Agronomy for Sustainable Development (2025) 45:30
https://doi.org/10.1007/s13593-025-01024-3

RESEARCH ARTICLE

Engaging, collaborating, and driving change within a multi-stakeholder platform through a step-by-step approach of innovation design applied to African dairy value chains

Eric Vall[1] · Sarah Audouin[2,11] · Etienne Sodré[3] · Souleymane Ouédraogo[4] · Ollo Sib[5,12] · Lovaniaina Jean Elisée Rakotomalala[6] · Nirina Lynah Rakotonoely[6] · Mathieu Vigne[5,13] · Papa Amadou Moctar Gaye[7] · Astou Camara Diao[8] · Jean Daniel Cesaro[1] · Christian Corniaux[1] · Asaah Ndambi[9] · John Irungu Mburu[10] · Mercy Nyambura Mburu[10] · Marie Ferré[2]

Accepted: 15 April 2025

Abstract

In Sub-Saharan Africa, dairy value chains' stakeholders face many challenges and have expectations for change. Step-by-step innovation design methodologies and multi-stakeholder innovation platforms are implemented to drive changes desired by stakeholders. We assumed that combining these two approaches would reinforce the potentiality of achieving the changes. To the best of our knowledge, the specific mechanisms and actions involved in such a combination are poorly documented. This study contributes to fill this gap by reporting on modalities of engagement, collaboration, and change generation with stakeholders of dairy innovation platforms deriving from a step-by-step innovation design approach that is embedded within an overall loop-structure dynamic and accounting for three levels of stakeholders' engagement. We applied this step-by-step approach as part of the "Africa-Milk project" on ten dairy innovation platforms located in four African countries (Senegal, Burkina Faso, Kenya, and Madagascar). The approach was led by a core team and applied adaptively across the various innovation platforms, according to both their organizational context and objectives. In this paper, we captured the lessons learned along the key implementation stages of the approach (i.e., engagement, action, and assessment) and regarding the type of stakeholders involved. Our results show that the initiation of the engagement highly depends on the pre-existence of an innovation platform. The action stage proceeds then through either cascading actions or parallel actions. Finally, the outcome assessment stage enables to identify different types of changes induced by the approach (i.e., changes in practices, interactions, capacities, and opinions). Owing to its adaptability, the overall loop-structure of the approach enables practical adjustments and reflexivity to best meet the needs of innovation platform stakeholders. This study paves the way to implement co-design of innovation approaches to broader multi-stakeholder platforms involved in agri-food system transformations.

Keywords Step-by-step design of innovations · Co-design · Dairy innovation platform · Outcomes · Sub-Saharan-Africa

✉ Eric Vall
eric.vall@cirad.fr

1 UMR SELMET , CIRAD, INRAE, Institut Agro, University of Montpellier, TA C-112/A - Campus international de Baillarguet, F-34398, Montpellier, France

2 UMR INNOVATION, CIRAD, INRAE, Institut Agro of Montpellier, F-34398 Montpellier, France

3 Animal Production Department, INERA, CNRST, Station of Farako Bâ, 01 BP 910, Bobo-Dioulasso, Burkina Faso

4 Natural Resources Management and Farming Systems Research Department, INERA, CNRST, Station of Farako Bâ, 01 BP 910, Bobo-Dioulasso, Burkina Faso

5 UMR SELMET, CIRAD, INRAE, Institut Agro, University of Montpellier, F-34398 Montpellier, France

6 FIFAMANOR, 110 BP 198, Antsirabe, Madagascar

7 LNERV, ISRA, BP 2057, Dakar, Senegal

8 BAME, ISRA, BP 2057, Dakar, Senegal

9 Wageningen Livestock Research, Wageningen University & Research, Wageningen, The Netherlands

10 Department of Agricultural Economics, University of Nairobi, Nairobi, Kenya

11 FOFIFA, Antsirabe, Madagascar

12 ISRA, Dakar, Senegal

13 FIFAMANOR, Antsirabe, Madagascar

Published online: 10 June 2025

1 Introduction

In Sub-Saharan Africa, stakeholders in the dairy value chains face numerous challenges. They strive to meet the growing and diversifying food demands of the population while responding to new societal expectations for more inclusive, environmentally friendly, and animal welfare-conscious value chains that comply with regulatory requirements (Sraïri et al. 2019; Vall et al. 2021). In the face of these evolving expectations and the needs for transformation, research is increasingly being called upon to develop methods to design the desired changes with dairy industry stakeholders.

In agronomic research, designing change in partnership with stakeholders such as farmers is commonly referred to as a "step-by-step" innovation design approach. This research-driven approach implemented with farmers aims to gradually facilitate changes in their farming system by actively engaging them in the transition through iterative improvement loops (Meynard and Dourmad 2014). In this approach, the concepts of iterative processes (also called "iterative learning process," "process with iteration," or "iterative cycles") and loops ("action loops," "feedback loops," or "learning loops") describe the learning processes that occur as part of this change development (Meynard et al. 2012, and 2023). However, the sequencing stages vary according to authors: current system analysis, solution identification, implementation, and results assessment for Meynard and Dourmad (2014); describe, explain, explore, and design for Ronner et al. (2019); and exploring and formalizing partnership, designing and testing options for change, and reviewing and disengagement for Vall et al. (2016). Overall, and following an analysis of a number of case studies, Meynard et al. (2023) outline a basic pattern underlying the "step-by-step" innovation design approach, which is made of the iterative stages of diagnosis, exploration, implementation, and assessment, and which is fostered by collective learning dynamics. However, this approach has mainly been experimented in the context of designing new farming system practices through bilateral interactions between research teams and farmers. Other stakeholders involved in the value chains, like collectors and processors, are rarely invited to join such design process. Such a narrow selection of stakeholders likely has implications, particularly in terms of taking into account potential divergent interests, power relations, and willingness to engage in transformative changes within the value chain.

Beside research on innovation design, a distinct research community has developed a participatory approach to innovation design through multi-stakeholder innovation platforms (IP). The concept of IP has now been used for more than a decade (Adekunle and Fatunbi 2012, and 2014) to better account for the diversity and roles of the stakeholders in a value chain or a territory when aiming to implement change. It was initially proposed for operationalizing research-action interventions intending to drive change by following an integrated and holistic approach of research-for-development. The IP concept is rooted in the concepts of innovation system (Klerkx et al 2012; Hounkonnou et al. 2012) and theory of change (Nyikahadzoi et al. 2012), which both emphasize the need to foster conducive innovation environments where researchers, policymakers, farmers, end-users, and entrepreneurs use their individual and collective knowledge for the purpose of making change happen. IPs have been conceptualized as intermediary structures that fulfill a set of functions to bring system-level changes that would then enable farmers to benefit from innovation, and thus shift towards an improved system (Hounkonnou et al. 2018; Kilelu et al. 2013; Lema et al. 2021). IPs aim to foster complementary technological, organizational, and institutional innovations through engaging a diverse set of stakeholders, mobilizing a variety of resources, fostering connections and cooperation, and stimulating learning (Schut et al. 2016; Barzola et al. 2020; Maryono et al. 2024). While a large number of IPs have emerged in Sub-Saharan Africa (e.g., Davies et al. 2016; Jiggins et al. 2016; Sanyang et al. 2016; Barzola et al. 2020; Maryono et al. 2024), we will pay particular attention here to lessons learned from recent IP experiences that used inclusive approaches to design innovation in dairy and livestock farming systems (Kilelu et al. 2013; Cadilhon et al. 2016; Lema et al. 2016, 2021 and 2023). This literature shows that IPs' members are urged to work towards identifying specific issues (e.g., around agronomic performances, stakeholder inclusion), prioritizing them, and then developing acceptable solutions by involving the relevant stakeholders (Adekunle and Fatunbi 2014; Sanyang et al. 2016; Barzola et al. 2020; Maryono et al. 2024). Moreover, IPs generate different types of changes in agricultural practices, marketing methods, natural resource management, institutional operations, and social interaction modalities (e.g., Hounkonnou et al. 2012; Nyikahadzoi et al. 2012; Adjei-Nsiah et al. 2016; Sanyang et al. 2016; Jiggins et al. 2016; Soumano and Traoré, 2016; Sartas et al. 2018, Lema et al. 2023; Barzola et al. 2020; Maryono et al. 2024). Changes driven by IPs are based on an iterative learning process (Adekunle and Fatundi, 2012, 2014; Nyikahadzoi et al. 2012; Dabiré et al. 2016; Swanns et al. 2013) and feedback loops (Sell et al. 2018; Sanyang et al. 2016; Cadilhon et al. 2016). To this end, the research-led iterative learning process is represented as a series of iterative loops, each one being composed of a sequence of actions (diagnosis, planning, implementation, monitoring, assessment) and interactions with the

IP's stakeholders at different levels (IP board, members, external stakeholders). This echoes the key stages of the "step-by-step" innovation co-design approach outlined by Meynard et al. (2023), but with an added multi-stakeholder dimension and extending actions across the value chain. While many studies about IPs functioning mention iterative learning and cycles of adaptation (Schut et al. 2017, Lema et al. 2023; Barzola et al. 2020), they offer little guidance on how to manage and operationalize, in a concrete way, such iterative processes when a participatory design approach is implemented with the stakeholders of an IP.

Therefore, to the best of our knowledge, the mechanisms and targeted actions involved in driving change as part of a step-by-step approach of innovations implemented within an IP are rarely documented in the literature. This study contributes to fill this gap by reporting on modalities of engagement, collaboration, and change generation with stakeholders of dairy innovation platforms deriving from a step-by-step innovation design approach that is embedded within an overall loop-structure dynamic and accounting for three levels of stakeholders' engagement.

The approach presented here, namely *a step-by-step loop-based design of innovations implemented in a collaborative way within a dairy innovation platform*, will be hereafter referred to as "the approach." The approach is meant to collaboratively design innovations that eventually aim to drive substantial changes in the dairy value chain, accounting for three circles of stakeholders' engagement (the core team, the IP's members, and the stakeholders influenced). It includes three stages: engagement, action, and assessment—making a loop that allows to integrate, step-by-step, the expectations, the initiatives, the outcomes, and the feedback of the three circles of stakeholders. At the end of the loop, a new one (new iteration) can start (if the stakeholders wish to continue), or the process can also stop if the goals are achieved and stakeholders pull out.

This approach was developed and tested with ten Dairy Innovation Platforms (DIPs) focusing on local dairy value chains in four Sub-Saharan African countries (Senegal, Burkina Faso, Kenya, and Madagascar; see Figure 1). The comparative analysis of these case studies aimed to (1) consolidate the understanding of the approach in terms of principles and practices; (2) highlight how the approach facilitates

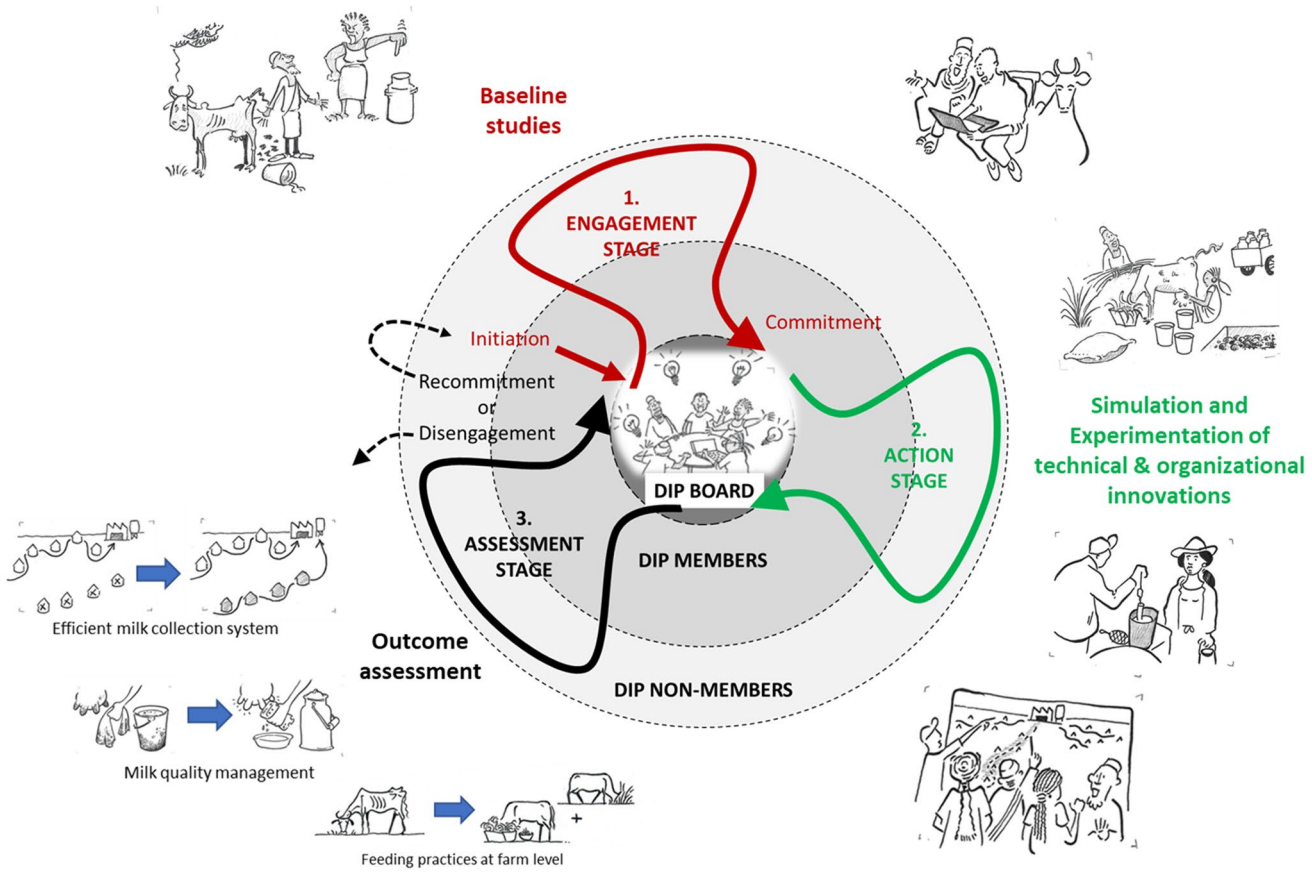

Fig. 1 Schematic representation of the approach: step-by-step loop-based design of innovations implemented in a collaborative way within a dairy innovation platform (DIP).

engagement and collaboration with a diversity and a large number of stakeholders involved in a value chain, helping to adapt the innovation and achieve the targeted changes; and (3) draw practical guidelines to implement the approach in other situations.

2 Materials and methods

2.1 The africa-milk project and the ten dips involved in the approach

The Africa-Milk project was conducted between 2018 and 2022 with the aim of testing a step-by-step loop-based design of innovations implemented in a collaborative way with ten DIPs sharing the following common issue: dairy processors face difficulties in securing local milk supplies in terms of volume, consistency, and quality, in a context of increasing demand. The Africa-Milk project covered a wide variety of climatic contexts (dry tropical conditions in the savannah areas and the Sahel region of Senegal and Burkina Faso, high altitude and highland tropical conditions in Kenya and Madagascar) and economic environments (emerging dairy economy in West Africa, established dairy economy in Kenya and Madagascar, mini-dairies in West Africa collecting less than 1000 l/day and semi-industrial or industrial dairies in Kenya and Madagascar > 10,000 l/day). The project involved a consortium of six research institutes including the French Agricultural Research Centre for International Development (CIRAD, France), the Centre for Rural Development and Applied Research on Crops and Livestock (FIFAMANOR, Madagascar), the Institute for the Environment and Agricultural Research (INERA, Burkina Faso), the Senegalese Institute for Agricultural Research (ISRA, Senegal), the University of Nairobi (UoN, Kenya), and Wageningen University & Research (WUR, the Netherlands).

The main objective of the project was to design, within the DIPs, innovations contributing to increasing and securing local milk supplies for dairies through the development of agroecological milk production units (with technological innovations at farm level) as well as efficient and inclusive milk collection systems (with organizational innovations at milkshed level). Based on the local context and DIP members' specific needs for change, the selected innovations were tailored to each case according to the extent and perception of the problems related to milk quantity, quality, and stability.

As part of the project, DIPs were defined as multi-stakeholder bodies composed of stakeholders operating upstream in the local dairy value chain: farmers, collectors, and processors. Table 1 outlines the characteristics and status of the ten DIPs. DIP configuration is such that farmers and collectors supply milk to one or more dairy processors within a milkshed. Each DIP had its own vision of the future of the value chain and was willing to collaborate with a research team on the design of technical and organizational innovations that would align with their objectives. Each DIP had its own governance body, as well as a ring of active members and partners. Their level of structuration was very much linked to their past experience: for instance, two DIPs existed prior to the project (Dagana in 2014 and Banfora in 2013) and had set up a governance structure, including a board, staff, stakeholder groups, farmers' cooperative, and a wide range of partnerships (milk collection company in Dagana (KSDE), private actors, livestock Ministry departments, various NGOs, research). On the other hand, the other eight DIPs were established during the project, hence their comparatively less advanced level of governance. They did benefit from the experience of the other DIPs through the involvement of researchers who supported the alignment of their vision and supported them setting up governance bodies, developing action plans, and building a network with technical and financial partners. During the project, researchers were considered partners of the DIP. As a result, the implementation of the approach was led by a "core team" bringing together the DIP board and the research team (Table 2).

2.2 The approach—conceptual background

The approach consists of a step-by-step loop-based design of innovations implemented in a collaborative way within a multi-stakeholder innovation platform that specifically integrates the various stakeholders involved in a value chain (i.e., the dairy value chain in this study). This approach builds upon theoretical elements combining the concepts of stakeholder engagement (Chevalier and Buckels 2008; Reed et al. 2009) and innovation design (Meynard et al. 2023). Based on the stakeholder identification method (Mitchel et al. 1997), we identified three main categories of stakeholders in IPs, which differ according to their level of involvement and the moment at which they are involved in the approach (see Table 2): the core team (DIP board and researchers), the IP members (dairy value chain stakeholders: dairy farmers, milk collectors, milk processors), and the influenced stakeholders (dairy farmers, collectors, and processors, as well as other dairy industry actors operating in the local milkshed but who are not DIP members). Typically, the DIP board included at least one representative from the upstream professions in the value chain (farmers, collectors, processors) and was generally chaired by a representative from the processing community. This prominent position of processors on DIP boards stems from the fact that they hold a key and strategic position in the value chain between its upstream (large number of farmers and collectors) and

Table 1 (Part I) Dairy Innovation Platforms (DIP) profiles and milkshed characteristics (BF: Burkina Faso; SN: Senegal; MD: Madagascar; KN: Kenya; MCC: milk collection center). (Part II) Dairy Innovation Platforms (DIP) stakeholders and researchers involved in the approach: step-by-step loop-based design of innovations implemented in a collaborative way within a DIP (Stages of the approach: engagement (ENG); action (ACT); assessment (ASS)).

Part I

DIP name	Registered Office (Country)	Created in	Number of Dairy farmers	Milk collectors	Dairy processors
Banfora	Banfora (BF)	2013	~200	8 non-refrigerated MCC 23 independent collectors Farmers supplying milk directly to processors	4 mini-dairies (collecting ~800 l/d from 200 farmer members of the DIP)
Bobo-Dioulasso	Bobo-Dioulasso (BF)	2020	~180	7 non-refrigerated MCC ~50 independent collectors Farmers supplying milk directly to processors	~15 mini-dairies (collecting ~1400 l/d from 180 farmer members of the DIP)
Dagana	Dagana (SN)	2014	~1000	1 collection company (KSDE) 8 collectors on three-wheelers Farmers supplying milk directly to processors	Laiterie du Berger (collecting ~9000 l/d from 1000 farmer members of the DIP)
Fatick	Fatick (SN)	2019	~100	1 refrigerated MCC (run by Kirène) Farmers supplying milk to MCC	Laiterie Kirène-SIAGRO (collecting ~800 l/d from 100 farmer members of the DIP)
Socolait	Betafo (MD)	2019	~1600	4 refrigerated MCC 6 collectors employed by the 4 MCC 94 private collectors 100 farmers supplying milk to MCC	Socolait (collecting ~10,000 l/d from 1600 farmer members of the DIP)
Sodimilk	Antsirabe (Md))	2019	~160	1 collection center 12 independent collectors	Small dairy (collecting ~1500 l/d from 160 farmer members of the DIP)
NKCC	Sotik/ Bomet (KE)	2020	~14,000	6 MCC (owned by Borabu Cooperative Union) 13 Dairy cooperatives Milk traders Farmers supplying milk directly to the processor	A quasi-government agency (collecting ~40,000 l/d, mainly from DIP members)
Happy Cow	Nakuru (KN)	2021	~2000	Network of cooperatives Farmers supplying milk directly to the processor	A private processor (collecting ~9000 l/d, only from DIP members)
Nyandarua	Ol Kalou (KN)	2021	~5000	5 dairy cooperatives aggregating milk	Various milk processors: cooperative and private processing ~50,000 l/d, from both DIP members and non-members
Nyeri	Mukurweini (KN)	2020	~7400	Network of processors' collection centers Dairy cooperatives Farmers supplying milk directly to the processor	A farmer dairy processor collecting 27,000 l/d, from both DIP members and non-members

Part II

DIP name	DIP board	Dairy farmers	Milk collectors	Dairy processors	Other stakeholders in the dairy value chain	Research institutes and disciplines
Banfora	Chairperson, Deputy chairperson, Secretary, Manager, Facilitator, responsible for: Training (1) Information (1), Monitoring (1)	ENG: ~70 ACT: ~100 ASS: ~50	ENG: ~10 ACT: 0 ASS: 2	ENG: 4 ACT: 0 ASS: 3	Agricultural and livestock extension services	INERA, CIRDES, CIRAD Livestock farming systems, Agronomy, Economy, Sociology
Bobo-Dioulasso	Idem Banfora	ENG: ~70 ACT: ~100 ASS: ~50	ENG: 5 ACT: 0 ASS: 5	ENG: 1 ACT: 0 ASS: 4	Agricultural and livestock extension services	Idem DIP Banfora

Table 1 (continued)

Part I						
Dagana	Steering committee (2 people), Executive Secretariat (9 people: representing the value chain stakeholders: farmers, collectors, processors, input suppliers, local political authorities, research, development actors, producers' organizations	ENG: ~70 ACT: ~20 ASS: ~25	ENG: ~10 ACT: 4 ASS: 2	ENG: 4 ACT: 1 ASS: 1	14 agricultural advisors Agricultural and livestock extension services	ISRA, CIRAD Livestock farming systems, Geography, Modelling
Fatick	The board has not been established	ENG: ~70 ACT: ~30 ASS: 0	ENG: 4 ACT: 0 ASS: 0	ENG: 1 ACT: 0 ASS: 0	Agricultural and livestock extension services	Idem DIP Dagana
Socolait	Chairman, Deputy-chairman; Collectors Committee (2 people); Farmers Committee (2); Secretary (1); Representatives: farmers (3), collectors (3) processor (1)	ENG: ~40 ACT: ~50 ASS: ~25	ENG: ~50 ACT: ~10 ASS: 6	ENG: 1 ACT: 1 ASS: 7	Agricultural and livestock extension services	FIFAMANOR CIRAD Livestock farming systems, Agronomy, Economy
Sodimilk	Idem Socolait	ENG: ~30 ACT: 0 ASS: 0	ENG: ~15 ACT: 0 ASS: 0	ENG: 1 ACT: 0 ASS: 0	-	Idem Socolait DIP
NKCC Sotik	Chairperson (1 representing the processor), Deputy chairperson (1 from extension), Secretary, (1 from extension), Farmer representatives (3)	ENG: ~350 ACT: ~200 ASS: ~200	ENG: 5 ACT:5 ASS:1	ENG:1 ACT:1 ASS:1	Representative from the Livestock Department at County Level	UoN, WUR Livestock farming systems, Agronomy, Economy
Happy Cow	Processor (1), Representatives from dairy cooperatives (2), Trainers (2)	ENG: ~300 ACT: ~300 ASS: ~190	ENG: 2 ACT: 2 ASS: 2	ENG:1 ACT: 1 ASS: 1	Representative from AgriFi	Idem NKCC
Nyandarua	Chairperson (1), Vice-chairperson (1), Secretary (1), Vice-secretary (1), Treasurer (1) all representing dairy cooperatives, dairy farmers, milk processors and livestock trainers	ENG: ~80 ACT: ~430 ASS: 0	ENG: 5 ACT: 5 ASS: 0	ENG:1 ACT: 1 ASS:0	Representatives from Agriculture Sector Development Support Programme, County Livestock Department	Idem NKCC
Nyeri	Chairperson (1), Vice-chairperson (1), Secretary (1), Vice-secretary (1), Treasurer (1) all representing dairy cooperatives	ENG: ~410 ACT: ~300 ASS: ~270	ENG: 6 ACT:6 ASS: 6	ENG: 4 ACT:3 ASS:3	Idem Nyandarua	Idem NKCC

Table 2 The stakeholders involved **in** the approach: step-by-step loop-based design of innovation implemented in a collaborative way within a Dairy Innovation Platform (DIP).

Circle of involvement	Type of stakeholders	Role within the approach
Core team	DIP board and researchers	Approach process steering
DIP members involved into the approach	Volunteer farmers, collectors, processor members of the DIP	Contributing and participating to the approach activities
Stakeholders influenced by the actions, outputs and outcomes driven by the approach	DIP non-members linked to the dairy value chain	Providing feedback on the approach findings, outputs, outcomes and prospects

downstream levels (large number of distributors and consumers). During the implementation of the approach, the core team was in charge of setting up decisions and action plans (engagement and initiation of the approach, facilitation and monitoring of actions engaged with volunteers, assessment of findings and changes induced by the approach) and designing guidelines for future work. The research team was specifically in charge of designing, implementing, and monitoring the experimental protocols (surveys, on-farm and on-value chain experimentations, co-designing scenarios workshops, assessment of the outcomes) and frequently facilitated workshops and meetings. The DIP board was in charge of facilitation, identification of volunteers, reporting and discussing research findings with members, training sessions, and capacity-building activities. During the implementation of the approach, the DIP board played an active role in selecting volunteers at each stage of the approach, with a view of ensuring that most DIP members could benefit from the lessons learned from the actions, either directly (through their direct participation, see Table 1 part II) or through sharing/learning moments. Volunteer DIP members were involved in the approach under research-led activities through events, surveys, and experiments. Influenced stakeholders are mainly potential future users of innovations via the spillover effects (Markow et al. 2023), following interactions with the other two categories of stakeholders that are more active in the initial stage of the approach.

Based on the step-by-step innovation design principles and practices proposed by Meynard et al. (2023), the approach is composed of a set of three stages (engagement, action, and assessment) through a loop-based structure. In other words, it is a cyclic approach that eventually returns to its starting point, yet relies on new hypotheses of changes or new change mechanisms as formulated by stakeholders.

Each stage comprises five basic steps: (1) starting point of the basic action decided by the core team (development of the basic action protocol); (2) "bottom-up and centrifugal" step of data collection among involved and/or influenced stakeholders (i.e., through focus group discussions, surveys, monitoring, sample collection, experiments, foresight exercises); (3) completion of the main data collection step (peak of the step that involves the influenced stakeholders); (4) "top-down and centripetal" step (i.e., guided tours of the projects, data analysis, additional data collection, feedback preparation); and (5) feedback and return to the core team for feedback/validation/results examination, and planning of subsequent actions.

The approach is designed to ensure a continuous and iterative process of reflexivity regarding the outputs of the approach and early changes achieved within the DIP. It encompasses a sequence of the following three stages (Figure 2).

The engagement stage (initiation, baseline studies, commitment) It is the first researchers' encounter with the dairy value chain stakeholders and the DIP (if already in place), often through a baseline study aimed at describing the situation and gaining a better understanding of stakeholders' issues and expectations. The results of the baseline study are reported back to the stakeholders during workshops, during which the areas of innovation on which the approach will focus are validated with the DIP board or with representatives of farmers, collectors, and processors for cases where the DIP is not yet established. Through a problem-setting process involving researchers and stakeholders, hypotheses

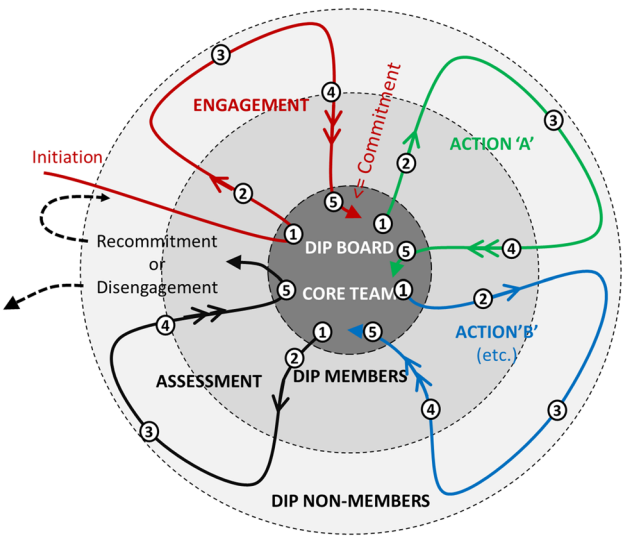

Fig. 2 Conceptual operating diagram of the approach: step-by-step loop-based design of innovations implemented in a collaborative way within a Dairy Innovation Platform (DIP).

on the causes of the problems are formulated and prioritized. Based on this, stakeholders and researchers define the main goal to be targeted and develop the expected impact pathway and an associated action plan considering what the core team (researcher and stakeholders engaged) can carry out ("go/no go" to the action stage). The final step of this stage consists of a joint commitment by the DIP to continue the implementation of the approach, establish the core team, and build an action plan (goal setting, protocol, contracting arrangements, shared arrangements on responsibilities and resources). If the DIP is not already in place, this stage also ends with the creation and setting up of the DIP (i.e., the formulation of the DIP's vision by its members, the drawing up of an action plan, and the establishment of the DIP's governing bodies).

The action stage The action stage is steered by the core team. We hypothesize that the approach can include as many actions as there are "innovations" selected by DIP members to be experimented with and developed. Several types of actions were carried out during the Africa-Milk project, including experiments involving livestock/dairy farmers on their farms and in their milk production facilities (on farm fodder demonstration-plots, cow rationing tests), techno-economic advice on dairy cow feeding, workshops for developing more efficient and more inclusive milk collection scenarios (using serious games or computer models), and capacity building of farmers and collectors on milking hygiene management.

The assessment stage The core teams and DIP members reflect together on achievements, changes (outcomes), and the pursuit of activities. For the Africa-Milk project, the core team decided to restrict the focus on assessing outcomes that would have emerged from the full approach cycle (i.e., after 3 years as part of the Africa-Milk project). These outcomes refer to changes experienced by stakeholders (in terms of new practices, behaviors, interactions, as well as opinions and mindsets) that were generated as a result of engaging in this approach. The two methods used to analyze these outcomes are described in Section 3.3.1 (page 17). At the end of the assessment stage and in light of the results and available resources, the question arises as to whether it is appropriate to continue over a loop. Several options may be considered: stakeholders may decide to pull out and stop the process (i.e., if the goals have been achieved) or to recommit to a new loop of design (if stakeholders wish to continue working on a new topic with new resources). If stakeholders decide to recommit, a new iteration loop is launched.

In the results and discussion section, we will explain the practical implementation of the three stages of the approach for the case of our DIPs. Each stage will be illustrated by specific actions implemented during the Africa-Milk project. We will compare cases, referring to them as variants. For each stage, we will draw theoretical and practical lessons to facilitate other future implementations of the approach.

3 Results and discussion

3.1 The engagement stage and its variants

We find that the pre-existence of an operational DIPs strongly influenced the way the approach was initiated. Indeed, with the Dagana and Banfora DIPs, which were established before the time of the Africa-Milk project, the first priority was to identify points of convergence between the DIP's vision and goals on the one hand, and the project's goals and approach on the other hand, in order to ensure optimum integration of the approach and its ability to contribute to the DIP's action plan (Figure 3A).

In contrast, and as part of newly implemented DIPs (Figure 3B), the first priority was to establish a network of dairy farmers, collectors, and processors. For this, dairy processors were targeted as an entry point, as they act as central and prominent stakeholders in the dairy milk value chains. As a consequence, DIPs were centered on the processor's network, in whole or in part (like the Socolait, Sodimilk, Kirène, NKCC Sotik/Bomet, Happy Cow, Nyandarua, and Nyeri DIPs). In Bobo-Dioulasso (Burkina Faso), stakeholders followed the Banfora DIP model and invited all dairy processors from the city to join the DIP. Hereafter, we detail two case studies (Dagana and Fatick in Senegal; Banfora and Bobo-Dioulasso in Burkina Faso) to illustrate the extent to which pre-existing DIPs may influence the engagement stage of the approach.

3.1.1 Comparison between the two variants of the engagement stage in senegal

In 2019, milk production and collection declined in Dagana due to farmers facing low milk purchase prices from processors, inability to find affordable alternatives to feed their cows, and high milk collection costs for processors. This trend was confirmed by the results of the baseline study conducted by the project. To boost production and collection, the Dagana DIP and the "Laiterie du Berger" decided to increase the purchase price of milk from farmers through VAT exemption and set up a collection and service company for dairy farmers (KSDE). The project supported this strategy in two areas of innovation, validated by the DIP board during the presentation of the baseline study findings to DIP members: (i) improving dairy cow diets and the dairy cow feed advisory service using a rationing tool and (ii) improving the efficiency of the milk collection system and providing a scenario for its restructuring. The DIP's

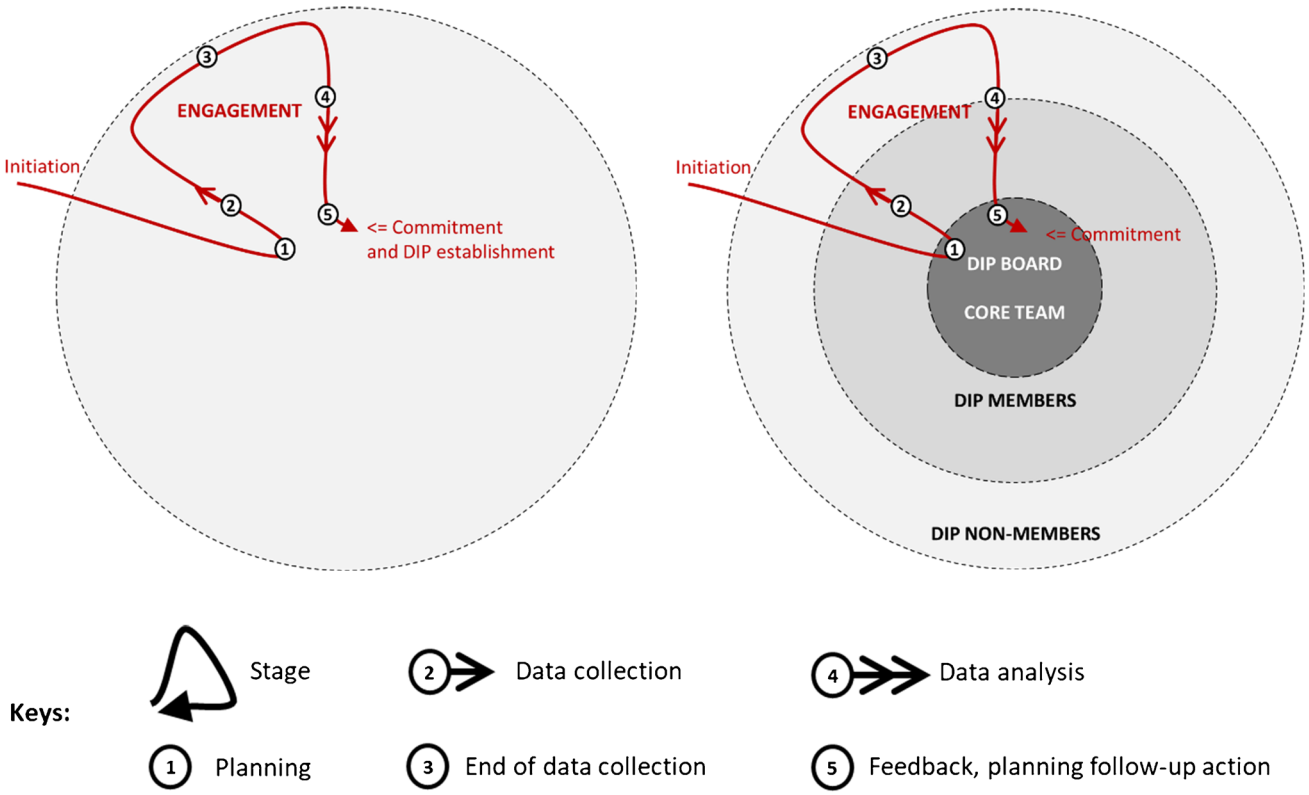

Fig. 3 Engagement stage variants of the approach (step-by-step loop-based design of innovations implemented in a collaborative way within a Dairy Innovation Platform (DIP)): **A** (left) : with no pre-existing DIP; **B** (right): with pre-existing DIP.

expectations from research teams were therefore clearly stated during the engagement stage of the approach on the two following topics.

In Fatick, the dairy situation in 2019 was characterized by very low supplies in the collection center run by the dairy processor (Kirène), and there was disagreement between dairy farmers and the collection center. Nevertheless, following the results of the baseline study, which were presented during a local workshop, the dairy value chain stakeholders showed interest in working on milk collection scenarios and on cow diet improvement strategies. A DIP was initiated in Fatick in 2019. In 2020, the engagement stage of the approach was launched even though the DIP was still not operational. We relied on the power of "collection scenario" workshops (involving dialogue between stakeholders around a serious game) to ease tensions and inspire stakeholders to move forward with establishing the DIP and the approach. The failure of both parties to fulfill their commitments during the DIP's initiation stage (supplying more than 500 l/day to milk collection centers for farmers; raising the farm-gate milk price for milk collection centers and processors) led to disagreements and a reduced willingness to collaborate, ultimately preventing the establishment of a DIP involving all these actors. As a result, the initiated actions (along participatory design of collection scenarios in 2020, and balance diets advisory for dairy cows in 2022) found little echo and were limited to volunteers involved in the actions. The failure to establish the DIP led to the failure of the approach on this site (in fact, the collection center closed down in 2022). This case highlights the importance of having motivated stakeholders to launch a prior collaboration within a DIP, as well as the proposed approach.

3.1.2 Comparison between the two variants of the engagement stage in burkina faso

In Burkina Faso, the approach was launched with the Banfora DIP (established before the project) and the Bobo-Dioulasso DIP (established during the project). As the Banfora and Bobo-Dioulasso production areas are relatively close to each other (less than 100 km apart), the research team organized, from the outset, discussions between stakeholders from both areas. The Banfora DIP thus acted as a "model" for stakeholders in Bobo-Dioulasso. Initially, the project's work focused on concerns raised by the Banfora DIP, such as the high cost of cow feed and the milk collection centres' low activity. These concerns were shared by farmers, collectors, and processors in Bobo-Dioulasso, as confirmed by baseline studies (Vall et al. 2021; Sodré et al. 2022). In 2020, with the support of the researchers, dairy value chain stakeholders

from Bobo-Dioulasso established a DIP based on the Banfora model. This DIP has since followed a very active development path, with the building of a head office, the raising of various types of funding for projects, and the implementation of several aspects of its action plan. Initially guided by research, this DIP stands on its own through its leaders' motivation and continues collaborating with research until now, although the leadership role of research in facilitating the DIP is gradually disappearing in favor of the DIP board which takes ownership of it, as shown by Lema et al. (2023). This case study shows that the initial presence of a DIP can help another one to take root through local interactions and that the commitment of those stakeholders at the heart of the DIP is key to ensure that the approach gets off the ground.

3.1.3 Lessons learned from the other cases regarding the engagement stage

In other areas, the process of initiating and setting up DIPs, and then launching the approach, was relatively long and often complex. We noted the key role played by processors in harnessing the engagement stage. In cases where processors were proactive, the process of setting up a DIP and launching the approach was smoother (like the Socolait DIP in Madagascar and the Kenyan DIP). However, when the engagement stage was led by processors, they tended to steer the process towards their own agenda, and the concerns of the other stakeholders took a back seat. While we acknowledge this risk, we also noticed that the approach was moving forward and produced tangible results and outcomes. Conversely, when no key stakeholder in the dairy value chain—particularly processors—acted as a catalyst between the research team and the various stakeholders (farmers, collectors and processors) from the outset, both the DIP and the approach failed (as seen in the cases of the Sodimilk DIP in Madagascar and the Fatick DIP in Senegal).

3.1.4 Discussion and key messages regarding the engagement stage

To guarantee the commitment of the core team (i.e., DIP board and researchers), this study underlines the importance of conducting baseline studies and paying particular attention to mutual relationships between stakeholders, in order to assess their willingness to commit to the process, as shown by Schut et al. (2015). Secondly, the local context of the dairy industry, and in particular its history, played a role in the success of the engagement stage. In our case, the objectives of the engagement stage were more easily achieved where the dairy value chain and a dairy processor had been established for a long time. By contrast, the situations where the initiation of the approach was more problematic were those in which the value chain and the dairy processor were not well established. This finding echoes that of Lema et al. (2023) who showed that while transitioning to a new farming system was enabled in the case of commercially oriented smallholders, it remained a challenge for less organized value chains based on subsistence-oriented farmers.

To go further than the usual structural typology of stakeholders (farmers, researchers, development partners, input providers, agro-dealers), it is also important to characterize the network of stakeholders in the value chain. This point implies drawing on specific insights into stakeholder engagement theories (Reed et al. 2009). Such preliminary analysis and understanding enable to identify stakeholders who may be in a position to steer the approach, those who may be directly involved in its implementation, those who may be impacted or affected, and those who may be influenced by the approach (Markow et al. 2023). When the approach is undertaken with an already established DIP, co-designing the baseline study with the DIP members appears relevant in order to develop a deeper understanding of the knowledge and information they need so as to launch an approach that fully meets their expectations (this option was not retained during the Africa-Milk project because the majority of DIPs were not established at the start of the project).

To better reflect and balance the priorities of the various professions involved in an emerging "value chain" DIP, it is important to involve a stakeholder who is relatively external, but sufficiently aware of the issues, as an intermediary and facilitator in the engagement stage. The importance of this intermediation function in the engagement stage is highlighted by Kilelu (2013), in order to facilitate the process of identifying innovations and changes needed by the various stakeholders. In the case studies presented in this paper, this role has been largely assumed by research which, at the beginning of the approach, played a leading role in facilitating the DIPs (Lema et al 2023).

3.2 The action stage and its variants

The action stage of the approach was conducted in two ways, depending on the DIP members concerned:

- In Burkina Faso, the core team implemented the action stage with the two DIPs on technical innovations at the dairy farm level. It was a "cascading" process, as findings of action N fed into action N + 1 (Sodré 2022; Figure 4A)
- In the other countries and with the seven other DIPs, the core team set parallel actions on innovations of different kinds (technical and organizational) with varying degrees of interaction between loops (Figure 4B)

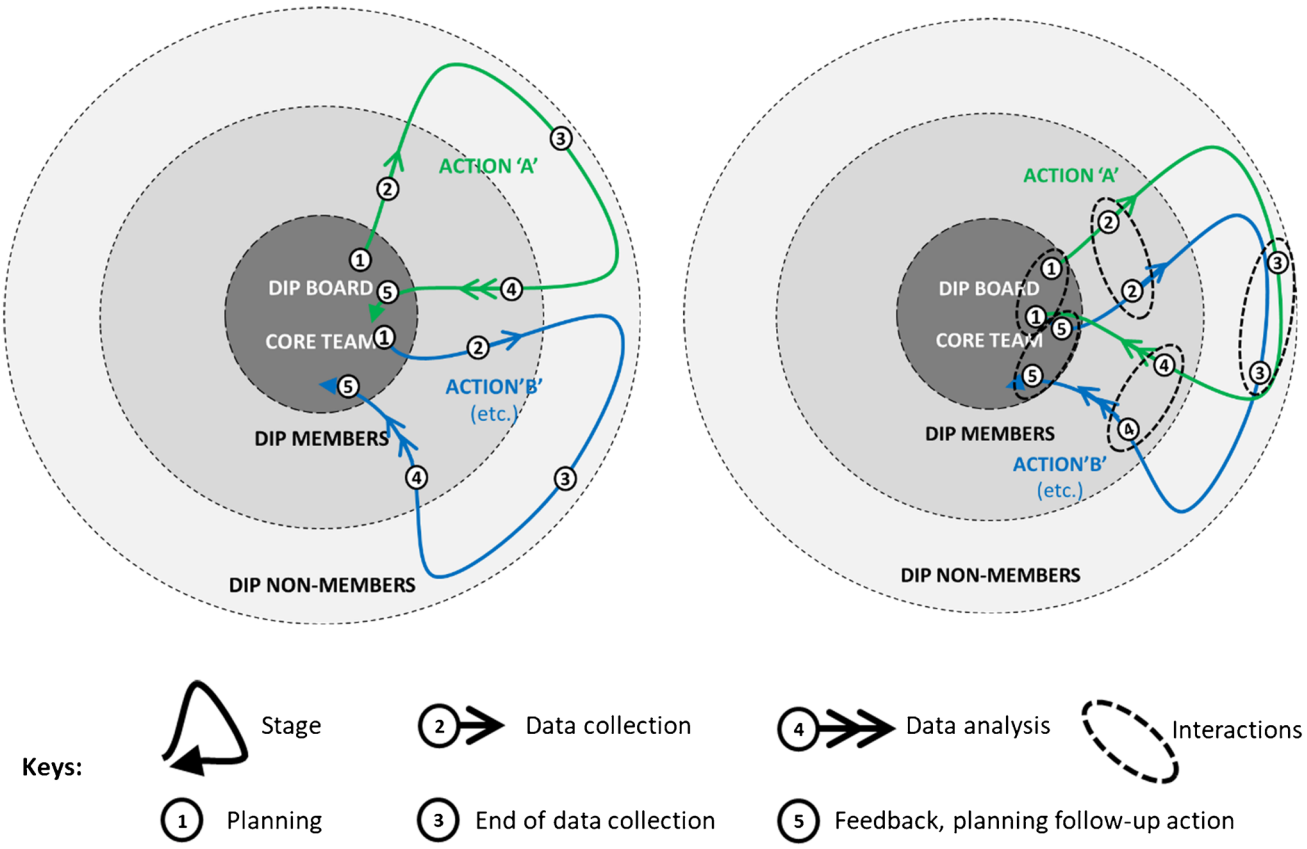

Fig. 4 Action stages variants of the approach (step-by-step loop-based design of innovations implemented in a collaborative way within a Dairy Innovation Platform (DIP)): **A** (left) cascading actions; **B** (right) parallel actions.

3.2.1 Cascading actions

In Burkina Faso, the baseline study established that an innovative feeding system based on quality forage as a partial substitute for industrial cattle feed was technically and economically promising, albeit implemented by few dairy farmers (around 7% of farms) (Sodré et al. 2022). As a result, the boards of both DIPs approved the introduction of a scheme aimed at testing and improving this cow feeding system among volunteer members. The approach was organized in two successive actions. The first action identified promising forages from among 12 varieties tested in cultivation by more than 200 dairy farmers, selected with the boards of both DIPs. During the feedback sessions, farmers expressed their preference for five forage varieties (*Vigna unguiculata*, *Mucuna pruriens*, *Sorghum bicolor*, *Zea mays*, and *Brachiaria ruziziensis)*. During the second action (the following year), 60 volunteer farmers experimented with one of these five varieties on large plots to supplement cow feed during the dry season. The researchers supported them in formulating nutritionally balanced and economically viable diets using the Jabnde tool (Lecomte and Vall 2022). Feedback to both DIPs helped to substantiate findings. The series of cascading actions (baseline study, first experiment, second experiment) performed on dairy farms provided useful knowledge for DIP stakeholders (i.e., three variants of the dairy cows feeding system based on quality fodder) and contributed to the proof of concept for the Jabnde tool (Sodré 2022).

3.2.2 Parallel actions

The case of senegal In Dagana, following the completion of the baseline study which, with the advice of the DIP board, identified the main bottleneck and key areas of innovation needed by farmers and collectors, the core team launched simultaneous and parallel actions on the following two topics: (1) improving dairy cow diets and the dairy cow feed advisory service using a rationing tool called Jabnde (Lecomte et Vall. 2022) and (2) improving the efficiency of the milk collection system and providing a scenario for its restructuring, using maps and a modelling tool called GASL (Delay et al. 2021) in a participatory way.

On the former, in 2020/2021, researchers simulated 128 feeding patterns with Jabnde by varying five parameters

(four seasons, two breeding systems, four genetic types, two feeding systems, two production periods). This was conducted to target situations where production was challenging (such as soaring production costs at the end of the dry season for minimal milk production). This finding was of interest to the DIP and, in particular, to the milk collection company (KSDE), partner of the DIP, whose advisers are in charge of providing feed recommendations to dairy farmers. The following year, the tool was used as part of KSDE's advisory service provided to 20 farmers. At the end of this initiative, agricultural advisors and most of the farmers involved said they were convinced by the usefulness of the tool. We are currently working on its IT development so that advisers can integrate it as a daily-working tool.

With regard to the second action, an updated map of milk collection routes was co-created with the DIP board, along with a georeferenced database of dairy farmers (to meet the needs for farm information of livestock advisors responsible for monitoring the dairy farms). The location of the new collection routes and collection points (associated to feed stores) was selected using a spatially explicit model (GASL). The different scenarios developed by researchers using the model were presented and discussed with the DIP board, and based on the impacts predicted by the model in terms of milk production and collection, stakeholders selected the one that best matched their objective. This participatory mapping work helped to validate the creation of two new collection routes crossing production areas that had previously seen little collection and to review the location of collection points (which also serve as feed and fodder outlets) in order to improve the efficiency of the collection network. Scenarios of milk collection reorganization combined with rational intensification of production highlighted the deep dependency between farmers and processors, making it advisable to set up milk collection centers offering multi-services to farmers (feed and drug store, advisory, payment facilities).

The case of madagascar In Betafo, following the presentation of the baseline study results, and after discussion and prioritization of the desired areas of innovation by the DIP board extended to DIP member farmers and collectors, the core team launched the action stage on two topics of interest for the DIP: (1) developing an advisory method for dairy cow feed rations by adapting the Jabnde tool to Madagascan conditions of dairy farming systems and (2) improving the microbiological quality of milk from farm to dairy processor.

Regarding the first topic, we adapted the Jabnde tool to Madagascan conditions in 2019 (through the addition of around 200 local feed resources and a specific calculation sheet designed to formulate feed for cows reared in zero-grazing conditions). We then tested the tool in 15 dairy farms in 2021 and 2022 to assess its effectiveness as a technical and economic advisory tool for dairy farmers. These tests delivered interesting results in that farmers realized the economic benefits of replacing expensive feed material with quality forage in cow diets.

In the Socolait-DIP milkshed, milk contamination leads to significant losses. That is why the Socolait-DIP and the core teams decided to implement an awareness, training, and testing program with more than 50 dairy farmers and ten collectors on good dairy hygiene practices (milking hygiene in general, separating evening and morning milk) and the use of small items of equipment including milking hygiene kits and easy-to-clean wide-neck milk cans. This action needed several cycles of awareness and training sessions and on-farm tests of small items of equipment in 2021 and 2022. The final evaluation of this initiative highlighted the beginning of a change in hygiene practices, as implemented by dairy farmers and collectors (Table 3).

The case of kenya The core team focused on addressing two main goals: reducing seasonality in fodder availability by promoting improved fodder varieties and improving milk quality through proper milk handling and improved hygiene.

Poor feeding management practices were identified as a priority challenge. To address this, training programs, demonstrations, and field trials were undertaken to expose farmers to 15 newly introduced improved fodder varieties. Farmers, guided by researchers, established field trials where the 15 fodder varieties were demonstrated on seedbed preparation, planting, fertilizing, weeding, harvesting, conservation, and rationing. The varieties were assessed continuously, capturing responses to weather changes and soil characteristics, biomass yield, maturity period, and potential for soil preservation. Besides, they were fed to animals to determine their contribution to the milk yield. These parameters were then used to determine farmers' preferred fodder varieties. Fodders that exhibited drought tolerance properties, had a high biomass yield, and contributed to increased milk yield were most preferred by farmers. In order to address the milk quality challenge, awareness raising trainings were undertaken along the milk collection chain across all DIPs. This involved training farmers, milk transporters, and cooperative staff on milking and milk handling hygiene and proper use of preventive and curative medicine and detergents. These practices were demonstrated using standards that aimed at having a collection process that fully complied with the milk hygiene and quality standards procedures. These led to a reduction in microbial load in milk and reduced losses from milk rejection. For the Happy Cow DIP, a quality-based milk payment system was applied as an incentive for adherence to milk quality standards.

Table 3 Outcomes induced by the approach (step-by-step loop-based design of innovations implemented in a collaborative way within a Dairy Innovation Platform (DIP)) in Betafo-DIP and Dagana-DIP.

Outcome statements	Outcome types	Stakeholders who experienced the outcomes	The approach contribution to the outcomes	Reach of the outcomes
Betafo DIP				
1. Applying hygiene practices to milking	Practice	Farmers, collectors	High: Training sessions, Hygiene kits	> 60 farmers (some DIP non-members)
2. Separating evening and morning milk	Practice	Farmers, collectors	High: On-farm experimentations	No dissemination
3. Improving milk quality through interaction between DIP stakeholders	Interaction, practice	Overall DIP	High: Workshops, Training sessions, Hygiene kits	~75 DIP members and non-members
4. Increased awareness of the role of forage crops in livestock feed	Opinion, practice	Farmers	High: Fodder on-farm experimentations, Fodder Day event	5 farmers
5. Strengthening Socolait's business strategy based on local milk value chain development	Capacity, interaction	Socolait	Medium: DIP meetings and workshops	Socolait staff
6. Building Socolait teams' skills in running experiments and supporting innovations	Capacity, interaction	Socolait	High: Socolait participation to LBCI actions	Socolait staff
7. Socolait's interest in interacting and working via a DIP	Capacity, interaction	Socolait	Medium: DIP meetings and workshops	Socolait Staff
Dagana DIP				
1. Changes in advisory practices and feeding practices for dairy cows using the Jabnde tool	Capacity, Practice	farmers, agricultural advisors, KSDE	High: Jabnde tool, training sessions on Jabnde, monitoring of the Jabnde test	> 20 farmers 14 agricultural advisors
2. Changes to the milkshed with the addition of milk collection routes	Practice	KSDE, farmer cooperative, farmers, collectors	High: Mapping of the milkshed, Co-designing of collection scenarios with GASL tool, DIP meetings	+ 4 new milk collection routes + 9 collectors + ~200 farmers
3. Delivery of useful farm database to the KSDE' agricultural advisors	Capacity	KSDE, agricultural advisors	High: Training session on KoboToolbox, design of the georeferenced farms database	Autonomy of KSDE 12 agricultural advisors in database management
4. Revitalization of the Dagana-DIP	Interaction	DIP board and five DIP "colleges"	Medium: DIP workshops and meetings, financial support	Multiplication of interactions between value chain stakeholders, improved DIP financing through member contributions

3.2.3 Discussion and key messages regarding the action stage

Firstly, when the approach focuses on designing several types of innovations (A and B, see Figure 4b) on the same site and at the same time, actions A and B operate in parallel, and each action comprises a series of cascading basic actions (i.e., the pattern shown in Figure 4 (A) merges with that of Figure 4 (B)).

Secondly, during the action stage, we have favored and facilitated learning over time and "cross-over learning" rather than training sessions bundled together at the end of the process and often hastily conducted due to time constraints (Lema et al. 2016). Thus, training sessions were sometimes organized in classrooms, but more often on the farm (cow feeding, milking hygiene) or at the edge of the fields (guided tours of fodder-demo-plot) with volunteers and often their neighbors. The "cross-over learning" that occurs throughout the approach (Adekunle and Fatundi 2012,2014; Nyikahadzoi et al. 2012; Dabiré et al. 2016; Swanns et al. 2016) is likely as important as the final feedback (Sell et al. 2018; Sanyang et al. 2016; Cadilhon et al. 2016) usually organized once the actions have been completed. Running actions in parallel generates cross-cutting knowledge and evidence at different levels (production system, farm, area).

The knowledge and evidence are useful to identify barriers or levers that operate at production, collection, or processing levels, with possible interactions between levels in a systemic perspective. In the Dagana-DIP, for instance, dependencies between stakeholders that were revealed in the collection scenarios strengthened the case for working on cow diets using local resources more efficiently. In the Betafo-DIP in Madagascar, the use of the Jabnde tool in on-farm cut and carry feeding systems led to a better understanding of the causes of milking hygiene issues in stalls where cattle were permanently housed. Using dedicated tools such as monitoring, evaluation, and learning (MEL) tools (Audouin et al. 2023; Agrinatura and FAO 2019) or reflexive monitoring in action (RMA) (Liberloo et al. 2021) helps to learn from previous activities and to overcome barriers and difficulties on the way.

Thirdly, we noticed that the economic context, and more precisely the existence of an already established dairy value chain, made the actions undertaken by the approach more effective. We believe this is because, when the value chain is established, stakeholders better understand market realities. As a result, farmers, collectors, and processors are more aware of each other's interests and are therefore more likely to accept changes in light of possible trade-offs. For example, in emerging value chain situations, dairy farmers who are accustomed to selling small quantities of milk at a high price on a sporadic basis found it more difficult to switch to a different market logic in which a processor offers a lower milk purchase price but with higher requirements in terms of quantity, quality, and regularity. In such a situation, farmers were quite resistant to the idea of investing in quality fodder crops to replace livestock feed in order to reduce their production costs. As Lema et al. (2021, 2023, 2024) show, addressing location-specific context, and especially the presence of an enabling environment, is key to adapting innovations to stakeholder needs.

3.3 The assessment stage and its variants

3.3.1 Two methodologies used for assessing the outcomes

The core teams followed two methodologies, depending on the country, to assess the tangible outcomes (changes) induced by the approach implementation across the ten DIPs, as shown in Figure 5: (A) single-pass survey and (B) outcome harvesting, which refers to a methodology for the qualitative identification and confirmation of (un)intended and (un)expected stakeholder-centered changes induced by an action, here the approach. Changes are collected using surveys and participatory workshops, and their formulation includes precise elements on how it occurred, the people who experienced it, the approach's contribution to it, and its scope and significance.

In Burkina Faso and Kenya, outcomes were assessed using a single-pass survey targeting both stakeholders involved in the action stage (volunteer group) and those not involved (control group), using a questionnaire designed by the researchers. Surveys focused on capturing changes that the approach had contributed to generate, as perceived by stakeholders (farmers, collectors, processors, and DIP board). These surveys aimed to capture the perception of the outcomes by the volunteer groups compared to those of the control groups (type of outcome, rationale, stakeholders' involvement, significance) between the initial situation and the end of the project (Figure 5A). Finally, the results of the outcome assessments were shared to the DIP board and DIP member representatives during a workshop.

In Senegal and Madagascar, outcomes were assessed using the outcome harvesting method (Wilson-Grau and Britt 2012; Pillai et al. 2017; Garred and Refai 2020; Giraldo et al. 2020). The method is about tracing tangible changes and associated evidence, and then drawing causal links between the captured change and the evaluated project or program. It contrasts with the other survey's principle in the sense that it is not about comparing two situations (before versus after or control versus treatment). Instead, it is about making, with knowledgeable stakeholders (referred to as "change agents"), an inventory of the changes that the project has contributed to generate, and specifying those along some key criteria. The method

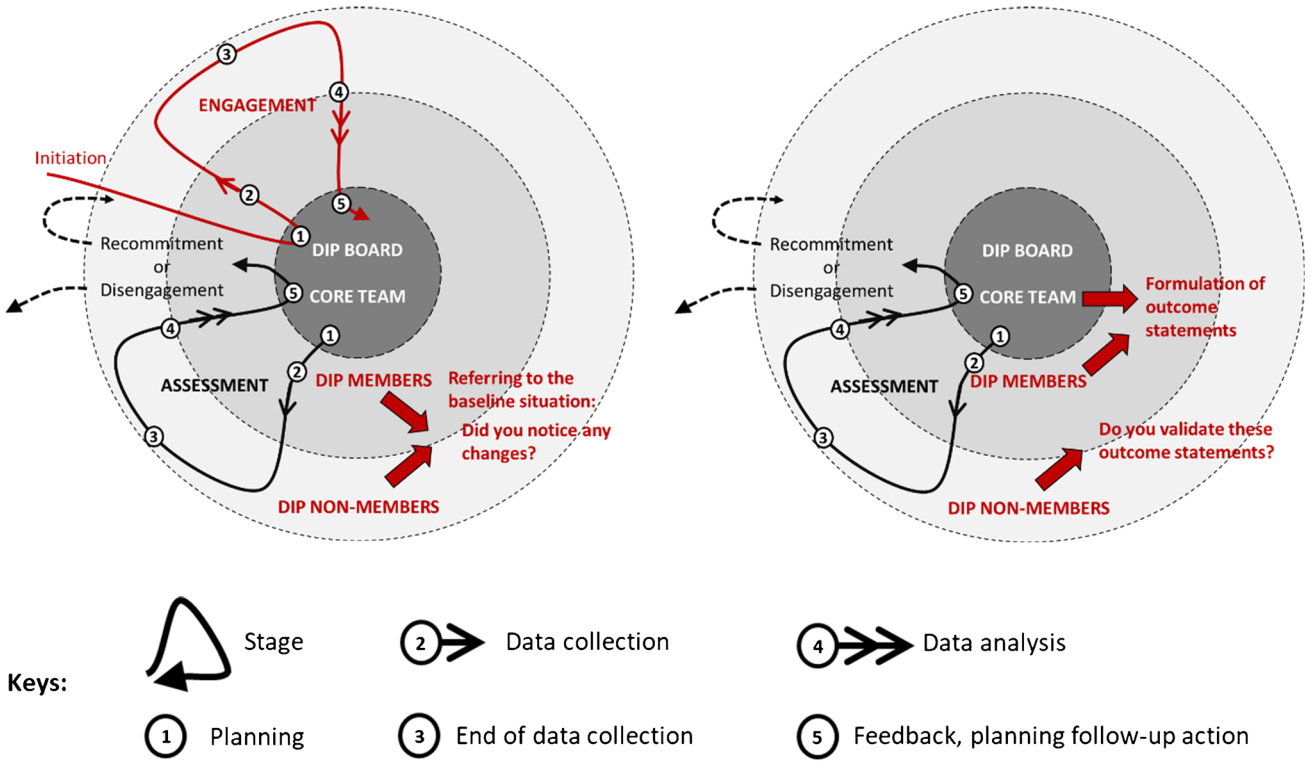

Fig. 5 Assessment stages variants of the approach (step-by-step loop-based design of innovations implemented in a collaborative way within a Dairy Innovation Platform (DIP)): **A** (left) with a single-pass survey (Burkina Faso, Kenya); **B** (right) with an outcome harvesting (Senegal, Madagascar).

involved in particular requesting the core team to formulate and set out the outcome statements, and having them substantiated (validated) by local stakeholders who were informed and therefore knowledgeable but not involved in the approach (Figure 5B). As part of the Africa-Milk project, we adapted and deployed the outcome harvesting method following the stages below:

1) "Documentary review" of outputs related to the approach implementation into the area of the DIP (conducted by researchers).
2) "Pre-inventory of possible outcomes" induced by the approach implementation through interviews with the DIP board and DIP volunteers for actions (conducted by researchers).
3) "Draft outcome statements workshop" involving the core team, the DIP board, and DIP member representatives (facilitation by research). The outcome statement's formulation comprises a description of the change (how it happened, who experienced it, the approach's contribution to the change, its reach).
4) "Outcome statement substantiation" (confirmation or invalidation of outcomes) through surveys. The aim of the surveys is to confront the outcome statements with informed independent stakeholders on the validity and tangibility of the outcomes. This was conducted by enumerators not belonging to the core team.
5) "Outcome statements validation workshop" through a final presentation and discussion on substantiation stage findings to the DIP board and DIP member representatives.

3.3.2 Outcomes revealed through a single-pass survey

The case of burkina faso The outcome assessment survey was sent to 88 dairy farmers involved in the action stage ("Experimenters"), 20 dairy farmers not involved in the experiments but who had developed forage cultivation ("Converted Controls"), seven collectors, and seven board members from both DIPs. Results suggest that the main expected outcomes were achieved. Here is an extract from the report on the outcomes induced by the approach in Burkina Faso: "Among 'Experimenters', 97% felt that milk production had increased (58% reporting a small increase and 39% a large increase). For 'Experimenters', this increase was due to an improvement in forage availability as a result of forage cultivation and crop residue storage. Among 'Converted Controls', forage cultivation was driven by a wish

to increase milk production in the dry season (75% of the 'Converted Controls' in both areas), and to improve income from milk sales (17% and 25% of the 'Converted Controls' in Bobo-Dioulasso and Banfora respectively). For 'Converted Controls', the integration of farm-grown forage into cow feed led to an increase in milk production (100% of respondents), an increase in income from milk (42% and 75% of 'Converted Controls' in Bobo-Dioulasso and Banfora respectively), an improvement in cow health (42% and 13% of farmers in Bobo-Dioulasso and Banfora respectively) and other benefits (33% of farmers in Banfora)."

However, based on actual observation in the field, these results seem to be overestimating in terms of achievement and not reflecting the actual level of change, which is most likely to a much lesser extent. This discrepancy might be explained by the fact that respondents tended to answer in line with the project's expectations because they knew that the interviewers (students or technicians) were not fully independent from the core team. In short, while direct surveys are easy to implement, a cautious selection of the enumerators is needed.

The case of kenya The outcome assessment survey was conducted with a sample of 665 dairy farmers comprising both DIP (297) and non-DIP members (368). Comparative analysis of milk yield between DIP members and non-members revealed milk yield and income differences between DIP members and non-members. The DIP members realized a higher milk yield of 7.4 l/cow/day, while non-members had a milk yield of 6.9 l/cow/day, which was significantly different at the 5% confidence level ($p = 0.047$). Besides, the DIP members showed high levels of dairy milk market participation, with a dairy milk commercialization index of 0.58 against that of non-members of 0.54, which were significantly different at the 5% ($p = 0.042$). The DIP members also earned a higher milk income of KES 93,554/year, while the non-members earned KES 87,075/year, though the differences were not significant, perhaps due to the short timelines of assessing changes in income. These findings were corroborated by those of focused group discussions with DIP members; they noted that their milk yield had increased from improved feeding practices learned through the DIPs. One farmer put it this way: "I have tested the improved fodder on one of my milking cows and the milk produced has increased. I also am now able to store feeds which is helpful during the dry season" (a response from a dairy farmer from NKCC DIP).

3.3.3 Outcomes captured through outcome harvesting

Outcome harvesting results in the betafo DIP's catchment area In this case study, the outcome harvesting's first three stages led to the formulation of seven outcome statements (Table 3). These statements were confirmed through individual interviews with people who had indirectly benefited from or been aware of the outcomes, but who had no hierarchical or financial link with the project's activities as mentioned earlier. The outcome harvesting assessment outlined outcomes regarding changes in practices, interactions, capacities, and opinions. We found that all professional groups within the dairy value chain (farmers, collectors, processors) experienced changes, as well as the three types of stakeholders (DIP board, DIP members, and influenced stakeholders). The contribution of the approach perceived by stakeholders, more or less intensively, occurred through various inputs (on-farm experimentation, training session, meetings, workshops). However, the reach of the outcomes remains limited, even though stakeholders often expressed great interest in the mentioned changes.

Outcome harvesting results in the dagana DIP's catchment area In this case study, the outcome harvesting's first three stages enabled the formulation of four outcome statements (Table 3). Three outcome statements were fully confirmed by the substantiation stage (no. 1, 2, and 3 in Table 3) and one partially (no. 4). The outcome harvesting assessment outlined a diversity of outcome types, covering changes in practices, capacities, interactions, and opinions. All professional groups within the dairy value chain (farmers, collectors, processors, agricultural advisors) experienced some levels of change. The contribution of the approach perceived by stakeholders, more or less intensively, is allowed through various inputs (tools, capacity building, facilitation). However, the reach of the outcomes is concentrated on the DIP board and DIP members involved in the action stage. A few influenced stakeholders were affected by the outcomes.

3.3.4 Discussion and key messages regarding the assessment stage

Our findings show that the approach can lead to tangible changes on the stakeholders in a value chain. Activities that encourage "cross-over learning" (feedback sessions, guided tours, etc.) throughout the implementation of the approach are key to fostering those changes among the circle of influenced stakeholders who are non-members of the IP. Similar outcomes regarding learnings related to the management of relationships among farmers and other stakeholders within the value chain have been outlined by Ochago et al. (2023). As highlighted by Lema et al. (2021), an adaptive, flexible, and innovative learning approach (including farmer exchanges, field days) is key to promoting the dissemination of new ideas arising from co-design work, within the DIP, in order to achieve the expected innovation outcomes. Our findings are therefore consistent with those of Winowiecki et al. (2021), who also showed a need for "long-term capacity

development of stakeholders," as well as a need for "creating a culture of evidence use and inclusive decision making" to assess the changes brought by a structured stakeholder engagement process. Hence, these results call for strengthening the capacity of IP stakeholders or of local experts to use relevant monitoring, evaluation, and learning tools to communicate about and facilitate the changes induced by the approach among members of the IP and influenced stakeholders (Audouin et al 2023) and support reflexive learning (Ochago et al 2023).

However, regarding the reach and longer-term impacts resulting from these changes (and therefore from the approach), this is not yet visible. This is consistent with the findings of Lema et al. (2021, 2024) who show that in short-term projects (around 3 years), it is particularly difficult to carry out the time-consuming work necessary to establish a functional platform while leaving sufficient time for field actions with stakeholders (on-farm experiments, co-design of change scenarios), assessing preliminary changes, and building reflexive learning. However, we would argue that it is important to strike the right balance between the time devoted to setting up an IP and that spent implementing action stage because, as Lema et al. (2024) have shown, the gradual institutionalization of an IP brings it recognition from public authorities and private actors and, consequently, easier access to the services and resources the IP will need to implement these changes on a large scale.

With the outcome harvesting methodology, stakeholders' recognition of the contributions made by the approach to the outcomes seems to provide richer results than with direct surveys as used for this study. Furthermore, outcome harvesting approach allows stakeholders to develop their learning skills and realize that they are able to co-create solutions and alternatives (Liberloo et al 2021). However, a difficulty with the outcome harvesting method is to find truly "informed and independent" stakeholders, as well as independent enumerators.

In both methods implemented to assess changes, the influence of the context on changes and the feasibility of the innovations that led to the changes were not formally considered. There is no doubt that these are two important dimensions to consider in order to better interpret the observed changes. In practice, this would involve the use of cost-benefit analysis in order to assess the feasibility of innovations and the use of econometric logistic regression models commonly used in the study of innovation adoption drivers.

4 Conclusion

This study shows how a step-by-step innovation design approach embedded in a loop-based structure applied to multi-stakeholder platforms facilitates engagement and collaboration with a significant number of relevant stakeholders, creating conducive conditions to change.

Regarding the principles and implementation of the approach, we highlight that this specific approach encompasses a succession of three stages (engagement, action, and assessment), with possible iterations over additional loops depending on the needs of DIP stakeholders. The comparative analysis of the approach implementation across the case studies revealed that (i) the initiation of the approach may vary according to the pre-existence of DIPs (where a DIP already exists, the approach's entry point is the platform's vision; and where the DIP is not yet established, it is necessary to take the time to analyze the context and support the actors in establishing the DIP), (ii) the approach may be implemented through either cascading or parallel actions, and (iii) changes induced by the approach affect the practices, capacity, interactions, and opinions of stakeholders directly involved or simply influenced by the approach. The approach allows multiple practical adaptations and reflexivity to meet the needs of DIP stakeholders.

Through the approach, three circles of stakeholders were involved, each with different levels of engagement and collaboration, namely the core team, the DIP members, and the influenced stakeholders. We found that this approach drives different types of changes, and ultimately seems to enable faster activation and expansion of targeted changes. In the eight established DIPs, the implementation of the approach met a significant proportion of the needs of stakeholders. The significant number of DIP members who took part in the approach on a voluntary basis over the three years (5 to 40% of farmers; 50 to 100% of collectors; 10 to 100% of DIP member processors; see Table 1 part II) and the changes highlighted at the end tend to prove this. The approach yielded promising results, particularly due to its ability to involve, step by step, the different stakeholders of the value chain beyond the farming system boundaries. However, not all the needs of the stakeholders could be met, and the approach combining innovation design and IP was sometimes unsuccessful.

- Firstly, in both cases where the DIP could not be established due to disagreements between the value chain stakeholders, attempts to implement actions did not generate significant levels of change. It is therefore important to carefully study the economic and social features of the value chain from the outset in order to anticipate the possible failure of a DIP.
- Secondly, appointing a processor as chair of the DIP board has enhanced the effectiveness of DIPs, but has often steered the approach's agenda towards the interests of processors. For this reason, it is advisable to appoint at least one vice-chairperson representing farmers to ensure a more balanced decision-making process.

- Thirdly, it is worth pointing out that the transition to substantial and sustainable changes in practices is still relatively slow. To overcome these constraints, the study suggests that it is important to create a community of followers among DIP members and non-members, through initiatives aimed at disseminating the findings, and to support reflexivity with DIP members.

Finally, the practical lessons that we draw from this work to implement a successful step-by-step loop-based design of innovations implemented in a collaborative way within a Dairy Innovation Platform are the following:

- During the engagement stage, we recommend to (1) perform a baseline study on the local farming system and value chain (actor practices, actor networks) to understand the initial situation, (2) co-design this baseline study with the stakeholders to consider their expectations, (3) integrate the DIP's vision and goals into the approach when a DIP is already in place, and (4) rely on stakeholders strategically located in the value chain who can rally the relevant stakeholders (such as processors) where there is no prior DIP.
- During the action stage, we recommend to (1) foster "cross-over learning" throughout the implementation of the actions, to provide as often as necessary opportunities for a structured and facilitated dialogue and reflexivity between the stakeholders involved in the action stage; (2) organize feedback, review, and refinement sessions at the end of each action in order to keep stakeholders involved and to allow for mid-term revision of initial thinking and strategies; (3) permanently involve the different circles of stakeholders with distinct responsibilities (the core team (steering the process), the stakeholders involved in the action (generating new knowledge and learning), and those who will be influenced by such new knowledge).
- During the assessment stage, we recommend to (1) entrust this task to an independent assessor to avoid any bias with interviewees when outcome assessment is carried out using a direct survey of the approach recipients; and (2) anticipate and establish beforehand a community of followers of the implementation of the approach when outcome assessment is carried out using outcome harvesting (so as to have a relevant channel for disseminating the results as well as independent stakeholders for the outcome statements substantiation). This community of followers can also be rallied in subsequent iteration of the full process (broadening the number of farmers involved, testing the innovation with different types of farmers or in other areas).

Looking ahead, this study paves the way for further analysis of the benefits of applying the approach to broader multi-stakeholder bodies (i.e., Living-Labs, Living-Landscapes) involved in all aspects of agri-food system restructuring and agroecological transition. Additionally, as this exploratory approach was mainly led by researchers, further studies are needed to explore the extent to which the proposed approach fully responds to the co-design principles, ensuring equal contribution from all stakeholders.

Acknowledgments All the authors acknowledge the partners of the ASAP platform (https://www.dp-asap.org/), SPAD platform (https://www.dp-spad.org/), and PPZS platform (https://www.ppzs.org/) and also thank the stakeholders of the ten Dairy Innovations Platforms in Senegal, Burkina Faso, Kenya, and Madagascar for their collaboration in this study.

Authors' contributions All authors contributed to the study conception and design. At a global level (four African countries), material preparation and data analysis were performed by EV, SA, and MF. For the Madagascar case study, material preparation and data collection, and analysis were performed by SA, LJER, NLR, and MV. For the Burkina Faso case study, material preparation and data collection, and analysis were performed by ES, SO, and OS. For the Senegal case study, material preparation and data collection, and analysis were performed by MPG, ACD, JDC, and CC. For the Kenya case study, material preparation and data collection, and analysis were performed by AN, JIM, and MNM. The first draft of the manuscript was written by EV, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open access funding provided by CIRAD. The research leading to these results received funding from (1) the ERA-NET Cofund "Long term EU-Africa research and innovation Partnership on food and nutrition security and sustainable Agriculture" (LEAP-Agri) funded by the European Union's Horizon 2020 research and innovation program under grant agreement No 727715, (2) the French Development Agency (AFD, France), (3) the Ministry of Education, Science and Technology (MOEST, Kenya), (4) and the Ministry of Economic Affairs/Agriculture and Nature Knowledge Department (MinEZ, The Netherlands).

Data availability The data and material generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability "Not applicable" for that section

Declarations

Ethics approval "Not applicable" for that section

Consent to participate " Verbal informed consent was obtained prior to the interview with the stakeholders of all ten DIPs."

Consent for publication Stakeholders from the ten DIPs interviewed consented to the results of this study being submitted to the journal.

Conflict of interest The authors declare no competing interests.

References

Adekunle AA, Fatunbi AO (2012) Approaches for Setting-up multi-stakeholder platforms for agricultural research and development. World Appl Sci J 16 (7): 981-988. https://www.researchgate.net/publication/267561798_Approaches_for_Setting-up_Multi-Stakeholder_Platforms_for_Agricultural_Research_and_Development

Adekunle AA, Fatunbi AO (2014) A new theory of change in African agriculture. Middle East J Sci Res 21(7):1083–1096. https://doi.org/10.5829/idosi.mejsr.2014.21.07.21564

Adjei-Nsiah S, Klerkx L (2016) Innovation platforms and institutional change: the case of small-scale palm oil processing in Ghana. Cah Agric 25:65005. https://doi.org/10.1051/cagri/2016046

Agrinatura and FAO (2019) Monitoring, evaluation and learning – concepts, principles and tools. Agrinatura, Paris and FAO, Rome. 24 pp. ISBN: 978-2-35709-006-4 (Agrinatura), ISBN: 978-92-5-131494-4 (FAO)

Audouin S, Raharison T, Rabesoa J et al (2023) To what extent can local-led innovation platforms tackle complex agricultural development challenges? Insights from Madagascar. J Agric Educ Ext 29(2):149–172. https://doi.org/10.1080/1389224X.2021.1997769

Barzola Iza CL, Dentoni D, Omta OSWF (2020) The influence of multi-stakeholder platforms on farmers' innovation and rural development in emerging economies: a systematic literature review. J. Agribus. Dev. Emerg. Econ. 10:13–39. https://doi.org/10.1108/JADEE-12-2018-0182

Cadilhon JJ, Diep Pham N, Maass BL (2016) The Tanga dairy platform: Fostering innovations for more efficient dairy chain coordination in Tanzania. Int J Int J Food Syst Dynam 7 (2): 81-91. https://doi.org/10.18461/ijfsd.v7i2.723

Chevalier JM, Buckles DJ (2008) A guide to collaborative inquiry and social engagement. Sage Publications, London

Dabire D, Andrieu N, Djamen P et al (2016) Operationalizing an innovation platform approach for community-based participatory research on conservation agriculture in Burkina Faso. Expl Agric OI: https://doi.org/10.1017/S0014479716000636

Davies J, Maru Y, Hall A et al (2016) Understanding innovation platform effectiveness through experiences from west and central Africa. Agr Syst. https://doi.org/10.1016/j.agsy.2016.12.014

Delay E, Müller J P, Cesaro J-D et al 2021. Empowering a model for improved multi-actor discussions: case study from dairy production in Sahelian agro-pastoral systems. In: GAMA Days: 2021 23-2021, Abstracts. INRAE, IRD, Thuyloi University. Toulouse. https://agritrop.cirad.fr/603000/ (Accessed on 03/11/2025)

Garred M, Refai M (2020) Change inside and out - an outcome harvesting plus attitude change toolkit for peacebuilders and other changemakers. https://michellegarred.files.wordpress.com/2021/03/ohac_toolkit.pdf (Accessed on 03/11/2025)

Giraldo DC, Camacho K, Navarro-Racines C et al (2020) Outcome harvesting: assessment of the transformations generated by local technical agroclimatic committees in Latin America. CCAFS Working paper No.299. CGIAR Research Program on Climate Change, Agriculture and Food Security. https://cgspace.cgiar.org/bitstream/handle/10568/108492/WP%20MTA%20Outcome%20Harvesting_Final.pdf. (Accessed on 03/11/2025)

Hounkonnou D, Brouwers J, van Huis A et al (2018) Triggering regime change: a comparative analysis of the performance of innovation platforms that attempted to change the institutional context for nine agricultural domains in West Africa. Agr Syst 165:296–309. https://doi.org/10.1016/j.agsy.2016.08.009

Hounkonnou D, Kossou D, Kuyper TW et al (2012) An innovation systems approach to institutional change: smallholder development in West Africa. Agr Syst 108:74–83. https://doi.org/10.1016/j.agsy.2012.01.007

Jiggins J, Hounkonnou D, Sakyi-Dawson O et al (2016) Innovation platforms and projects to support smallholder development - experiences from Sub-Saharan Africa. Cah Agric 25:64002. https://doi.org/10.1051/cagri/2016051

Kilelu CW, Klerkx L, Leeuwis C (2013) Unravelling the role of innovation platforms in supporting co-evolution of innovation: contributions and tensions in a smallholder dairy development programme. Agr Syst 118:65–77. https://doi.org/10.1016/j.agsy.2013.03.003

Klerkx L, van Mierlo B, Leeuwis C (2012) Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions. In: Darnhofer I, Gibbon D, Dedieu B (eds) Farming Systems Research into the 21st Century: The New Dynamic. Springer, Dordrecht, pp. 457-458. https://doi.org/10.1007/978-94-007-4503-2_20Lecomte P, Vall E (2022) Jaƃnde - Un outil logiciel pour la complémentation alimentaire des bovins dans les troupeaux laitiers pastoraux et agropastoraux de l'Afrique subsaharienne. Montpellier,CIRAD, 38 p. https://agritrop.cirad.fr/612645/. (Accessed on 31 March 2025)

Lema Z, Lobry de Bruyn LA, Marshall GR et al (2021) Multilevel innovation platforms for development of smallholder livestock systems: how effective are they? Agr Syst 189. https://doi.org/10.1016/j.agsy.2020.103047

Lema Z, Lobry de Bruyn L A, Marshall G R et al (2023) The influence of multilevel innovation platforms on continuing utilization of smallholders' livestock feeding practices. Innov Dev 1–26. https://doi.org/10.1080/2157930X.2023.2178877

Lema Z, Mulema A A, Le Borgne E, Duncan A J (2016) Innovation platforms for improved natural resource management and sustainable intensification in the Ethiopian Highlands. Innovation Platforms for Agricultural Development 117: 117–132. https://cgspace.cgiar.org/server/api/core/bitstreams/19b3d583-89bf-4640-998a-2fda91667896/content. (Accessed on 03/11/2025)

Liberloo M, Bijttebier J, Lacour E et al (2021) Reflexive monitoring in action: setting up a monitoring system for learning effectiveness in agroecological farm innovation. J Agric Educ Ext 0 (0): 1–20. https://doi.org/10.1080/1389224X.2021.1984954

Lecomte P, Vall E (2022) Jaƃnde - Un outil logiciel pour la complémentation alimentaire des bovins dans les troupeaux laitiers pastoraux et agropastoraux de l'Afrique subsaharienne. https://agritrop.cirad.fr/612645/

Markow J, Fieldsend AF, von Münchhausen S, Häring AM (2023) Building agricultural innovation capacity from the bottom up: using spillover effects from projects to strengthen agricultural innovation systems. Agr Syst 209. https://doi.org/10.1016/j.agsy.2023.103670

Maryono M, Killoes AM, Adhikari R, Aziz AA (2024) Agriculture development through multi-stakeholder partnerships in developing countries: a systematic literature review. Agric Syst 213. https://doi.org/10.1016/j.agsy.2023.103792

Meynard JM, Cerf M, Coquil XMH et al (2023) Unravelling the step-by-step process for farming system design to support agroecological

transition. Eur J Agron 150. https://doi.org/10.1016/j.eja.2023.126948

Meynard J M, Dedieu B, (Bram) Bos AP (2012) Re-design and co-design of farming systems. An overview of methods and practices. In: Darnhofer I, Gibbon D, Dedieu B (eds) Farming Systems Research into the 21st Century: The New Dynamic. Springer, Dordrecht, pp. 405-429. https://doi.org/10.1007/978-94-007-4503-2_18

Meynard J M, Dourmad J Y (2014) L'innovation en élevage : de nouvelles démarches pour de nouveaux enjeux. In : Numéro spécial, Quelles innovations pour quels systèmes d'élevage ? Ingrand S, Baumont R (Eds). Inrae Prod Anim 27, 77.88. https://doi.org/10.20870/productions-animales.2014.27.2.3056

Mitchell RK, Bradley RA, Wood DJ (1997) Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts. Acad Manag Rev 22(4):853–886.

Nyikahadzoi K, Pali P, Fatunbi AO et al (2012) Stakeholder participation in innovation platform and implications for integrated agricultural research for development (IAR4D). Int. J Agric Biol for 2(3):92–100.

Pillai R V, Awantang G, Gurman T A, Leslie L T (2017) Outcome harvesting evaluation of social and behavior change communication capacity strengthening activities in Liberia. Baltimore, MD: Health Communication Capacity Collaborative Project, Johns Hopkins Center for Communication Programs. https://healthcommcapacity.org/wp-content/uploads/2018/05/Liberia_OH-Report_Final.pdf. (Accessed on 03/11/2025)

Reed MS, Graves A, Dandy N et al (2009) Who's in and why? A typology of stakeholder analysis methods for natural resource management. J Environ Manage 90(5):1933–1949.

Ronner E, Descheemaeker K, Almekinders C et al (2019) Co-design of improved climbing bean production practices for smallholder farmers in the highlands of Uganda. Agr Syst 175:1–12.

Sanyang S, Taonda SJB, Kuiseu J et al (2016) A paradigm shift in African agricultural research for development: the role of innovation platforms. Int J Agr Sustain 14(2):187–213. https://doi.org/10.1080/14735903.2015.1070065

Sartas M, Schut M, Hermans F et al (2018) Effects of multi-stakeholder platforms on multi-stakeholder innovation networks: implications for research for development interventions targeting innovations at scale. PLoS ONE 13(6). https://doi.org/10.1371/journal.pone.0197993

Schut M, Andersson J A, Dror I et al (2017) Guidelines for innovation platforms in agricultural research for development. Decision support for research, development and funding agencies on how to design, budget and implement impactful innovation platforms. International Institute of Tropical Agriculture (IITA) and Wageningen University (WUR) under the CGIAR Research Program on Roots Tubers and Bananas (RTB). https://cgspace.cgiar.org/server/api/core/bitstreams/49c8adb1-7146-4bc1-b95f-5f72a26330c8/content. (Accessed on 03/11/2025)

Schut M, Klerkx L, Rodenburg J et al (2015) RAAIS: rapid appraisal of agricultural innovation systems (Part I). A diagnostic tool for integrated analysis of complex problems and innovation capacity'. Agr Syst 132:1–11. https://doi.org/10.1016/j.agsy.2014.08.009

Schut M, Klerkx L, Sartas M et al (2016) Innovation platforms: experiences with their institutional embedding in agricultural research for development". Expl Agric 52:537–561. https://doi.org/10.1017/S001447971500023X

Sell M, Vihinen H, Gabiso G, Lindström K (2018) Innovation platforms: a tool to enhance small-scale farmer potential through co-creation. Dev Pract 28(8):999–1011. https://doi.org/10.1080/09614524.2018.1510473

Sodré É (2022) Co-conception en cascades d'innovations technologiques dans l'alimentation des vaches traites pour une augmentation durable de la production laitière de saison sèche à l'Ouest du Burkina Faso. Dissertation, Université de Montpellier

Sodré É, Moulin C H, Ouédraogo S et al (2022) Améliorer les pratiques d'alimentation des vaches traites en saison sèche, un levier pour augmenter le revenu des éleveurs laitiers extensifs au Burkina Faso. Cah Agric 31 (12). https://doi.org/10.1051/cagri/2022006

Soumano L, Traoré M (2016) Contribution of an innovation platform to change the management of collective irrigation: a case study from the Office du Niger (Mali). Cah Agric 26:45003. https://doi.org/10.1051/cagri/2017030

Sraïri M T, Chatellier V, Corniaux C et al (2019) Le développement du secteur laitier et sa durabilité dans différentes parties du monde. Inrae Prod Anim 32: 339-358. https://doi.org/10.20870/productions-animales.2019.32.3.2561

Swaans K, Cullen B, van Rooyen A et al (2013) Dealing with critical challenges in African innovation platforms: lessons for facilitation. Knowl manag dev j 9(3): 116-135. http://journal.km4dev.org

Vall E, Chia E, Blanchard M et al (2016) (2016) La co-conception en partenariat de systèmes agricoles innovants. Cah Agric 25:15001. https://doi.org/10.1051/cagri/2016001

Vall E, Sib O, Vidal A, Delma BJ (2021) Dairy farming systems driven by the market and low-cost intensification in West Africa: the case of Burkina Faso. Trop Anim Health pro 53:288. https://doi.org/10.1007/s11250-021-02725-z

Wilson-Grau R, Britt H (2012) Outcome harvesting. Fordfoundation, Mena Office. https://outcomeharvesting.net/wp-content/uploads/2016/07/Outcome-Harvesting-Brief-revised-Nov-2013.pdf. (Accessed on 03/11/2025)

Winowiecki Leigh A, Bourne M, Magaju C, Neely C et al (2021) Bringing evidence to bear for negotiating trade-offs in sustainable agricultural intensification using a structured stakeholder engagement process. Int J Agric Sustain 19(5–6):474–496. https://doi.org/10.1080/14735903.2021.1897297