

Examining Actor-Level Change and Contribution Pathways in a Multisectoral WASH–SRH Programme Using an Integrated Implementation Mapping–Outcome Mapping–Outcome Harvesting Framework

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Abstract

Background

Implementation science needs methods that explain how strategies generate change through interacting actors in complex systems. This study examined implementation processes in a multisectoral water, sanitation and hygiene, menstrual hygiene management, and sexual and reproductive health programme in Ethiopia.

Methods

We conducted a longitudinal, complexity-informed implementation study in Jimma and Borena Zones from 2022 to 2025. Implementation Mapping specified determinants, strategies, and intended pathways; Outcome Mapping identified boundary partners and expected behavioural changes; and Outcome Harvesting identified and substantiated emergent changes. Evidence from routine monitoring, supervision, programme records, and stakeholder validation was analysed using deductive and inductive coding and contribution pathway analysis.

Results

Of 48 candidate outcomes, 35 met substantiation criteria. The outcomes concerned governance and coordination (11), capacity and practice (9), financing and market adaptation (6), reporting and data use (5), and service or infrastructure delivery (4). Eighteen outcomes were highly substantiated, 12 moderately substantiated, and five had low substantiation. Progress arose through alignment among demand creation, service readiness, financing access, market responsiveness, and governance rather than through isolated activities.

Conclusions

The integrated framework connects prospective implementation planning with retrospective analysis of actor-level and emergent change. It offers implementation researchers a practical, contribution-focused method for examining adaptation, pathway interaction, and learning in multisectoral complex systems.

Background

Implementation science seeks to understand not only whether interventions are effective, but also how they are adopted, delivered, adapted, and sustained within real-world settings. This challenge becomes particularly pronounced when implementation involves multiple interacting actors, organisations, and system components operating within dynamic contexts [1]. Although implementation science has generated robust frameworks for examining determinants, strategies, and outcomes of implementation, many approaches remain grounded in relatively linear assumptions about how implementation occurs. Such assumptions may be insufficient for understanding implementation within complex adaptive systems, where outcomes emerge through interactions, feedback loops, adaptation, and contextual influences rather than through predictable cause-and-effect pathways [2–5].

This presents an important methodological challenge. Existing implementation science frameworks provide valuable tools for identifying determinants, designing implementation strategies, and assessing implementation outcomes. However, they often provide limited guidance for understanding how implementation processes evolve over time through interactions among multiple actors, organisations, and contextual influences [1,3,6].

Consequently, there is growing recognition that implementation research requires methodological approaches capable of capturing emergence, adaptation, and system-level change while maintaining analytical rigor [2–5].

Several implementation science frameworks contribute important but distinct perspectives. The Consolidated Framework for Implementation Research (CFIR), for example has substantially advanced understanding of multilevel influences on implementation by identifying determinants operating across intervention, organisational, and contextual domains [1]. However, its primary purpose is to explain why implementation succeeds or fails rather than to document how implementation processes evolve through interactions among actors over time. Similarly, Implementation Mapping extends Intervention Mapping principles by systematically linking implementation determinants to theory-informed implementation strategies and intended outcomes [8]. While this strengthens prospective planning and transparency in implementation design, it does not inherently provide mechanisms for documenting how implementation unfolds once strategies encounter real-world contexts, contextual adaptation, unintended consequences, and emergent responses frequently occur [8,9].

Outcome Mapping (OM) and Outcome Harvesting (OH) offer complementary methodological strengths for addressing these limitations. Outcome Mapping provides a prospective framework for identifying boundary partners whose behaviours, relationships, actions, or practices are expected to influence implementation processes [10]. Outcome Harvesting, in contrast, retrospectively identifies observable changes and examines how interventions may have contributed to those changes without relying exclusively on predefined indicators [11,12]. When integrated with Implementation Mapping, these approaches provide a means of linking implementation strategies to actor-level changes while remaining sensitive to emergence, adaptation, and non-linearity [4,7].

This contribution-oriented perspective aligns with contemporary implementation science, which increasingly distinguishes implementation outcomes from intervention effectiveness outcomes. Implementation success is increasingly conceptualised in terms of adoption, acceptability, feasibility, fidelity, reach, penetration, and sustainability, all of which require methods capable of explaining implementation processes and contextual adaptation rather than estimating causal effects alone [13]. Methodological pluralism is therefore increasingly recognised as necessary for studying implementation in complex systems [2-5,14].

These methodological challenges are particularly relevant in multisectoral WASH, menstrual hygiene management (MHM), and sexual and reproductive health (SRH) programmes, where implementation depends on coordinated action among community actors, service providers, market systems, financing mechanisms, and government institutions. Evidence from WASH and health systems research demonstrates that sustained uptake and service improvement depend on interacting social, institutional, financial, and governance factors rather than isolated interventions [15–20]. Consequently, implementation outcomes emerge through interconnected processes operating across multiple levels of the system.

Against this backdrop, this study applies an integrated Implementation Mapping, Outcome Mapping–Outcome Harvesting (IM–OM–OH) approach to examine implementation processes within a multisectoral WASH–SRH programme implemented in Oromia Region, Ethiopia between 2022 and 2025. Rather than evaluating intervention effectiveness, the study seeks to understand how implementation progressed through interacting actors, institutions, and systems, and how observable changes emerged across governance, service delivery, market, financing, and community domains. By integrating prospective pathway specification with retrospective identification, and substantiation of outcomes the study contributes methodological evidence on the application

of complexity-informed approaches within implementation science. This study was guided by a complexity-informed implementation science framework integrating Implementation Mapping, Outcome Mapping, and Outcome Harvesting (Figure 1).

The study aimed to examine how implementation unfolded within a complex multisectoral WASH–SRH programme using an integrated Implementation Mapping–Outcome Mapping–Outcome Harvesting (IM–OM–OH) framework. Specifically, the study seeks to: (1) document actor-level implementation changes among key boundary partners across community, service, market, financing, and governance domains; (2) identify and classify emergent implementation outcomes arising during programme delivery; (3) analyse contribution pathways linking implementation strategies, contextual conditions, and observed implementation outcomes; and (4) assess the utility of the integrated OM–OH approach for studying implementation processes within complex adaptive systems.

Methods

2.1 Study design and theoretical orientation

We conducted a longitudinal, complexity-informed implementation science study to examine how implementation unfolded within a multisectoral water, sanitation and hygiene (WASH), menstrual hygiene management (MHM), and sexual and reproductive health (SRH) programme in Oromia Region, Ethiopia. The study covered the 2022–2025 implementation period and focused on documenting emergent implementation outcomes, actor-level changes, and contribution pathways across interacting community, service delivery, market, financing, and governance systems.

The study was non-experimental and did not aim to estimate intervention effectiveness or causal impact. Instead, it adopted a contribution-focused and interpretivist-pragmatic orientation, emphasising explanation, learning, and plausibility of contribution rather than attribution [4,21]. The methodological approach integrated Implementation Mapping, Outcome Mapping, and Outcome Harvesting to combine prospective specification of implementation pathways with retrospective identification and substantiation of observed implementation changes [4,8,10–12].

The primary unit of analysis was the harvested outcome, defined as an observable change in the behaviour, practices, relationships, decisions, or institutional routines of a boundary partner that was plausibly linked, at least in part, to programme implementation activities.

2.2 Study setting and programme context

The study was conducted in Jimma and Borena Zones of Oromia Region, Ethiopia. The two zones represent distinct implementation contexts. Jimma is predominantly agrarian and has relatively established service infrastructure, while Borena includes extensive pastoralist and semi-pastoralist communities characterised by dispersed populations, greater mobility, and more limited access to services and markets. These contextual differences provided an opportunity to examine how implementation processes varied across settings.

The programme was implemented through a consortium-based approach involving government sectors, community structures, service providers, financial institutions, and market actors. Core implementation strategies included community demand creation, referral strengthening, sanitation marketing, artisan capacity

building, microfinance linkage, school-based MHM interventions, governance strengthening, and routine performance review mechanisms. Implementation was adaptive, allowing contextual tailoring across woredas while maintaining alignment with the programme’s overall implementation pathways.

2.3 Conceptual approach: integrating Implementation Mapping, Outcome Mapping, and Outcome Harvesting

This study was guided by a complexity-informed implementation science framework that integrated Implementation Mapping (IM), Outcome Mapping (OM), and Outcome Harvesting (OH) to examine how implementation unfolded within a multisectoral WASH–SRH programme (Figure 1). The framework was informed by systems thinking and complexity science perspectives, which conceptualise implementation as a dynamic process shaped by interactions among multiple actors, organisations, and contextual influences rather than as a linear sequence of inputs, activities, and outcomes [2–5]. It was further informed by contribution-focused evaluation approaches that emphasise understanding how interventions contribute to change within complex systems rather than establishing simple causal attribution [21,24].

Implementation Mapping provided the prospective foundation of the framework by identifying implementation determinants, specifying implementation strategies, and articulating intended pathways of change [8,9]. Outcome Mapping was used to define the actor system by identifying boundary partners whose behaviours, relationships, practices, or institutional routines were expected to influence implementation [10, 22]. Outcome Harvesting was then applied retrospectively to identify, document, and substantiate observable changes that emerged during implementation [11, 12, 23]. Details of the IM–OM–OH documentation tool are provided in Supplementary Table S1. The operationalisation of Implementation Mapping tasks is summarised in Supplementary Table S3.

This integration enabled the study to link intended implementation strategies to observed actor-level changes and contribution pathways. Implementation Mapping clarified what the programme intended to change and through which strategies. Outcome Mapping clarified who was expected to change and how those changes would influence implementation. Outcome Harvesting documented what actually changed, how the programme plausibly contributed, and what evidence supported each claim.

Implementation pathways and boundary partner categories are summarised in Table 1.

Table 1. Boundary partner categories, implementation pathways, and expected implementation changes identified through Outcome Mapping (2022–2025).

Boundary Partners (Outcome Mapping)	Implementation Pathways	Expected Change (Outcome Harvesting)
Community-level actors • Community Health Workers (CHWs) • Health Extension Workers (HEWs) • Social Mobilisers/marketers	• Demand creation and social mobilisation/marketers • Referral and follow-up • Gov't/community-Leveraging • Livelihoods	• Increased household sanitation uptake and referral engagement • Strengthened social influence and trust • Improved linkage between demand and services
Service providers • Sanitation artisans • Health facilities • schools	• Service readiness and supply • Safe space/menses management • Service delivery • Life skill training	• Adoption of strengthened referral and service delivery practices • Increased responsiveness to demand • Expanded service reach
Financial actors • Households • Microfinance institutions (MFIs) • Informal support networks	• Financing and affordability mechanisms • Savings, loans, and in-kind support	• Diversified financing practices • Increased household investment • Reduced financial barriers such as loans and in-kind contributions.
Government and coordination actors • water, health and education offices	• Oversight and coordination • Capacity building • Reporting and feedback loops	• Strengthened system coordination • Improved reporting completeness • Institutionalisation of practices

Identification of intervention areas and boundary partners

Intervention areas were purposively selected based on predefined complexity criteria. These criteria included involvement of multiple interacting actor groups, reliance on adaptive or context-sensitive implementation strategies, and the likelihood of emergent or non-linear outcomes. Selected intervention areas included infrastructure development, demand creation, referral processes, sanitation marketing, financing facilitation, artisan livelihood development, youth services, MHM safe spaces, school-based interventions, and reporting systems.

Boundary partners were identified through structured stakeholder mapping. This process combined document review, consultative workshops with programme and government stakeholders, and iterative consensus refinement. Boundary partners were defined as individuals, groups, organisations, or institutions whose behaviours, relationships, decisions, or practices were expected to change during implementation. They were grouped into functional categories: community-level actors, households and service users, service providers, market actors, financial actors, government and coordination actors, and reporting/data actors.

Development and piloting of the IM–OM–OH documentation tool

A structured IM–OM–OH documentation tool was developed to support systematic identification, standardisation, substantiation, and analysis of harvested outcomes. The tool captured the following fields: implementation pathway, thematic area, boundary partner, actor category, outcome title and description, location and year, contribution narrative, alternative explanations, sustainability considerations, evidence sources, substantiation level, and relevance.

The tool was piloted using a small set of outcome signals from routine programme documentation and reflection sessions. Piloting focused on improving clarity of outcome statements, distinguishing outputs from outcomes, and strengthening documentation of contribution mechanisms. Based on piloting, outcome statements were standardised to specify: (1) who changed; (2) what changed; (3) when and where the change occurred; (4) why the change was significant for implementation; and (5) how the programme plausibly contributed.

Outcome harvesting procedures

Outcome harvesting was conducted iteratively between 2022 and 2025 by members of the programme monitoring, learning, and evaluation team in collaboration with implementing partners [11,12]. Potential outcome signals were identified through quarterly reflection meetings, routine monitoring reports, supervision records, programme documentation, and stakeholder feedback. Outcome signals were screened against predefined harvesting criteria requiring evidence of an observable change in behaviour, practice, relationships, decision-making, or institutional routines among identified boundary partners. Eligible outcome signals were reformulated into standardised outcome statements using the IM–OM–OH documentation tool. Each statement was reviewed for specificity, observability, plausibility, and relevance to implementation pathways. Where necessary, additional clarification was sought from field teams, woreda stakeholders, or programme documentation.

Draft outcome statements were prepared using a standardised outcome formulation template describing (1) who changed, (2) what changed, (3) when and where the change occurred, and (4) how programme activities plausibly contributed to the observed change. Outcome statements were reviewed for consistency and duplication before inclusion in the outcome database.

To reduce positive reporting bias, the harvesting process sought to capture both enabling and constraining changes, including delays, bottlenecks, incomplete institutionalisation, and uneven uptake across contexts. A total of 48 outcome records were initially identified. After screening, cleaning, and de-duplication, 35 outcomes were retained for final analysis.

Outcome Validation and Substantiation

Each harvested outcome was substantiated using available evidence sources. Evidence included routine monitoring data, mobile application reports, supervision checklists, meeting minutes, referral records, facility registers, loan records, financial documentation, programme reports, photographs where available, and stakeholder confirmation during reflection sessions.

Outcomes were classified into three substantiation levels. High substantiation was assigned when an outcome was supported by two or more independent evidence sources and/or stakeholder validation. Moderate substantiation was assigned when an outcome had one credible source with partial corroboration. Low substantiation was assigned when an outcome relied primarily on a single source without independent

corroboration. Substantiation ratings were used to assess confidence in each outcome and to avoid over-weighting weakly evidenced claims during synthesis.

Reflexivity and positionality

Members of the evaluation team were involved in programme monitoring and learning activities. To reduce potential confirmation bias, harvested outcomes were reviewed using predefined criteria, triangulated across multiple evidence sources, and subjected to team-based coding and validation procedures. Disagreements in interpretation were resolved through discussion, clarification with field teams where needed, and refinement of coding definitions.

Coding and data analysis

Data analysis combined deductive and inductive coding. Deductive codes were derived from the conceptual framework, including boundary partner categories, implementation pathways, and implementation outcome constructs [13]. Inductive codes were added during analysis to capture emergent domains of change that were not fully anticipated in the initial framework.

The evaluation team developed a structured codebook containing code names, operational definitions, inclusion and exclusion criteria, and illustrative examples. Initial coding was undertaken by two members of the evaluation team, after which coded outcomes were reviewed collectively during analytic review sessions. An initial calibration exercise was conducted using a subset of harvested outcomes to improve consistency in coding. All harvested outcomes were independently reviewed by at least two members of the evaluation team. Formal inter-rater reliability statistics were not calculated; instead, coding discrepancies were discussed and resolved through iterative team review, consensus discussion, and reference to supporting documentation and substantiation records. The codebook was refined throughout the analysis process to maintain consistency in outcome classification.

Coded outcomes were synthesised into thematic clusters representing dominant domains of actor-level implementation change. These clusters included governance and coordination strengthening, capacity and practice change, financing and market adaptation, reporting and data-use improvement, and service or infrastructure delivery change.

Contribution pathway analysis

Contribution pathways were developed by linking implementation strategies, boundary partner changes, evidence sources, and contextual factors. For each harvested outcome, the analysis examined: (1) the implementation strategy or pathway associated with the change; (2) the boundary partner or actor group that changed; (3) the observed behavioural, relational, practice, or institutional shift; (4) the evidence supporting the change; (5) alternative explanations or contextual influences; and (6) the plausible contribution of programme activities.

Outcomes were then compared across actor groups, geographies, and implementation pathways to identify recurring mechanisms and system-level patterns. Particular attention was given to whether changes occurred in isolation or as mutually reinforcing shifts across community, service delivery, market, financing, and governance

domains. This process generated contribution narratives explaining how implementation unfolded through interacting actors rather than through linear programme activities alone.

Use of routine programme indicators

Routine programme indicators were analysed descriptively to characterise implementation scale, coverage, distribution, and system functioning. Indicators included household sanitation uptake, household investment, loan uptake, artisan income generation, service readiness measures, reporting completeness, and selected WASH–SRH service indicators. These data were not used to estimate impact or effectiveness. Instead, they were treated as descriptive system signals and triangulated with harvested outcomes to interpret implementation reach, feasibility, responsiveness, and pathway alignment across contexts.

Results

3.1 Implementation Dataset and Coverage

Between 2022 and 2025, routine programme monitoring systems and Outcome Harvesting processes generated a structured dataset documenting implementation-related changes across Jimma and Borena Zones. A total of 48 outcome records were initially identified through iterative outcome harvesting and routine implementation review processes. Following screening, de-duplication, and substantiation assessment, 35 outcomes were retained for final analysis.

The retained outcomes were documented across 23 woredas, including 21 outcomes from Jimma Zone and 14 from Borena Zone. Outcomes were distributed across multiple boundary partner groups, including community actors, households and service users, service providers, market and financial actors, and government institutions. Harvested outcomes were recorded throughout the implementation period, with two outcomes identified in 2022, nine in 2023, thirteen in 2024, and eleven in 2025, indicating continued emergence of implementation-related change during programme scale-up and adaptation.

Each outcome record included information on the boundary partner involved, implementation pathway, location, timing, contribution narrative, sustainability considerations, and supporting evidence sources. This structure enabled systematic comparison of implementation processes across actor groups and implementation domains.

3.2 Outcome Typology

Analysis of harvested outcomes generated an empirically derived typology of implementation change comprising five domains: (1) governance and coordination strengthening; (2) capacity and practice change; (3) financing and market adaptation; (4) reporting and data-use improvement; and (5) service or infrastructure delivery change (Table 2).

Table 2. Outcome typology and classification of harvested outcomes (2022–2025)

Outcome domain	Type of actor-level change captured	Typical boundary partners	Primary implementation pathway linkage	Illustrative example	No. of outcomes
Governance and coordination strengthening	Changes in coordination routines, joint planning, oversight, role clarity, and cross-sector collaboration	Woreda/zonal offices; education/health/water associations; coordination platforms	Oversight and coordination; integration; standard setting	Strengthened cross-sector coordination platforms addressing planning gaps	11
Capacity and practice change	Changes in skills and routine practices, including mentorship effects and service quality improvements	HEWs/CHWs; private providers; schools; implementers	Training and mentorship; service readiness; quality improvement	Mentorship improved method mix and early ANC uptake in supported facilities	9
Financing and market adaptation	Shifts in affordability pathways, loan uptake, market engagement, and sanitation value chain functioning	Households; SMEs; MFIs; artisans/youth masons	Market facilitation; financing mechanisms; livelihoods	Sanitation loan uptake and artisan engagement supporting household investment	6
Reporting and data-use improvement	Changes in documentation practices, reporting completeness, integration into routine information systems	Private clinics; woreda offices; facilities; supervisors	Reporting and feedback loops; routine system integration	Improved reporting from private facilities into woreda systems	5
Service or infrastructure delivery change	Observable improvements in service access and readiness linked to enabling environments	Schools; government implementers; community leadership	Infrastructure development; school WASH/MHM platforms	Expansion of adolescent-responsive school facilities and referral systems	4

Governance and coordination strengthening represented the largest category (n=11), followed by capacity and practice change (n=9), financing and market adaptation (n=6), reporting and data-use improvement (n=5), and service or infrastructure delivery change (n=4).

Governance outcomes included changes in joint planning mechanisms, cross-sector coordination platforms, oversight routines, and institutional collaboration. Capacity and practice outcomes reflected changes in service delivery routines, mentorship practices, referral systems, and frontline implementation behaviours. Financing and market adaptation outcomes captured shifts in sanitation financing, household investment pathways, artisan

engagement, and market responsiveness. Reporting and data-use outcomes documented improvements in reporting completeness, integration of private-sector data into routine systems, and use of performance information for decision-making. Service and infrastructure delivery outcomes reflected changes in service readiness, facility improvements, and enabling environments supporting WASH and SRH implementation. Together, these domains provide an analytic classification of the principal forms of implementation-related change observed across the study period. The alignment between harvested outcome domains and implementation outcome constructs is presented in Supplementary Table S2. Governance and coordination outcomes primarily reflected penetration and sustainability, whereas financing and market adaptations were most closely aligned with feasibility and reach.

3.3 Boundary Partner Changes Across the Implementation System

Community Actors

Harvested outcomes indicated changes in community engagement practices among Community Health Workers, Health Extension Workers, and Village Health Leaders. Between 2023 and 2024, community actors increasingly adopted sustained household follow-up, structured referral practices, and repeated interpersonal engagement rather than one-time awareness activities. Outcome records documented strengthened referral linkages between households, sanitation artisans, financial actors, and service providers.

For example, one harvested outcome documented the establishment of routine referral tracking between Community Health Workers and sanitation artisans in Jimma Zone. Community Health Workers began systematically following up referred households and sharing referral information with artisans, strengthening continuity between demand-generation activities and service uptake.

Another harvested outcome documented that sanitation artisans shifted from ad hoc construction work to more responsive service provision. This includes including follow-up with referred households, improved product standardisation, and stronger linkage with community demand-generation activities. This change strengthened the supply side of the sanitation pathway by making services more accessible and predictable for households.

Households and Service Users

Households demonstrated changes in sanitation-related decision-making and investment behaviour. Outcome records documented increasing use of multiple financing pathways, including household savings, microfinance loans, informal borrowing, and in-kind contributions. These changes were observed across both implementation zones and were associated with increased engagement with sanitation and WASH-related services.

For example, harvested outcomes documented that households in both Jimma and Borena increasingly combined savings, microfinance loans, informal borrowing, and in-kind contributions to finance sanitation improvements. This shift reflected an actor-level change in household decision-making, where sanitation investment moved from passive interest to active resource mobilisation.

Service Providers and Artisans

Service providers and sanitation artisans demonstrated changes in service delivery practices and responsiveness. Harvested outcomes documented improved client follow-up, expanded service availability,

greater product standardisation, and enhanced SRH service provision within supported facilities. Several outcomes reflected increased interaction between service providers and community demand-generation mechanisms.

One harvested outcome documented that sanitation artisans adopted more standardised pricing and service packages following mentorship and market-linkage activities. Artisans also reported increased engagement with referred households, indicating greater responsiveness to community demand.

Financial Actors

Microfinance institutions and other financing actors demonstrated adaptation of financing mechanisms supporting sanitation investment. Harvested outcomes documented increased availability of sanitation-related loans, expanded engagement with sanitation value-chain actors, and greater use of formal financing mechanisms by households.

One harvested outcome documented that microfinance institutions introduced sanitation-focused lending arrangements after programme-facilitated engagement demonstrated household demand and repayment potential. This adaptation expanded financing options available to households seeking sanitation improvements.

Government and Coordination Actors

Government actors demonstrated changes in coordination, reporting, and oversight practices. Outcomes documented strengthened multi-sector review platforms, increased use of routine reporting systems, integration of WASH–SRH indicators into planning processes, and improved coordination among health, water, and education sectors.

Across actor groups, implementation-related changes were observed in behaviours, relationships, routines, decision-making processes, and institutional practices rather than solely in programme outputs or service delivery indicators.

One harvested outcome documented the integration of WASH–SRH indicators into routine multi-sector review meetings involving health, water, and education offices. This change strengthened joint planning, accountability, and oversight across sectors. This institutional change improved cross-sector oversight and created a more structured mechanism for tracking implementation progress across sectors.

Terms of reporting and data system actors, private facilities and woreda offices improved documentation and reporting of WASH–SRH indicators into routine systems. This change strengthened implementation penetration by moving reporting practices from project-specific documentation toward routine administrative use.

3.4 Contribution Pathways and System Learning

The analysis demonstrated that demand creation alone was insufficient to generate sustained sanitation uptake. Community actors, including CHWs, HEWs, and social mobilisers, successfully increased awareness and interest in improved sanitation and SRH services. However, uptake was strongest when demand-generation activities were accompanied by accessible services, available artisans, and financing mechanisms. In several instances, increased community demand did not immediately translate into service uptake where households faced affordability constraints or where service providers lacked capacity to respond. These findings suggest that

implementation progression depended not on individual strategies operating independently, but on the alignment of multiple implementation components.

A recurring implementation pathway involved frontline actors serving as brokers between households and the wider implementation system. CHWs and HEWs frequently linked households to sanitation artisans, health facilities, microfinance institutions, and community support structures. One harvested outcome documented the establishment of routine referral tracking between community actors and sanitation artisans, strengthening continuity between demand generation and service access. Contribution pathway analysis demonstrated that implementation unfolded through the alignment of demand creation, service readiness, financing access, market responsiveness, and governance mechanisms. Rather than acting independently, these components reinforced one another, producing actor-level changes that collectively generated implementation outcomes across the system.

Financing and market actors played a critical role in translating intention into action. Households increasingly combined savings, loans, informal borrowing, and in-kind contributions to finance sanitation improvements. At the same time, sanitation artisans strengthened their engagement with communities, and microfinance institutions adapted financing arrangements in response to demonstrated demand. These mutually reinforcing changes suggest that market and financing mechanisms functioned as enabling conditions for implementation. Where such mechanisms were weak or absent, implementation outcomes were less consistent despite successful demand-generation efforts.

Taken together, the harvested outcomes suggest that implementation progressed through interconnected changes across community, service delivery, market, financing, and governance systems. Rather than following a linear pathway from programme activities to outcomes, implementation emerged through adaptive interactions among actors operating within a complex system. The findings indicate that successful implementation depended on coordination, responsiveness, and feedback across multiple domains, highlighting the importance of systems-oriented implementation strategies in multisectoral programmes.

3.5 Quantitative Mapping of Implementation Scale and System Signals

Routine programme monitoring data were analysed as descriptive implementation signals to complement harvested outcomes and provide contextual evidence on implementation scale, reach, and system functioning. These indicators were not interpreted as measures of intervention effectiveness but as observable markers of implementation progression across community, service delivery, market, financing, and governance pathways.

Between 2022 and 2025, programme monitoring systems documented implementation at substantial scale across the two study zones. More than 12,000 households constructed safely managed sanitation facilities, representing an important signal of implementation reach and progression along demand-to-adoption pathways. These indicators were not treated as implementation outcomes and were not used to infer programme effectiveness. Rather, they served as contextual implementation signals used to triangulate and interpret harvested outcomes. From an implementation perspective, these investments indicate movement beyond awareness and intention toward behavioural uptake among households exposed to programme activities.

Household expenditure on sanitation improvements exceeded ETB 119 million during the implementation period. Rather than serving solely as a measure of programme output, household investment was interpreted as a signal

of implementation adoption, reflecting willingness among households to commit financial resources to sanitation improvements when enabling conditions were present. This finding is consistent with harvested outcomes documenting increased prioritisation of sanitation within household decision-making processes.

Financing indicators provided additional evidence regarding implementation feasibility. A total of 435 households accessed sanitation-related loans amounting to approximately ETB 15.2 million. Loan utilisation suggested that financing mechanisms became sufficiently accessible and acceptable for some households to translate demand into action. The uptake of formal financing products also reflected increasing engagement of financial institutions within sanitation implementation pathways, supporting progression from demand generation to behavioural adoption.

Market responsiveness was reflected through sanitation-related income generation among artisans and service providers, estimated at approximately ETB 42 million during the implementation period. This finding provided a signal of increasing alignment between demand-generation activities and supply-side capacity. From an implementation perspective, artisan engagement indicated that market actors were responding to emerging demand and adapting service provision practices to support implementation progression (Table 3).

Table 3. Routine Monitoring Indicators as Implementation Signals (2022–2025)

Implementation Signal	Observed Value	Interpretation
Households constructing sanitation facilities	>12,000	Reach and behavioural adoption
Household sanitation investment	ETB 119 million	Adoption and willingness to invest
Households accessing sanitation loans	435	Feasibility of financing pathways
Loan disbursement	ETB 15.2 million	Financing accessibility
Artisan income generated	ETB 42 million	Market responsiveness and supply-side adaptation
Reporting completeness	95%	Penetration into routine systems

3.6 Outcome Substantiation and Evidence Sources

Harvested outcomes were supported by multiple forms of evidence, including routine monitoring records, supervision reports, programme documentation, meeting minutes, financial records, facility records, and stakeholder validation processes.

Of the 35 harvested outcomes included in the final analysis, 18 (51.4%) were highly substantiated, 12 (34.3%) moderately substantiated, and 5 (14.3%) had low substantiation. Routine monitoring records and supervision documentation were the most frequently cited evidence sources. Stakeholder validation was particularly common for governance, coordination, and reporting-related outcomes.

More than half of all harvested outcomes were supported by multiple independent evidence sources, providing confidence in the consistency of observed implementation patterns across actor groups and implementation

domains.

Discussion

This study contributes to implementation science by demonstrating how an integrated Implementation Mapping–Outcome Mapping–Outcome Harvesting (IM–OM–OH) approach can be used to examine implementation processes, actor-level change, and contribution pathways within complex adaptive systems. Applying this framework to a multisectoral WASH–SRH programme, the study showed that implementation outcomes emerged through interacting changes among community actors, households, service providers, market actors, financial institutions, and government stakeholders rather than through isolated implementation activities. Implementation progression depended on the alignment of demand creation, service readiness, financing access, market responsiveness, and governance mechanisms, highlighting the importance of coordinated system-wide action. These findings reinforce complexity-informed perspectives that conceptualise implementation as an adaptive and relational process shaped by interactions among actors, institutions, and contextual conditions. They further illustrate the value of integrating prospective implementation planning with retrospective analysis of emergent outcomes to generate actionable learning about how implementation unfolds in real-world settings.

A central finding of this study is that implementation progressed through observable changes in the behaviours, practices, relationships, and institutional routines among boundary partners. Notably, implementation progress was observed across multiple implementation outcome domains simultaneously. Governance-related changes primarily reflected penetration and sustainability; capacity and practice changes reflected fidelity and appropriateness; financing adaptations reflected feasibility and reach; and reporting improvements reflected penetration into routine systems. This pattern suggests that implementation success emerged through cumulative changes across several implementation outcome dimensions rather than through improvement in a single outcome alone. Consistent with Outcome Mapping theory, implementation was not primarily driven by programme activities themselves but by how actors responded to, adapted, and incorporated those activities into routine practice (Earl et al., 2001; Smutylo, 2005). Community actors strengthened referral systems and household engagement; service providers adapted service delivery practices; financial institutions expanded financing opportunities; and government actors strengthened coordination and reporting accountability mechanisms.

These findings accord with complexity-informed implementation research, which treats adaptation, actor agency, and contextual responsiveness as central to implementation success.

The contribution pathway analysis suggests that implementation success depended less on the volume of activities delivered and more on the alignment of multiple implementation pathways (Mayne, 2012; Patton, 2010; Whelan et al., 2023). Demand generation alone was insufficient to sustain implementation outcomes. Instead, uptake and continued engagement were observed where generated demand was matched by responsive service providers, functioning sanitation markets, accessible financing mechanisms, and supportive governance structures. Likewise, improvements in service readiness were insufficient when demand creation, referral systems, or affordability pathways remained weak (Mayne, 2012; Patton, 2010; Whelan et al., 2023).

These findings support systems-oriented perspectives that conceptualise implementation as an emergent property of interconnected actors and institutions operating within complex systems (Mayne, 2012; Patton,

2010; Whelan et al., 2023). Rather than functioning independently, implementation pathways interacted in mutually reinforcing ways. Areas demonstrating stronger implementation progression were characterised by greater synchronisation across community engagement, service delivery, financing, market development, and governance domains. These observations are consistent with evidence from health systems and WASH research demonstrating that sustained adoption depends on coordinated action across multiple system levels rather than on isolated interventions (Bouzid et al., 2018; Freeman et al., 2022; Mamo & Novotný, 2024; Martin et al., 2018; WaterAid, 2021; World Health Organization & United Nations Children's Fund, 2019).

Although implementation science offers numerous frameworks for identifying determinants and designing strategies, fewer approaches systematically document how implementation unfolds through actor-level change once interventions enter real-world systems (Damschroder et al., 2009; Fernandez et al., 2019). The integrated Implementation Mapping–Outcome Mapping–Outcome Harvesting framework addresses this gap by linking prospective specification of implementation pathways with retrospective identification and substantiation of emergent outcomes. The three approaches served complementary functions. Implementation Mapping specified intended implementation pathways and strategy logic; Outcome Mapping identified the actor systems through which implementation was expected to occur; and Outcome Harvesting documented observable changes and emergent outcomes arising during implementation. Together, these methods enabled prospective specification and retrospective explanation of implementation processes within a complex adaptive system.

The integrated framework moved beyond identifying determinants to explain how strategies were translated into behavioural and institutional change, how these changes interacted across system domains, and how they generated implementation outcomes while accommodating adaptation and contextual variation.

The framework therefore complements determinant-based implementation approaches such as CFIR by providing a mechanism for examining how implementation evolves after strategies are introduced into complex systems (Damschroder et al., 2009; Nilsen, 2015). It also shares conceptual similarities with developmental evaluation and contribution analysis, which emphasise learning, adaptation, and plausible contribution within dynamic environments (Mayne, 2011, 2017; Patton, 2010). However, the integrated framework offers a distinctive actor-centred perspective that explicitly links implementation pathways, boundary partner changes, and substantiated implementation outcomes.

The findings have several implications for implementation practice. First, implementation monitoring systems should move beyond activity tracking and predefined indicators to include systematic documentation of actor-level changes, adaptations, and emergent outcomes. Such information is essential for understanding how implementation strategies operate in practice and why implementation trajectories vary across settings.

Second, multisectoral programmes should pay greater attention to pathway alignment. Strengthening a single implementation component may be insufficient if complementary pathways remain underdeveloped. Effective implementation requires coordinated investments in demand generation, service readiness, financing mechanisms, market responsiveness, and governance systems.

Third, adaptive learning mechanisms should be embedded within implementation processes. The prospective–retrospective feedback loop generated through Outcome Harvesting provided actionable information that could inform refinement of implementation strategies and strengthen responsiveness to contextual conditions. Such

adaptive learning approaches are increasingly recognised as essential for implementation within complex systems (Greenhalgh & Papoutsis, 2018; Mayne, 2012; Patton, 2010; Whelan et al., 2023; Wilson-Grau, 2018).

A major strength of this study is the integration of Implementation Mapping, Outcome Mapping, and Outcome Harvesting within a longitudinal implementation science design. The approach enabled systematic examination of implementation processes across multiple actor groups and generated evidence from diverse sources, including routine monitoring systems, programme documentation, stakeholder validation, and implementation records.

Several limitations should also be acknowledged. First, Outcome Harvesting relies partly on retrospective reconstruction of implementation processes and may be subject to reporting and recall bias despite efforts to triangulate evidence. Second, because the study focused on contribution rather than attribution, findings cannot establish causal relationships between specific implementation strategies and observed outcomes. Third, some harvested outcomes had limited supporting evidence and were therefore interpreted cautiously. Finally, the study was conducted within a specific multisectoral WASH–SRH programme in Ethiopia, which may limit transferability of findings to other implementation contexts. However, the methodological approach may be transferable to other multisectoral implementation contexts where implementation outcomes emerge through interacting actors and systems.

Conclusions

Implementation within multisectoral WASH–SRH programmes emerged through interacting changes among community actors, households, service providers, market actors, financial institutions, and government stakeholders rather than through isolated intervention activities. The findings demonstrate that implementation progression depended on the alignment of demand creation, service readiness, financing access, market responsiveness, and governance pathways operating within a complex adaptive system.

Integrating Implementation Mapping, Outcome Mapping, and Outcome Harvesting provided a practical complexity-informed implementation science framework for documenting implementation processes, analysing contribution pathways, and generating implementation learning. By linking prospective implementation planning with retrospective identification and substantiation of emergent outcomes, the framework offers a useful methodological option for studying implementation processes in complex systems where adaptation, interaction, and emergence are central features of change.

Future implementation research should further evaluate the applicability of this approach across different health and development programmes and explore how actor-centred, contribution-focused methods can complement existing implementation science frameworks to strengthen understanding of implementation processes and adaptive system change.

Declarations

Consent for Publication

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

Author Contribution

Geteneh Moges Assefa (GMA) conceived the study, developed the conceptual and methodological framework, led the data analysis, interpreted the findings, and drafted the manuscript. Genetu Addisu (GA) and Makida Berhan (MB) contributed to programme implementation, and revision of the manuscript. Wendemagegn Yeshanehe (WY) and Muluken Dessalegn Muluneh (MDM) contributed to methodological refinement, interpretation of results of the manuscript. All authors read and approved the final manuscript.

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Availability of Data and Materials

The datasets generated and analysed during the current study are not publicly available because they contain programme monitoring and implementation data subject to institutional data-sharing agreements. De-identified data supporting the findings of this study are available from the corresponding author upon reasonable request and with permission from Amref Health Africa in Ethiopia.

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Figures

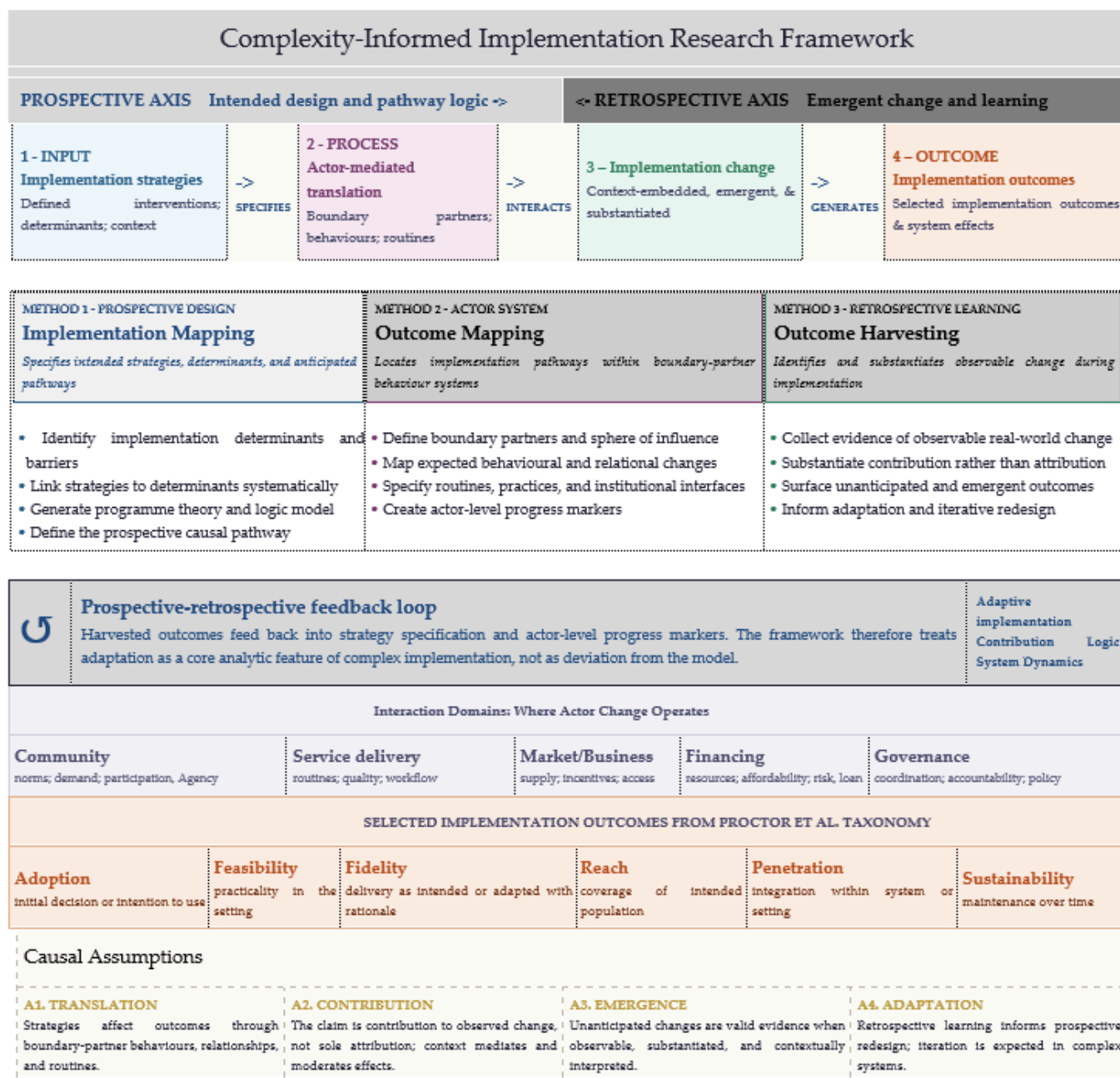


Figure 1

Complexity-informed implementation research framework integrating Implementation Mapping, Outcome Mapping, and Outcome Harvesting

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