covering nutrition and health assistance.

The idea of an outcome trajectory as a high-level generative mechanism, together with the modified Policy Window theory, will be useful in the following ways:

- To encourage planners to take more notice of context by seeing initiatives as contributing to outcome trajectories over time—that is a patterned and co-evolving system made up of actors, knowledge, technology, and institutions from which program outcomes will emerge.
- To think about how an initiative can most effectively contribute to the three main outcomes—change in social norms; capacity development; and strengthened enabling environment—while generating and taking advantage of policy windows as and when they arise.
- To think about and identify dynamics and nested generative mechanisms driving the outcome trajectories of interest

If our theory-driven, realist-informed approach is used in the evaluations of similar policy change initiatives, then the modified Policy Window theory (Figure 3) can be further specified in terms of which strategies and generative mechanisms worked, or did not work, in which contexts. Elements of other published theories can be brought in, if found to fit. This will allow further accumulation of learning after each evaluation that can improve future planning and implementation. This should help programs become more convincing in the proposals they write to donors, more accountable and better able to deliver on their goals.

6. Conclusions

The point of departure for this article is that influencing policy is an important way for agricultural research for development to achieve impact at scale, but doing so is not straightforward because of the context-specific and complex processes involved. Accordingly, we addressed two questions: (1) how can policy change theory be used to accumulate and synthesize learning and insight from one policy evaluation to the next? and (2) how can theory be adapted and specified to help understand how families of similar policy change programs work?

We found that middle-range theories are useful in providing a conceptual framework that can be adapted and specified to build more plausible program theories. In addition, middle-range theory can be applied to multiple cases and, as showed in this article, they may constitute a relevant framework to accumulate learnings across cases and contribute in identifying and progressively deepening the understanding of causal mechanisms supporting similar change processes. Specifically, the four-case ToC developed in this article can serve as the middle-range theory in any future theory-driven evaluation of similar policy outcomes.

We also found that by taking an ‘outcome trajectory’ approach, evaluation may become more accurate in estimating the contributions of the program under evaluation as well as the ones of other trajectory actors and initiatives. An outcome trajectory is understood to be the co-evolving sets of interactions between actors, knowledge, technology, and institutions from which emerge the outcomes to which programs claim contribution. An outcome trajectory evaluation builds ToC to model the workings of the outcome trajectory and then

describes the program’s contribution to that trajectory. This is different to program theory evaluations that put the program at the center of the ToC and so risk overestimating the program’s causal power, particularly in complex settings in which many actors interact.

In answering the questions, we showed how evaluation can help agricultural research for development programs become more convincing in their proposals to funders, more accountable and better able to deliver on their goals.

Funding

This work was funded by the CGIAR Research Program on Roots, Tubers and Bananas.

Conflict of interest statement. There was no conflict of interest.

Notes

1. <https://www.gainhealth.org/sites/default/files/publications/documents/gain-organisational-strategy-17-22.pdf> (accessed 4 Oct 2022).
2. <https://www.cgiar.org/annual-report/performance-report-2019/financial-highlights/> (accessed 4 Oct 2022).
3. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-data/ODA-2019-detailed-summary.pdf> (accessed 4 Oct 2022). Total development finance was US\$153 billion in 2019.
4. This reference, and others, are provided in the four published evaluations upon which this synthesis draws (Douthwaite 2020a,b,c,d).
5. https://www.snr-d-africa.net/wp-content/uploads/2017/06/AU_CAA-DP-Malabo-Business-Plan.pdf (accessed 4 Oct 2022).
6. Network distance is a synonym for path length and is simply the number of contacts that link the researcher to the policy-maker.
7. How easy it is to trail a new technology and see its performance—a word used by Rogers (2010).
8. Coherence is a recently-added DAC evaluation criterion and refers to the compatibility of an intervention with other interventions in a country, sector or institution (OECD 2021).

References

- Arensman, B., Van Waeningh, C., and Van Wessel, M. (2018) ‘Twinning “Practices of Change” with “Theory of Change” Room for Emergence in Advocacy Evaluation’, *American Journal of Evaluation*, 39: 221–36.
- Axelrod, R. M. and Cohen, M. D. (2000) *Harnessing Complexity*. New York: Basic Books.
- de Brauw, A., Eozenou, P., Gilligan, D. O., Hotz, C., Kumar, N., and Meenakshi, J. V. (2018) ‘Biofortification, Crop Adoption and Health Information: Impact Pathways in Mozambique and Uganda’, *American Journal of Agricultural Economics*, 100: 906–30.
- Douthwaite, B., Keatinge, J. D. H., and Park, J. R. (2002) ‘Learning selection: an evolutionary model for understanding, implementing and evaluating participatory technology development’, *Agricultural Systems*, 72: 109–31.
- Douthwaite, B., and Shepherd, K. (2020) *Outcome evaluation of climate-smart research on solar-powered irrigation in India*, p. 59. Colombo, Sri Lanka: CGIAR Research Program on Water, Land and Ecosystems (WLE).
- Douthwaite, B. (2020a) *Mainstreaming of Biofortification in the African Union: Evaluation of CGIAR Contributions to a Policy Outcome Trajectory*. CGIAR Research Programs on Roots, Tubers and Bananas & Agriculture for Nutrition and Health. Lima: International Potato Center. <<https://cgspace.cgiar.org/handle/10568/109849>> accessed 4 Oct 2022.

- Douthwaite, B. (2020b) *Development of a Cassava Seed Certification System in Tanzania: Evaluation of CGIAR Contributions to a Policy Outcome Trajectory*. Lima: International Potato Center. <<https://cgspace.cgiar.org/handle/10568/110093>> accessed 4 Oct 2022.
- Douthwaite, B. (2020c) *Development of a Cassava Seed Certification System in Rwanda: Evaluation of CGIAR Contributions to a Policy Outcome Trajectory*. Lima: International Potato Center. <<https://hdl.handle.net/10568/110289>> accessed 4 Oct 2022.
- Douthwaite, B. (2020d) *Control of Potato Purple Top in Ecuador: Evaluation of CGIAR Contributions to a Policy Outcome Trajectory*. Lima: International Potato Center. <<https://hdl.handle.net/10568/110195>> accessed 4 Oct 2022.
- Douthwaite, B., Proietti, C., Polar, V., and Thiele, G. (in press). 'Outcome Trajectory Evaluation (OTE): An Approach to Tackle Research-for-Development's Long-Causal-Chain Problem', *American Journal of Evaluation*.
- Douthwaite, B., Mayne, J., McDougall, C., and Paz-Ybarnegaray, R. (2017) 'Evaluating Complex Interventions: A Theory-Driven Realist-Informed Approach', *Evaluation*, 23: 294–311.
- FAO (2013) The State of Food and Agriculture. <<http://bit.ly/KAn84P>>
- FAO (2015) Food and Agriculture Policy Classification. <<http://www.fao.org/3/a-bc358e.pdf>> accessed 4 Oct 2022.
- Kingdon, J. W. (1995). *The Policy Window, and Joining the Streams. Agendas, Alternatives, and Public Policies*, pp. 172–89. New York: Longman.
- Lacouture, A., Breton, E., Guichard, A., and Ridde, V. (2015) 'The Concept of Mechanism from a Realist Approach: A Scoping Review to Facilitate Its Operationalization in Public Health Program Evaluation', *Implementation Science*, 10: 153.
- Low, J. and Thiele, G. (2020) 'Understanding Innovation: The Development and Scaling of Orange-Fleshed Sweetpotato in Major African Food Systems', *Agricultural Systems*, 179: 102770.
- Mayne, J. (2012) 'Contribution Analysis: Coming of Age?', *Evaluation*, 18: 270–80.
- Mueller, B. (2020) 'Why Public Policies Fail: Policymaking under Complexity', *Economia the journal of the National Association of Graduate Centers in Economics (ANPEC) in Brazil* 21: 311–23.
- OECD. (2021) *Applying Evaluation Criteria Thoughtfully*. Paris: OECD Publishing.
- Pawson, R. (2010) 'Middle Range Theory and Program Theory Evaluation: From Provenance to Practice', in Vaesen J, Leeuw FL (eds) *Mind the Gap: Perspectives on Policy Evaluation and the Social Sciences. Comparative Socioevaluation*, vol 16, pp. 171–202. London: Transition Publishers.
- Pawson, R. (2013) *The Science of Evaluation: A Realist Manifesto*. London: Sage.
- Paz-Ybarnegaray, R. and Douthwaite, B. (2017) 'Outcome Evidencing: A Method for Enabling and Evaluating Program Intervention in Complex Systems', *American Journal of Evaluation*, 38: 275–93.
- Renkow, M. (2018) *Outcomes of Policy-Oriented Research in the CGIAR*. SPIA Technical Note N 4. Rome: CGIAR Independent Science and Partnership Council (ISPC) Secretariat. <https://cas.cgiar.org/sites/default/files/pdf/ispc_technicalnote_outcomes_policy_research_cgiar_0.pdf> accessed 4 Oct 2022.
- Rogers, E. M. (2010) *Diffusion of Innovations*, 5th edn. New York: Simon and Schuster.
- Sabatier, P. A. (2007) The Need for Better Theories, in Sabatier PA (ed.) *Theories of the Policy Process*, 2nd edn, pp. 3–20. Boulder, CO: Westview Press.
- Schmitt, J. and Beach, D. (2015) 'The Contribution of Process Tracing to Theory-Based Evaluations of Complex Aid Instruments', *Evaluation*, 21: 429–47.
- Stachowiak, S. (2013) *Pathways for Change: 10 Theories to Inform Advocacy and Policy Change Efforts*. Washington: Center for Evaluation Innovation. <<https://www.evaluationinnovation.org/publication/pathways-for-change-10-theories-to-inform-advocacy-and-policy-change-efforts/>> accessed 4 Oct 2022.
- Stevens, G. A., Bennett, J. E., Hennocq, Q., Lu, Y., De-Regil, L. M., Rogers, L., Danaei, G., Li, G., White, R. A., Flaxman, S. R., Oehrlé, S. P., Finucane, M. M., Guerrero, R., Bhutta, Z. A., Then-Paulino, A., Fawzi, W., Black, R. E., and Ezzati, M. (2015) 'Trends and mortality effects of vitamin A deficiency in children in 138 low-income and middle-income countries between 1991 and 2013: a pooled analysis of population-based surveys', *Lancet Global Health*, 3: e528–36.
- Verma, S., Durga, N. and Shah, T. (2019) 'Solar Irrigation Pumps and India's Energy-Irrigation Nexus', *Economic and Political Weekly*, 54: 62–5.
- Whelan, J. (2008). *Advocacy Evaluation: Review and Opportunities*. Brisbane: The Change Agency. <<http://www.alnap.org/resource/8977>> accessed 4 Oct 2022.
- Zahariadis, N. (2007). 'The Multiple Streams Framework: Structure, Limitations, Prospects', in Sabatier PA (ed.) *Theories of the Policy Process*, 2nd ed., pp. 65–92. Boulder, CO: Westview Press.