LEGACY SERIES 1

Impact Tracking:
A Practitioner-Developed Approach to Scaling Agricultural Innovation in Ethiopia

Keith Child, Gizaw Desta, Boru Douthwaite, Amare Haileslassie, Andre van Rooyen, Lulseged Tamene and Stefan Uhlenbrook.

CGIAR Research Program on Water, Land and Ecosystems (WLE)

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Front cover photo: Local farmers work restored terraced fields in the Yewol highlands, Ethiopia; Mulugeta Ayene / WLE

Acknowledgements

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Acronyms

Africa RISING	Africa Research in Sustainable Intensification for Next Generation
AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
AR4D	Agricultural Research for Development
ATA	Ethiopian Agricultural Transformation Agency
AWM	Agricultural Water Management
BCM	Billion cubic meters
BMGF	Bill & Melinda Gates Foundation
CALM	Climate Action through Landscape Management
CIAT	International Center for Tropical Agriculture
CIFOR	Center for International Forestry Research
CoW	Coalition of the Willing
CRP	CGIAR Research Program
EiA	Excellence in Agronomy
EIAR	Ethiopian Institute of Agricultural Research
ELLN	Ethiopian Learning Landscapes Network
ETC	Ethiopian Transformation Council
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit; German Corporation for International Cooperation
GTP	Growth and Transformation Plan
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
IT	Impact Tracking
IWMI	International Water Management Institute
LSFM	Landscape Specific Fertilizer Management
MoA	Ministry of Agriculture
NGO	Non-governmental organization
OT	Outcome Trajectory
PM	Prime Minister
POR	Policy-Oriented Research
PSNP	Productive Safety Net Program
RLLP	Resilient Landscape and Livelihood Project
SDG	Sustainable Development Goal
SLM	Sustainable Land Management
ToC	Theory of Change
VAT	Value-Added Tax
WLE	CGIAR Research Program on Water, Land and Ecosystems
WLRC	Water and Land Resource Center

Abstract

This paper argues for more creativity and flexibility in agricultural research for development (AR4D) scaling and impact evaluation in complex contexts. While acknowledging the importance of setting reasonable end-of-project targets and outcomes, we argue that the achievement of outcomes and impacts, particularly in complex contexts, requires adaptive management and acknowledgment that significant positive outcomes and impacts may occur after the project funding cycle is complete. The paper presents a practitioner-developed approach to scaling AR4D innovations called Impact Tracking (IT). We illustrate IT in practice by presenting three case studies from Ethiopia in which IT proved crucial to achieving impact. The paper concludes by drawing lessons from the case studies and discussing what implications IT may have for development practitioners.

Introduction

Despite persistent calls for change, many development professionals continue to hold traditional, reductionist expectations about how agricultural innovation takes place and impact is achieved. This "push" approach to agricultural research four development (AR4D) (Wigboldus and Brouwers 2016) follows a supply-side model in which scientists push innovation through product development and testing pipelines to farmers who adopt the innovation to accrue the promised benefits. Donors responsible for managing public money have often subscribed to this narrative in which project outcomes and impacts follow a simple monotonic progression from a clearly defined starting point to the delivery of development results at scale, thereby making conventions of accountability straightforward. The underlying assumptions are many, but foundational among them are the alignment of funding cycles with the length of the innovation pipeline; the achievement of impacts in a planned, stepwise manner; the belief that the mere supply of development outputs is sufficient to bring about their adoption and use, and that the development process is linear (i.e., more supply of development outputs leads to proportionally more development outcomes).[1]

In contrast to a linear, push scaling model, recent thinking in agricultural innovation studies emphasizes adopting a more systems-based paradigm that embraces complexity, transdisciplinary and co-learning. Here, the complex ways in which innovation is transformed into development results are acknowledged, even to the point where outcomes can be unexpected because they emerge from interactions between actors that are difficult, if not impossible, to predict in advance. A foundational assumption is that the development process is non-linear; that is, small, well-judged interventions together with positive feedback loops can lead to outcomes that are orders of magnitude larger than the outputs that contributed to them. This gives rise to the idea that actors in innovation systems can purposively navigate and harness complexity with the right set of functional capabilities.[2] In AR4D contexts characterized as adaptive and complex, this approach to scaling is likely much more common (and practical) than generally acknowledged (Wigboldus et al. 2016).

This paper argues for more creativity and flexibility in AR4D scaling and impact evaluation in complex contexts. While acknowledging the importance of setting reasonable end-of-project targets and outcomes, we argue that the achievement of outcomes and impacts, particularly in complex contexts, requires adaptive management and acknowledgment that significant positive outcomes and impacts may occur after the project funding cycle is complete. The paper presents a practitioner-developed approach to scaling AR4D innovations called Impact Tracking (IT). IT was coined by scientists in Ethiopia who have been working together with the CGIAR Research Program on Water, Land and Ecosystems (WLE). As an emergent approach, IT's key features became apparent to evaluators who were tasked with evaluating WLE's research outcomes related to soil and water management at landscape scale. As conceptualized by practitioners and confirmed by the evaluation team, IT proved to be a useful mechanism for illuminating how project outcomes and impacts were achieved over the long term while also posing significant implications for project management, the measurement of results and end-of-project evaluation.

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[1] It should be noted that nested within this short list of assumptions is the additional assumption that A4RD typically produces "technologies" for farmers. In practice, however, researchers also produce knowledge and assessments to inform policy-making processes, research prioritization processes, investment decisions, and so on. The contribution of these types of outputs to development do not generally follow a monotonic progress and achieving impact does not depend on passive/straightforward adoption of products, but on a complex interaction of stakeholders and decision makers.

[2] Equally, large investments in producing development outputs can lead to very little, or negative, outcomes.

In this paper, we first define key terms, including our definition of IT. We then turn to three case studies from Ethiopia that illustrate well how IT led to the achievement of outcomes. In all three cases, outcomes unfolded over a complex implementation context and over a very long time. In all three cases, significant policy-related outcomes are achieved; and in all three cases, IT proves an apt concept to describe the broad contours of how outcomes came about. Having defined IT and provided concrete examples of IT in practice, we then discuss lessons learnt and what implications IT may have for development practitioners.

> *"...it is complex interventions that present the greatest challenge for evaluation and for the utilization of evaluation because the path to success is so variable and it cannot be articulated in advance. – Patricia Rogers" (Westhorp et al. 2016)*

What is Impact Tracking?

Impact Tracking (IT) and outcome trajectories (OTs) are complementary concepts. Following Wilson-Grau and Britt (2012), an outcome is a change in the behavior, relationships, actions, activities, policies or practices of an individual, group, community, organization or institution. Outcomes of interest come in sets, e.g., the adoption by farmers of solar pumping requires a whole suite of changes to be sustained over time, alongside an enabling environment. An OT is a system of patterned interactions between actors, technology and institutions, leading to the emergence of an identified set of outcomes (Paz-Ybarnegaray and Douthwaite 2017). IT is the job of nurturing an OT to fruition. In other words, IT is an approach to scaling innovations in complex contexts over a prolonged period of time. IT, as manifest in Ethiopia, involves senior scientists using their professional networks to bring innovations to scale by taking advantage of windows of opportunity through behaviors that resemble "product championing." Here, the pathway to impact is not through a project *per se*, but rather scaling and influencing is targeted at bringing about a desired impact when and where an opportunity presents itself, aligning advanced pipeline research activities, capacities and professional networks to a concrete demand from next-users (e.g., governments, farmers, investors, etc.). This is to say, the precise nature of a set of the outcomes resulting from IT will become more apparent as the set of outcomes move to scale over a period of time that is almost always longer than any single project or program phase.

IT is particularly germane to complex adaptive systems where bringing an innovation to scale involves a high level of uncertainty, where systems are highly dynamic, where what is considered the innovation changes in the process, and where timelines are often prolonged (Box 1). To the great annoyance of managers, AR4D researchers and donors alike, time-bound planning for desired outcomes and impacts is extremely difficult under these conditions, not only because working in complex adaptive systems requires adaptive management responses, but also because stakeholders may define and redefine problems and desired solutions that are often adapted to local contextual realities. And yet, many of the most pressing and intractable problems that demand attention are precisely the kinds that emerge within complex adaptive systems (Axelrod and Cohen 1999). In short, retreating from challenging problems is not an option in most cases.

Thematically, IT is likely to be most helpful in relation to projects that focus on social movements and networks; advocacy; large-scale, cross-sector, collaborative initiatives; technological innovation or public policy.[3] At WLE, our theory of change (ToC) incorporates several AR4D pathways to scale; however, here we focus exclusively on bringing innovations to scale through changes in government policy.[4] Specifically, our focus is on the idea of policy windows described by Kingdon and Stano (1984), which we have found to usefully apply in theory-driven evaluations at WLE and other CGIAR Research Programs (CRPs). Furthermore, by situating IT within a convincing off-the-shelf middle-range theory such as Kingdon and Stano's, we can also show the conditions in which IT is most likely to be employed.

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[3] This list is intended merely to be indicative of the thematic areas in which IT could be most useful – other thematic areas might also be germane.
[4] The WLE theory of change (ToC) is composed of nested ToCs at different levels of organization. ToCs that explicitly incorporate the idea of a policy window are found at the lowest level of analytical resolution (e.g., country specific projects).

Box 1: Characteristics of complex adaptive systems

- Emergence: Patterns emerge from self-organization among interacting agents. What emerges is beyond, outside of, and oblivious to any notion of shared intentionality. Each agent or element pursues its own path, but as paths intersect and the elements interact, patterns of interaction emerge, and the whole of the interactions becomes greater than the separate parts.
- Nonlinearity: Sensitivity to initial conditions; small actions can stimulate large reactions, thus the butterfly wings (Gleick 1987) and black swans (Taleb 2007) metaphors, in which highly improbable, unpredictable and unexpected events have huge impacts.
- Dynamical: Interactions within, between and among subsystems and parts within systems are volatile, turbulent, cascading rapidly and unpredictably.
- Uncertainty: Under conditions of complexity, processes and outcomes are unpredictable, uncontrollable and unknowable in advance. The book "Getting to Maybe" (Westley et al. 2006) captures the sense that interventions under conditions of complexity take place in a "Maybe World."
- Co-evolutionary: As interacting and adaptive agents self-organize, ongoing connections emerge that become co-evolutionary as the agents evolve together (co-evolve) within and as part of the whole system over time.
- Adaptive: Interacting elements and agents respond and adapt to each other so that what emerges and evolves is a function of ongoing adaptation among both interacting elements and the responsive relationships interacting agents have with their environment.

Source: Patton 2010.

Policy windows

Kingdon and Stano's (1984) classic theory of agenda setting draws heavily on the metaphor of "policy streams" to explain why some policy innovations move from the realm of ideas to policy change, while other potentially good ideas simply wither and fade away as if from neglect. According to Kingdon and Stano (1984), it is the confluence of three policy streams in which the potential for large-scale change in the policy realm is greatest: (1) the "problem stream" alludes to a societal problem that requires intervention; (2) the "policy stream" refers to potential solutions that originate from policymakers and other advocates; and (3) the "politics stream" which touches on changes to legislative turnover, the "national mood" or public opinion (Box 2). Each of these streams is regarded as independent of the others until, through the convergence of two or more streams, they merge, opening a metaphorical "policy window" during which change becomes possible. Policy change advocates can create policy windows from expected and unexpected events by helping to bring two or more streams together. Examples of policy windows identified in evaluations of policy outcomes in CGIAR include holding side events at high-level nutrition meetings to include biofortification in the policy agenda of the African Union (Douthwaite 2020) and highlighting serious outbreaks of cassava mosaic disease to advocate for a cassava clean seed system underpinned by national legislation (Douthwaite et al. 2020).

Box 2: Kingdon and Stano's (1984) three streams

1. *Problem Stream:* Identification of an issue is the first stream of Kingdon and Stano's model. This stream refers to the process of convincing decision-makers that one problem needs more attention than other problems. In the universe of potential problems, this is more easily said than accomplished due to the competitive jockeying of lobbyists, advocates and policy influencers who are constantly attempting to elevate their problem issues into the national discourse. Problem recognition by decision-makers is critical, thus making how problems are defined (e.g., framed or labeled) or conveyed (e.g., through creditable scientific research, constituent demands or some focusing event like a crisis or disaster) a critical dimension of the problem stream.

2. *Policy Stream:* This stream encompasses the processes involved in generating, debating, revising and elevating policy solutions. Here, interest groups committed to a particular policy change play a dominant role. The policy stream is where proposals start to gain uptake traction, moving from the merely possible to a shortlist of prominent solutions. Policy proposals that are technically feasible, cost-effective, acceptable to the public and in line with political imperatives typically have more potential than those that lack these qualities.

3. *Politics Stream:* This stream is intended to encapsulate a broad swath of factors that may influence the overall political climate, including the mood of the electorate, the dominance of the elected party, the proximity to elections, and so on.

The example of a crisis helps to illustrate how a policy window is opened. First, an acute problem is manifest, sometimes in sudden and unexpected ways. By appearing as a crisis, problem identification becomes self-evident in most cases. Once the problem becomes clear and the political will to resolve or overcome the problem is attained, ideas that might previously have been regarded as premature or formative suddenly emerge as potential solutions. The appearance of a crisis and a potential "solution-in-waiting" makes policy change politically feasible, thus opening a policy window of opportunity to transform an idea into a concrete course of action.

While other models (e.g., punctuated equilibrium, institutional rational choice approach, policy diffusion models, etc.) also challenge conventional notions of incrementalism, Kingdon and Stano's (1984) multiple stream model remains a favorite among political scientists because it captures the sometimes inexplicable appearance in the policy realm of "an idea whose time has come" (Howlett et al. 2015). Sabatier (2019) identified policy window theory as the most broadly applicable across a spectrum of policy arenas. Using FAO (2015) categories, the policy arena considered in this paper is agricultural producer-oriented policy.

Case studies

For scientists working within an AR4D paradigm, policy-oriented research (POR) can be a frustrating pursuit. At the same time that policy change at a national level is a clear pathway to scaling up research solutions, the opening of a policy window is rarely predictable. Indeed, Kingdon and Stano's (1984) model has been criticized for its emphasis on contingency and "chance" and its blinkered focus on problem identification at the agenda setting stage of the policy cycle. Even when a policy window is reasonably predictable as a consequence of an election or budgetary cycle, agenda setting is merely the first step in complex processes that typically involve a large number of stakeholders, many of whom will hold confounding positions. As Jann and Wegrich (2007) note about policy formation, "how the different variables – actors, institutions, ideas, and material conditions – interact is highly contingent, depending on the specific situation."

Douthwaite et al. (Forthcoming) have developed a ToC to describe how CGIAR research has contributed to policy change in CGIAR. The ToC was built from exploring how Kingdon and Stano's (1984) model worked to explain CGIAR contributions to four policy outcomes, specifically to the development of clean cassava seed systems in Tanzania and Rwanda, policy response to outbreaks of the purple top potato disease in Ecuador, and the development of a continental declaration supporting biofortification of food crops by the African Union Commission. We take this ToC, shown in Figure 1, as our assumed model of the causal dynamics in play in Ethiopia, to which WLE researchers contributed through IT. The titled boxes are outcomes leading to impact and the remaining boxes are strategies used to achieve the respective outcomes. Specifically Figure 1, we present three POR case studies drawn from our research activities in Ethiopia. These short case studies illustrate well the complex and dynamic implementation context in which POR and scaling take place, and they provide a real-world example of how IT can be employed to bring about positive outcomes and impacts even if an enabling policy window only appears years after an innovation has been piloted.

It should be noted that while the case studies presented here are drawn from research funded by WLE, POR is conducted by other CRPs and is the primary mandate of four CGIAR Centers (and to a lesser extent all the CGIAR Centers), including the International Water Management Institute (IWMI), the International Food Policy Research Institute (IFPRI), the Center for International Forestry Research (CIFOR), and the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) (hereafter referred to as 'the Alliance'). Indeed, POR has historically been regarded as a core strength of CGIAR (CGIAR Science Council 2008), and its Centers claim to have contributed significantly to a large number of policy-related outcomes.[5]

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[5] The CGIAR policy indicator is defined as the "number of policies/strategies/laws/regulations/budgets/ investments/curricula (and similar) at different scales (international to local) that were modified in design or implementation, with evidence that the change was informed by CGIAR research" (CGIAR 2018).
The CGIAR Results Dashboard lists 150 policies influenced by CGIAR research in 2019 alone (CGIAR 2019a).
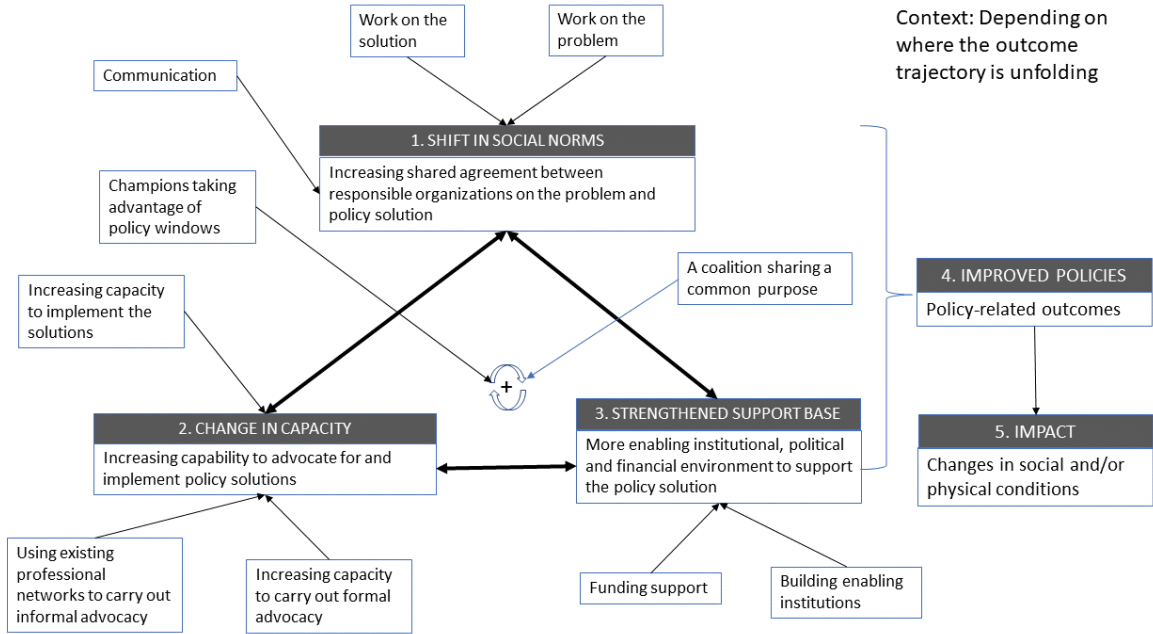
Figure 1: "Policy Window" ToC (*Source*: Douthwaite et al. Forthcoming).

Case study 1: Tax exemption for irrigation equipment

Expanding and upgrading irrigation systems – of all types – requires successful partnerships between farmers, governments and the private sector, in part, through tax cuts on imported technologies. This is particularly important under circumstances when there is uncertainty about the effectiveness of a new agricultural technology, and the private sector market is weak. Subsidies could reduce risk and generate demand for the new technology and thus increase their rate of adoption. In this regard, Omotilewa et al. (2019) has suggested that subsidized households are more likely to buy an additional bag of fertilizer at retail prices relative to households with no subsidy who are equally aware of the technology.

With this understanding, an IWMI-led project recommended tax exemption on water-lifting technologies for scaling irrigation. The recommendation was picked up by the Ethiopian Agricultural Transformation Agency (ATA) and eventually approved by the government for all agricultural technology, with the effect that the tax exemption is currently implemented nationwide. The impact on the rate of adoption and sustainability needs further investigation, but this case study illuminates lessons about tracking outcomes and impacts, and provides a concrete example of the strategies touched upon in Figure 1.

Context

Agriculture is the mainstay of Ethiopia's economy (34.8% of gross domestic product (GDP)), with more than 70% of the population employed in the agricultural sector. Lewis (2017) has suggested that one central assumption about Ethiopia's agriculture is that rainfall variability is a critical driver of food insecurity. This assumption is warranted by several studies that report a correlation between GDP and rainfall variability (Brown et al. 2011). Accordingly, securing food and achieving the Sustainable Development Goals (SDGs) remains elusive, and the government is advocating for irrigation development to help meet these challenges.

Water basin master plan studies in Ethiopia indicate a total availability of about 123 billion cubic meters (BCM) of river water, 70 BCM of lake water and 30 BCM of groundwater (Awlachew et al.

2007). These natural resources endowments, combined with government policy (Figure 1), create opportunities to expand irrigation and improve existing schemes. Recent estimates by the ATA put the potentially irrigable land at more than 11 million hectares (ha). However, total land currently under irrigation is estimated to be less than 11% of this potential area. Indeed, productivity is low when compared with sub-Saharan African countries (Haileslassie et al. 2016). The Ethiopian government has recognized these opportunities and challenges following a five-year Growth and Transformation Plan (GTP I and II). More recently, it has launched a ten-year plan to transform agriculture, particularly irrigated agriculture, through mechanization and the development of agro-processing industry parks.

Such development will further increase the demand for irrigation production while, worryingly, the adaption and scaling of modern irrigation technologies are very slow. There are several factors to which the slow progress in scaling can be attributed. For example, Haileslassie et al. (2016) point to production, input service, processing, marketing and extension-related factors. Regarding production-related factors, lack of access to irrigation water and appropriate water-lifting technologies are notable concerns. The commonly used water lifting techniques are either manual or motorized pumps, and these suffer from poor maintenance. The second important constraint is poor water application techniques. Substandard furrow irrigation techniques and, most often, oversupply of water (by 40%) by farmers is reported (Haileslassie et al. 2016). These constraints are attributed to the lack of technology options and the high initial financial cost they incur. Faced with such challenges, it is hard to envisage that smallholders will adopt irrigation, transform agriculture and meet food and nutrition security targets.

Impact Tracking story
With this set of fundamental challenges and opportunities in Ethiopia, and with similar challenges in other countries in Africa and in India, the Agricultural Water Management Solutions Project (Agwater Solutions) was conceived and initiated in 2009. The Agwater Solutions Project, led by IWMI and funded by the Bill & Melinda Gates Foundation (BMGF), aimed to bring a shift in social norms (Figure 1) to unlock the potential of smallholder farming by identifying, evaluating and recommending a variety of agricultural water management (AWM) solutions. The project strengthened the support base (Figure 1) by mapping and assessing the potential for investments in AWM technologies and the necessary supporting policies, institutions and financing arrangements.

Two years after its inception (in 2011), the project presented findings to stakeholders in Ethiopia, including decision-makers from ATA, to change their perception and capacity to advocate in support of policy change (Figure 1). One key finding was that water-lifting technologies, particularly motorized pumps, were too expensive for smallholder farmers to purchase and operate. In addition to import taxes, the technologies were subject to several national taxes, bringing the total Value-Added Tax (VAT) to 37% of the cost of the pumps. To reduce the cost of these technologies and encourage their use, researchers at the Agwater Solutions Project recommended a "pro-poor" tax exemption on mechanized irrigation technology, thereby making pumps more attractive to poor farmers (premised on observed experience from Bangladesh).

Building on the information gleaned from the seminar, ATA, taking advantage of a policy window in 2013, carried out a more in-depth analysis of the Bangladesh experience and subsequently recommended tax exemption for small-scale pumping equipment. The recommendation was presented to the Ethiopian Transformation Council (ETC), which was headed by the former Prime Minister (PM), Hailemariam Desalegn. ATA managed to convince the ETC that a tax exemption of this kind would benefit smallholder farmers if appropriately implemented. The ETC accepted the initiative and even suggested that the tax exemption be taken further to cover other agricultural types of machinery, such as tractors and combines.

In 2015, the PM's Office requested a feasibility study on tax exemption for all agricultural equipment. A final feasibility study was carried out in 2017 and made several recommendations: i) remove all duty and taxes to agricultural mechanization, irrigation and drainage equipment, and animal feed ingredients in a phased manner; ii) put in place a mechanism to efficiently and effectively administer the proposed tax reform so that it directly and proportionally benefits smallholder farmers; iii) administer the existing tax incentives more transparently and consistently; and iv) tax removal or reduction reform should be accompanied by supporting measures to ensure that reforms directly benefit smallholder producers, after which the ETC decided to exempt all agricultural equipment from import taxes.

In 2018, the PM's Office instructed the Ministry of Finance to implement the tax exemption in May 2019, which was later approved by the Ministry of Finance with guiding directives. Implementation commenced in early 2020 following the development of a modality suggested by the Ministry of Agriculture (MoA). Now the authorization for importers is issued by the Directorate of Agricultural Mechanization in the MoA.

Although no comparison has been made against the baseline, from informal communication, the MoA claims that the price of the AWM technologies has decreased by over 42% because of the reform. The question remains as to how many farmers have benefited from the subsidies and how far this has accelerated the adoption and scaling of smallholder irrigation. In fact, this is a question that needs to be evaluated to better understand the ultimate impact of the reform. It is notable that the overall process, from inception to implementation, took approximately a decade. While the reform process overcame numerous challenges, the important work of tracking innovation had to overcome a similarly large set of challenges, including those posed by the extended timeframe of change and the inevitable loss of key staff and institutional memory.

Case study 2: Powering data-driven solutions for Ethiopian agriculture

A collaborative effort by WLE/CIAT, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)-Ethiopia and other partners to institutionalize data sharing in Ethiopia has resulted in further funding of the activity and scaling the framework to other countries. The exercise started with the creation of a community of practice composed of soil scientists, agronomists, geospatial analysts and data scientists who come together under a 'coalition of the willing' (CoW) to develop digital solutions that can support the agricultural transformation efforts of Ethiopia. In its unique undertaking, the CoW (composed of over 100 scientists and agricultural practitioners) has engaged in a range of activities, including data collation, developing a digital web portal, developing data standardization guidelines, conducting big data analysis and developing location-specific agro-advisory services. Using a dataset collected with CoW partners, the team has developed a prototype location-specific fertilizer recommendation and integrated this with climate advisories to develop agro-advisory services. This exercise has led to better-targeted recommendations and a paradigm shift in the research and development discourse regarding the development of tailored and contextualized agro-advisory services.

This effort, combined with training courses conducted by the CoW members, has created awareness and inspired both the national and sub-national governments to embrace the approach to the extent that the MoA has assigned members of the CoW to develop a national soils/agronomy data sharing policy. The policy has been approved at different levels and will be signed and operational in the near future. The consequent improvement in data and analytical skills has attracted further funding from other investors to develop an integrated advisory service that can be scaled to other regions.

Context

In its effort to reach middle income status by 2030, Ethiopia has developed an 'agriculture-led industrialization' strategy that relies partly on the development of digital solutions to facilitate its growth. This strategy is made explicit in the Digital Ethiopia 2025 strategy.

With the need to transform the agricultural system in Ethiopia, the Alliance, supported by GIZ and WLE, have envisaged various alternatives to support the country's development agenda. As a first step, the Alliance and its partners have focused on improving the supply of agricultural data. As part of their efforts, the CoW conducted a 'soils/agronomy data mapping and characterization' exercise (Ali et al. 2020). This allowed for the identification of who owns what kind of data and assessing whether the data has associated documentation and meta-data. The template used to do the mapping and characterization also enabled CoW scientist to determine who would be willing to share their data and under what modalities. The members of the CoW then devised various strategies to collate available data, which resulted in an impressive database consisting of tens of thousands of data points. To enhance interoperability and facilitate efficient data sharing, the team developed a digital web portal at the Ethiopian Institute of Agricultural Research (EIAR). An important achievement in this regard is the various training modules on the web portal. In addition to building capacity, these modules helped to catalyze substantive national and subnational interest, motivation and rapid buy-in. Other achievements include the development of data standardization guidelines and the use of big data to create a site-specific fertilizer recommendation tool for the country.

Noting the above developments and recognizing the timeliness for devising digital solutions to help transform Ethiopian agriculture, the MoA constituted a taskforce to develop a soils/agronomy data sharing policy. The majority of the taskforce members were drawn from the CoW members in order to benefit from their experiences. In collaboration with CABI,[6] the taskforce members conducted detailed reviews, consultations and focus group discussions to develop a data sharing policy and associated implementation guideline.

The engagements and activities of the CoW are now gaining traction. The CoW activities are valued within the EIAR and MoA and the potential contributions of the CoW initiatives to support the agricultural transformation agenda of the country is well recognized. Beyond Ethiopia, the efforts of the CoW are also recognized and appreciated, with a potential for scaling as noted by senior members of BMGF and other partners.[7]

Impact Tracking story

At first, the CoW focused on creating awareness so that partners and individuals could share their data. Through iterative discussions and meetings, trust was built among the CoW members, which lead to the exchange of datasets and ideas about how to transform the data into usable formats. A data sharing guideline was developed to facilitate data sharing in a more organized and formalized manner.

While exploring the shared data, an obstacle emerged: the data were not interoperable and preparing data had become a serious challenge. The CoW took measures to overcome this challenge through the development of operational guidelines. A total of six guidelines consisting of different themes were prepared. Two have been published while the rest are under review.

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[6] https://www.cabi.org/
[7] These include the Supporting Soil Health Initiatives, Excellence in Agronomy (EiA) and Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA). See also, Rose (2020).

One of the critical impacts of the CoW activities, including its data-sharing guideline, is the inspirational role they played in encouraging the MoA to constitute its national taskforce to support the development of a national soil/agronomy data-sharing policy. By showcasing the need for and possibility of fair and transparent data access and sharing, the CoW has influenced national action that will change the course of agricultural research and its role in Ethiopia (Figure 1). The CoW's initiative and persistent efforts helped to create a policy window by placing data sharing and access at the center of Ethiopia's agricultural development discourse.

The CoW has achieved remarkable results within a short time since its formation. Its increasing acceptance and popularity are driven by its timely agenda of powering data-driven solutions for Ethiopian agriculture. The key to the successful engagement of the CoW is its relevance for Ethiopian soil and agronomy stakeholders. The CoW approached old and complicated problems with pragmatic and well-sequenced interventions that appealed to individual professionals and institutions looking for simple and forward-looking solutions. The CoW's carefully selected interventions have been highly effective in unclogging the path to data-driven agriculture with simple, cost-effective and practical steps.

Case study 3: Community-based watershed management for informing Ethiopian landscape management

The community-based watershed management approach at the Yewol learning site provides an example of contextualized knowledge and locally-specific approaches (e.g., stakeholder collaboration, experimentation, social learning) that were successfully applied to the transformation of a degraded and unproductive landscape (Kane-Potaka 2015). The knowledge gained from this research for development program was shared widely, establishing the basis for partnerships and dialogue between scientists, practitioners and policymakers. The codesigned, integrated landscape solutions paved the way for sustainable development pathways, up-and-out scaling and integrated landscape management policy changes.

Context
Since 2013, WLE has supported an integrated watershed management approach implemented by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and local partners to enhance the adaptive capacities of communities in the Ethiopian highlands to climate change. In these dry areas, subsistence farming has been practiced for millennia, and land degradation continues to be a severe threat to food security and poverty alleviation. Farmers in the Yewol watershed in the northern Ethiopian highlands (at 3,500 meters (m)) live a basic lifestyle as opportunities in these mountains are severely constrained by soil erosion and seasonal water scarcity. During the long rains, the bare soil on steep slopes results in devastating soil erosion that leaves little topsoil behind. The farmers urgently need sustainable solutions to these challenges.

The rehabilitation of the Yewol mountain landscape was implemented through public works of the Productive Safety Net Program (PSNP), where communities implemented natural resource rehabilitation and sustainable land management practices. Activities were codesigned and driven by the needs of communities and local partners, while implementation was led by the communities, local authorities and specialists. In the codesigning process, integrated solutions of locally adaptive land and water management practices and agricultural intensification options such as soil conservation practices, soil fertility management techniques, improved crop and fodder varieties, contour ditches, and agroforestry practices have been implemented through investing in public works. Capitalizing on the PSNP public work, each farmer worked 60 days annually to build terraces and bunds, resulting in 7,500 hectares (ha) of terracing in the watershed. The soil conservation activities support enhanced water availability through replenishing the subsurface flow. Some of this water then emerges on the mountainside as springs. In the well-rehabilitated and terraced mountainside of the watershed, a

youth group captured the spring water in earthen storages and used it for mountainside potato production. The upstream treated areas benefit from regulating peak river flows, and the communities utilized the regulated flow to expand irrigable lands (increased from 240 to 970 ha) on the foot slopes. The rehabilitation work was complemented with soil fertility management interventions and further helped to develop site-specific fertilizer management where fertilizer response is dictated by landscape fertility gradient and hydrologic conditions. Consequent improvement in the rehabilitation of the watershed has led to strengthening institutional support, including the establishment of an irrigation users' group with 200 registered users in the downstream valley areas and a community-based watershed users' association. Part of the rehabilitated mountain landscape was converted to mountain-based irrigated potato production and facilitated the operationalization of potato producers' cooperatives. Thus, the Yewol watershed demonstrates what natural resource management practices can achieve over time with the right approach and also serves as a learning site for practitioners and policymakers. Annual field days and exchange visits of stakeholders facilitated horizontal and vertical scaling of the enhanced technologies and innovations. Significantly, Wollo University, in collaboration with local farmers, has replicated many of the integrated landscape solutions in adjacent districts.

Impact Tracking story
In the past, watershed management focused on biophysical aspects of landscapes, while people and institutions were often ignored. In contrast, this work aimed to develop technically sound solutions by building the capacity of local development agents who could then translate this knowledge into practice. This approach could only evolve with the active participation of local stakeholders, the thematic research focus on the synergy of natural resources management and agricultural intensification, and relevant institutional development. The approach provides highly contextualized knowledge and context-specific solutions for sustainable development through stakeholder collaboration, intensive social learning and deliberation processes that can shape landscape management pathways.

The knowledge gained from the Yewol watershed management research was widely shared at different forums with practitioners and policymakers, and helped to build the basis for establishing dialogue and partnerships between scientists, practitioners and policymakers. The knowledge and innovations have played a role in changing practices at the local level and have influenced landscape management policies and programs at the national level. ICRISAT's engagement in the national Sustainable Land Management (SLM) Platform contributed to shaping the watershed management strategies. While updating the community-based watershed development guideline of the MoA, the recommended land and water management practices were incorporated as info-technologies and helped improve the work norms of PSNP public works. The collaborative watershed approach at Yewol watershed also informed the dialogue on the implementation and policy frameworks of integrated landscape management at the national level. In 2015, the knowledge gained for integrated landscape management shared and exchanged through the policy dialogues in the Ethiopian Learning Landscapes Network (ELLN) convened by the Water and Land Resource Center (WLRC) and the African Landscape Dialogue. Later in 2018, the outcomes of the dialogues provided the basis for designing and shaping the Resilient Landscape and Livelihood Project (RLLP) and the Climate Action through Landscape Management (CALM) program of the MoA. Initiating fertilizer trials in later years at the Yewol watershed contributed to building the national database on crop response to fertilizer, supporting the operationalization of the National Soil Fertility Strategy and Digital Agriculture initiatives. In partnership with the National Research System, GIZ Integrated Soil Fertility Management Program, Africa Research in Sustainable Intensification for Next Generation (Africa RISING) and the CGIAR Excellence in Agronomy 2030 initiative, the dataset was translated into a smartphone-enabled landscape specific fertilizer management (LSFM) decision support tool. A fertilizer advisory prototype application was developed and is being tested, which enables extension agents to know the specific

site fertilizer requirement and expected yield by taking input information on landscape strata, cropping system, soil fertility status and seasonal rainfall.

The Yewol watershed case study demonstrates that land and water management solutions continue to evolve and tackle increasingly complex issues. To understand and address these emerging issues, continuous interactions between social and technical innovations are required.

Implications

These case studies illuminate how IT works in a specific context. They are intended to highlight the salience of contextual idiosyncrasies and the often-prolonged time horizons necessary to bring to scale a policy-related innovation. Furthermore, they also clarify that outcome trajectories (OTs) typically become more transparent as the outcome sets they produce are scaled up, and that OTs are nearly always longer than any single funding cycle. Moving from the specific to the general, we can deduce several generic project implications related to IT.

Boundary partners

WLE provides targeted, thematic research funding through three funding windows, with progressive levels of collective donor action (CGIAR 2019b). Accordingly, WLE fashions itself as an integrating organization that is able to effectively span CGIAR research centers, national partners (including those in the government and private sectors) and non-governmental organizations (NGOs).[8] *Prima facie,* this claim appears to be warranted; however, in the context of Ethiopia, other organizations, including GIZ, Africa RISING, ATA and others were critical in bringing about outcomes because of their role as boundary organizations (Douthwaite and Getnet 2019).[9] A boundary organization in this context is one that brings researchers together with policy and development actors, and is able to "construct informal and sometimes even partially hidden spaces in which project managers can foster user-producer dialogues, joint production definition and end-to-end system building free from distorting dominance by groups committed to the status quo" (Kristjanson et al. 2009). While WLE was certainly instrumental in helping to bring about the outcomes reported here, evaluative evidence suggests that its primary mission as a research organization is too deeply ingrained to allow it to assume the role of a boundary partner. In fact, competition among researchers for scare research funding may have seriously undermined the ability of WLE and other CGIAR actors to prioritize development-focused activities, since research funding is awarded to scientists based on their scientific outputs rather than other considerations. The stiff competition for research funding may also have led WLE to exaggerate its contribution to achieving outcomes and thereby inadvertently damaged partnerships in the process. In either case, the evidence from Ethiopia makes clear that assumptions about WLE's ability to act as a boundary partner should be reconsidered.

Setting targets and measurement

Organizations and their funders need to be more realistic about making *ex-ante* impact projections, particularly when research is geared to informing policy change. In terms of measurement, these observations lead to at least two "attribution" problems: (1) documenting how and to what extent POR, combined with other influences, contributed to a policy outcome; and (2) measuring the subsequent welfare effect of the policy against a plausible counterfactual. In the first instance, IT makes it clear that POR can take a very long time to bear fruit and that the causal chain from POR to policy outcome is often built on a fair degree of happenstance and luck. Even when a scientist is available to champion a body of research years after a funding cycle, the appearance of a suitable policy window is generally the result of causal influences that are beyond the capacity of any single actor to bring about. In cases where IT has led to a policy outcome, finding a plausible body of evidence to attribute the size or relative importance of a contribution claim may be challenging. The second challenge to measuring the welfare impact of a policy change, which is not specifically related to IT, is that prolonged timelines that exceed a project funding cycle mean that an impact evaluation must be

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[8] WLE claims to work with over 800 partners through almost 130 projects (CGIAR 2021).
[9] It is also worthwhile mentioning that the GIZ-Ethiopia office (mainly the Integrated Soil Fertility Management Program and the Supporting Soil Health Initiatives) is trying to bring relevant institutions together to develop coordinated and integrated national agroadvisory services.

paid for through a funding mechanism other than the one created to fund the research in the first place. Both of these challenges necessarily combine to make the development of *ex-ante* impact projections exceedingly risky, and, ultimately, even more difficult to evidence.

The problem of setting targets and measuring results implies the need for more attention to what can be achieved during the limited time period of an AR4D funding cycle. As a first step, this means shifting donor expectations away from indicators like "the number of policies changed" and subsequent impact indicators related to social welfare, like "the number of people lifted from poverty." Instead, more emphasis should be placed on setting realistic goals/milestones that are achievable by the end of the project (e.g., "end-of-project outcomes") and building a ToC that is sufficiently detailed to form the basis for an evaluation (e.g., an evaluable ToC). In most instances of POR, putting in place a process that can plausibly contribute to a policy change is the most that can be hoped for within the confines of a typical funding cycle.

Staffing

IT would not be possible without the existence of champions who are able to promote innovations through both formal and informal professional networks when a policy window emerges. For many researchers and scientists, bringing an innovation to scale is regarded as "somebody else's job," and yet over the course of building a career, these same people are often well connected with policymakers and private sector actors who can facilitate the scaling of an innovation to large numbers of beneficiaries.

In terms of staffing, managers of AR4D organizations should be mindful of the following:

1. The cultivation of formal and informal networks can be pivotal in bringing to scale an innovation "whose time has come." Anthropologists, political and other social scientists have long recognized personal networks, organizational grapevines and informal diplomacy as foundational to understanding human interactions.[10] However, despite their obvious utility in bringing innovations to scale, many scientists and donors view policy networks with a high level of suspicion, fearing that their informality and ambiguity are a double-edged sword. For scientists, the primary fear is that the informal qualities that make policy networks effective are just as likely to call into question the legitimacy or quality of their scientific research findings. For donors, a similar calculus leads to fears of "colonial science" or external interference (de Vos 2020). In both cases, AR4D research is imagined to be sufficient in itself, even though empirical studies in policymaking and governance (among other areas of study) have convincingly documented the centrality of informal networks to policy development.

2. If professional networks are important to achieving policy influence, then organizations need to make a long-term commitment to staff who can contribute their expertise, institutional memory and a roster of collegial friendships with partners and policymakers. In the cases presented here, all lead scientists who played a role in IT are Ethiopian nationals who have enjoyed long-term employment with a CGIAR Center and have known each other for many years. Given the frequent use of one-time consultancies and the fact that international research organizations tend to be staffed with a diverse mix of foreign nationals, organizations should prioritize investment in staff who have a deep understanding of the country's political economy in which they work most. Just as an organization can exploit its existing credibility to gain traction within policy networks, at an individual level, so too can innovation champions.

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[10] Börzel (1997) reviews the historical emergence of informal policy networks. His study of European policy making provides a detailed analysis of policy networks and their use by policy actors to co-ordinate their interests through non-hierarchical bargaining.

Management

Few research organizations embrace the idea of thinking and working politically to achieve impact. In their study of evidence-informed policymaking, Vogel and Punton (2018) conclude that the use of evidence is inherently political and that interventions, particularly those aimed at building the capacity to use evidence, mean "thinking and working politically to harness (these) windows of opportunity, and effectively navigating political economy constraints that can undermine meaningful reform." The case studies presented here reinforce this message. Innovation champions need to push beyond mere government expressions of interest and think strategically about how to navigate political bottlenecks and opportunities. Experience and the available scholarly evidence all point to the conclusion that the mere delivery of an innovation is just the first step in a much more convoluted process of bringing it to scale through policy influence.
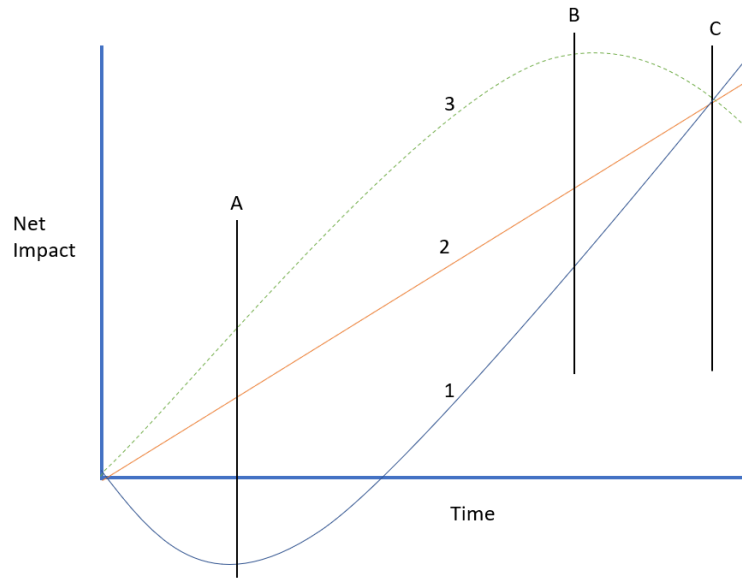
Evaluation

Fundamentally, IT calls into question assumptions about the "functional form" or impact trajectory of a project. At the request of donors, most projects are designed to produce a set of desired outcomes and impacts by the end of the project's funding cycle. The assumption is that change over time is monotonically linear, progressing from a baseline starting point to an end-of-project impact. Woolcock (2009) defines a project's functional form as "the impact trajectory that reflects the underlying "technology" of the project and that is deemed to be (in effect) independent of scale, context and implementation effectiveness." He argues that a key assumption of most development projects is that they embody an invariant "technology", where X leads to Y over time period Z. This assumption is deeply tied to traditional command and control management practices but is entirely inappropriate in complex adaptive systems.

To illustrate the importance of a project's functional form, Woolcock (2013) examines the "success" of a project represented by three hypothetical impact trajectories (Figure 2). As he points out, if a project were to undergo a rigorous evaluation at point C, all of the impact trajectories would lead to the same conclusion: the project was a success. However, if the project actually has a non-linear impact trajectory and the same project is evaluated at points A or B, then evaluative evidence would point to a very different conclusion. Indeed, if an evaluation were conducted a point A for the J-curve project, it would most likely result in the immediate termination of funding because evaluative evidence would indicate that the project is causing harm. The point here is to recognize that the timing of an impact evaluation tied to a funding cycle is largely arbitrary[11] and that the measure of success of a project with a non-linear impact trajectory may depend on when an evaluation is conducted. For this reason, evaluations must attempt to understand impact trajectories.

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[11] Within the new One CGIAR, Initiatives (which are replacing CRPs) will have a funding cycle of 3 years. Previously, CRPs were funded for 5 years (2011 to 2016) and 4 years (2017 to 2021).

Figure 2: Understanding Impact Trajectories (*Source*: Woolcock 2013).

Conclusions

For CGIAR and other similar national and international organizations, IT suggests the need for more flexibility in AR4D scaling and evaluation, particularly when outcomes are achieved over a long time and in complex policy-related contexts. In summary, we point to five important lessons:

- While ensuring staff development and integration of young, fresh minds as well as experienced researchers, AR4D organizations must make a long-term commitment to staff in order to preserve institutional memory and help establish and work within high-level policy networks.
- Projects should rarely be conceptualized as linear or monotonic; much more effort should be put toward developing plausible ex-ante theories of change that include problem identification, identification of relevant existing outcome trajectories to which to contribute, key players for achieving desired outcomes (problem-solving), targeting of solutions and scaling of solutions over time. Adaptive approaches are required throughout.
- Results-based management should complement performance-based incentives, not substitute for them. Using only results as a basis for future funding is dangerous unless results are explicitly contextualized relative to the outcome trajectory or trajectories to which it has or will contribute.
- Evaluations must acknowledge the path dependency of proposed solutions, with explicit recognition of project antecedents and potential long-term impacts; in other words, evaluations should make outcome trajectories specific.
- Evaluations should assess both planned and unintended outcomes instead of only planned outcomes. Some key achievements are the result of unintended positive outcomes and, by being out of the range of initial projects' plans, are not captured by conventional evaluations.

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RESEARCH PROGRAM ON
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