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Do multilevel agricultural innovation platforms support inclusive innovation? Lessons learned from a case study in the Ethiopian Highlands

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Abstract

To facilitate smallholder farmers' inclusion and interactions with diverse actors to foster innovation, agricultural innovation platforms (IPs) are increasingly used. Such farmer-centric approaches are connected to the concept of inclusive innovation. Despite the rhetoric of IPs as inclusive structures, questions persist regarding farmers' inclusion in decision-making within IPs. This research, based on a livestock innovation case study in the Ethiopian Highlands, examines the role of multilevel IPs in supporting inclusive innovation. Qualitative data collection, timeline analysis of the innovation process, and thematic analysis were employed. Results reveal varying levels of farmer inclusion across different phases of the innovation process and IP operational levels. While successful farmer inclusion was apparent in the diagnosis and decentralised learning innovation processes, maintaining inclusivity during the latter phases of the innovation process was difficult, and negatively impacted on farmer-centric outcomes. Decentralised resources, decision-making, and reflexive monitoring emerge as crucial in improving smallholder farmers' inclusion and addressing institutional biases inherent in the technology-push approaches to innovation, especially during farmers' selection processes that continued to favour better-off or well-connected 'model' farmers.

Keywords: inclusive innovation, livestock systems, innovation platforms, smallholder farmers, Ethiopia

1. Introduction

Since the seminal work of Chambers et al. (1989), who argued for putting "Farmers First", various inclusive approaches have arisen to support a shift from linear technology-push approaches to farmer-centred approaches to agricultural development (Klerkx et al., 2012). Globally, scholars continue advocating for a farmer-centric approach that recognizes farmers' skills and capitalizes on different sources of knowledge to foster open innovation (Lacoste et al., 2021). In Sub-Saharan Africa (SSA), this shift aims to respond to farmers' needs and improve their access to interlinked services to ultimately address the low rates of farmers' technology adoption that are a feature of historic linear technology-push approaches to the innovation paradigm (Hounkonnou et al., 2012).

The imperative to involve smallholder farmers in the knowledge production process arises not only to enhance their participation in technology development and ensure solutions are tailored to their needs and preferences (Swaans et al., 2014), but also to interactively work with farmers to address the neglected institutional barriers, such as access to interlinked input and output services, that have historically limited productivity growth (Hounkonnou et al., 2012). Despite local successes with the participatory technology development approaches, evidence suggests that smallholder farmers have limited opportunities to benefit from the new technologies where they depend on interlinked institutional conditions, such as access to seeds (Sterk et al., 2013).

The increasing focus on inclusive approaches is exemplified by the agricultural innovation system (AIS) concept (Hall et al., 2001), which emphasises how inclusive innovation emerges through interactions between diverse sets of stakeholders (researchers, government, private sector, and policymakers) with farmers, including collectively pursuing institutional changes necessary for use. Such a change in structure and process acknowledges the important role of farmers' inclusion in knowledge co-production (Nederlof et al., 2011), where "new goods and services developed for and/or by those who have been excluded from the development mainstream", a concept known as 'inclusive innovation' (Foster & Heeks, 2013). This, in AIS thinking, entails shifting the farmer's role in research for development (R4D) from being seen as an "end-user" to being recognized as "partners, entrepreneurs and innovators exerting demands" (Klerkx et al., 2012, p. 461). AIS thinking also acknowledges that stakeholders might have conflicting interests (Klerkx et al., 2012); the rationale for farmer inclusion, access, and benefit may not be shared by all stakeholders or the institutions they represent (de Roo et al., 2019), including value chain actors (Ayele et al., 2012).

Such inclusive processes are increasingly facilitated through a multi-stakeholder approach involving agricultural innovation platforms (IPs). These are promoted to bring together a set of individuals who represent smallholders, value chain actors and different organizations in inclusive innovation spaces for learning, action, and change (Devaux et al., 2018; Lema et al., 2016). IPs are expected to prioritize inclusivity and the collective action, aligning with the concept of 'inclusive innovation' (Heeks et al., 2014), by actively involving farmers and other excluded actors in the innovation process (Ayele et al., 2012; Homann-Kee Tui et al., 2013). Farmers' inclusion can take many forms including representation and participation in key stages of the innovation process facilitated by IPs, from problem identification to co-designing, testing, and evaluating solutions through iterative learning events and actions (Kilelu et al., 2013; Lema et al., 2021).

Yet, there are unanswered questions regarding how the design and implementation of IPs should proceed to foster inclusive innovation by effectively including farmers and their needs in the innovation process and value chains (Devaux et al., 2018), and trigger institutional changes that help farmers connect to interlinked services by working with higher-level decision makers (Hounkonnou et al., 2018). The focus in previous studies on this topic has been on obstacles to this greater inclusion; these were found to relate to institutional barriers, and prevailing power dynamics (Hall et al., 2016; Schut et al., 2016). However, there is a notable knowledge gap regarding operational strategies for overcoming these inclusion barriers when implementing IPs (Dorai et al., 2016). This gap led to reconsideration of how IPs might better be designed and implemented to strengthen farmer-centric innovation processes locally (Swaans et al., 2014), while also pursuing enabling institutional changes at higher level to widen windows of opportunities for farmers (Hounkonnou et al., 2018), which, in turn, has led to an emerging emphasis on multi-level engagement (Davies et al., 2018). The emphasis involves linking actions at different levels through a multilevel network of IPs (multilevel IPs) established from the local to national levels in order to address system-level issues constraining farmers from utilising new knowledge developed locally (Lamers et al., 2017; Tucker et al., 2013).

This article builds upon previous works that were based on the same case study, the Africa RISING (Africa Research in Sustainable Intensification for the Next Generation) Ethiopian Highlands project which employed a multilevel IP structure from 2012 to 2016. Our earlier works investigated if the multilevel IPs fulfilled the various "functions of technological innovation systems" and assessed their contribution to sustained use of innovation outcomes (Lema et al., 2021; Lema et al., 2023). By incorporating a new data set based on interviews with non-participating farmers who were indirectly involved with the project through farmer field days to evaluate on-farm trials, we take a closer look into the case study to examine how these multilevel IPs practically support inclusive innovation. This article aims to answer the question 'do multilevel agricultural IP supports an inclusive innovation?' Specifically, how do kebele (community-level) IPs interact with higher-level IPs at the woreda (district) and national levels, and what role do smallholder farmers play in various phases of the innovation processes facilitated by these multilevel IPs? In considering "inclusion" we mainly focus on inclusion of farmers in general in the innovation process rather than considering marginalized groups of farmers specifically. We do touch on social inclusion to some extent where the data allows.

The paper is structured as follows. Section 2 considers the case-study IP network as an inclusive model and discusses its three phases. Section 3 then details the case study background and the qualitative methods used in the case study to collect and analyse data, after which section 4 presents the study's findings. The last two sections discuss the implications of the findings and conclude.

2. Innovation platforms as an inclusive innovation model

According to Heeks et al. (2014, p. 177), the inclusive innovation concept is based on an understanding of two elements. The first element refers to the social groups that are excluded, in this case, from an agricultural innovation process and need to be included and empowered by new approaches to innovation. In our case, this group refers to smallholder farmers who are marginalised and lack effective organisation to advocate for their interests within the traditional approach to innovation and market value chains (Hounkonnou et al., 2012). The second element refers to which aspect of innovation the marginalised groups (in our case smallholder farmers) needed to be included in. The six levels of inclusive innovation are illustrated as a ladder in Figure 1, where each level depends on the inclusion of the levels below while further deepening the extent of inclusion. Heeks et al. (2014) identified two contrasting views on inclusive innovation, one those who think greater inclusion can be addressed by sharing innovation outputs (Level 1-3) and those who believe that inclusion of farmers in the innovation process is essential to success (Level 4-5) (Figure 1).

The IP concept is based on the later view, acknowledging the importance of actively involving diverse actors including smallholder farmers, and other local and market actors in co-innovation process (Foran et al., 2014). Heeks et al. (2014) in their review of IPs as an inclusive model consider the IPs to be at level 5 of their framework ("inclusion of structure" in Figure 1), where IPs represent a sub-structure of the national agricultural R4D systems with the aim to provide an inclusive space for farmers along with other stakeholders in the innovation process, meaning by accepting the Level 4 below, Inclusion of Process. In SSA, including Ethiopia, the prevailing institutional context is characterised by the linear technology-push for farm productivity, which is found to influence sub-structures like IPs aiming for inclusive innovation (Hounkonnou et al., 2012; Schut et al., 2016). This is because the actors forming IPs are brought from existing institutions operating with mindset of technology-push paradigm (Schut et al., 2016). To elucidate the institutional factors and the evolving roles of different actors, we utilize an illustrative diagram in Figure 2 to map the three phases of the innovation process. This helps to better understand the expected and changing roles of farmers and other stakeholders in the innovation process when evaluating farmer inclusion.

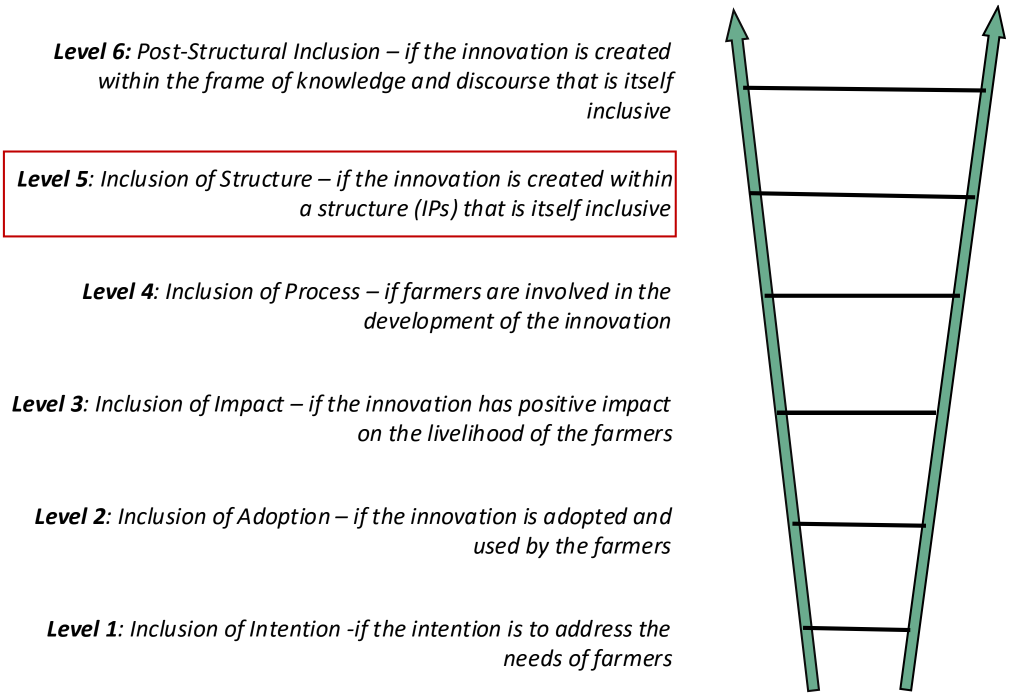

Figure 1: Heeks et al. (2014) classified IPs as Level 5 (inclusion of structure) in their inclusive innovation framework, shown as a red rectangle around Level 5.

Implementing IPs as an inclusive model requires deliberate efforts to include farmers alongside other actors in the innovation process (Swaans et al., 2013), more specifically how their views' are connected to other stakeholders' views, across issues and over time (Quick & Feldman, 2011). Unlike the linear model that focuses solely on formalised research as a source of innovation, IPs are designed to integrate multiple sources of knowledge, skills, and resources to foster diverse forms of innovation (technical, organizational, and institutional) (Hawkins et al., 2009). Understanding issues around farmers' inclusion requires an in-depth analysis of not only farmers' participation but also the quality of their interactions during each phase of the innovation process (see Figure 2). This innovation process is Level 4, *Inclusion of Process*, as shown in Figure 1. Quick and Feldman (2011) distinguishes the two different but complementary terms – *participation* and *inclusion*, defining *participation* as a practice oriented to increasing input from diverse representation to influence decisions and *inclusion* as a practice of making connections among people, across issues and over time where enhanced inclusive practices build the capacity of the stakeholders to implement the decision and solve related problems.

Thus, farmers' participation and the quality of inclusion in Leve 4, *Inclusion of Process,* can be assessed using Arnstein's ladder of participation (Arnstein, 1969) as part of the Heeks et al. (2013) inclusive innovation framework (Figure 1). The levels of participation in Arnstein's ladder - *informed, consulted, collaborating, empowered and controlling* - were adapted to the following three categories, in order to assess inclusiveness of the IP activities through the three phases:

i) ***Being informed and consulted** is assessed as low (*) when farmers are informed about decisions or consulted for their input, but they have limited influence over the outcomes.*

ii) ***Collaborating*** *is assessed as medium (**) when farmers are actively collaborating with decision-makers, contributing their knowledge and expertise to the decision-making process.*

iii) ***Empowered and controlling*** *is assessed as high (***) when farmers are empowered to make decisions and have control over the outcomes, ensuring that their interests are prioritised.*

The three main phases of the innovation process were: initiation, implementation, and performance with the expected level of involvement of stakeholder groups shown in Figure 2. There are three main groups of stakeholders involved in the IP: farmers and other local stakeholders operating at the local level, the R4D partners at the national level who initiated the IPs, and private sector actors. The width of the triangle shape shows the changing role of each stakeholder group through the innovation process that was expected. Focusing on the role of farmers initially, it would build from a small group during the initiation phase that would grow in number as interest increased over time with farmers taking on a collaborative role during the implementation phase, and finally the farmer's role would be dominant by the end of the innovation process with increased ownership (Figure 2). We used these phases to assess the expected role of farmers during the innovation process against the empirical data obtained from the case study.

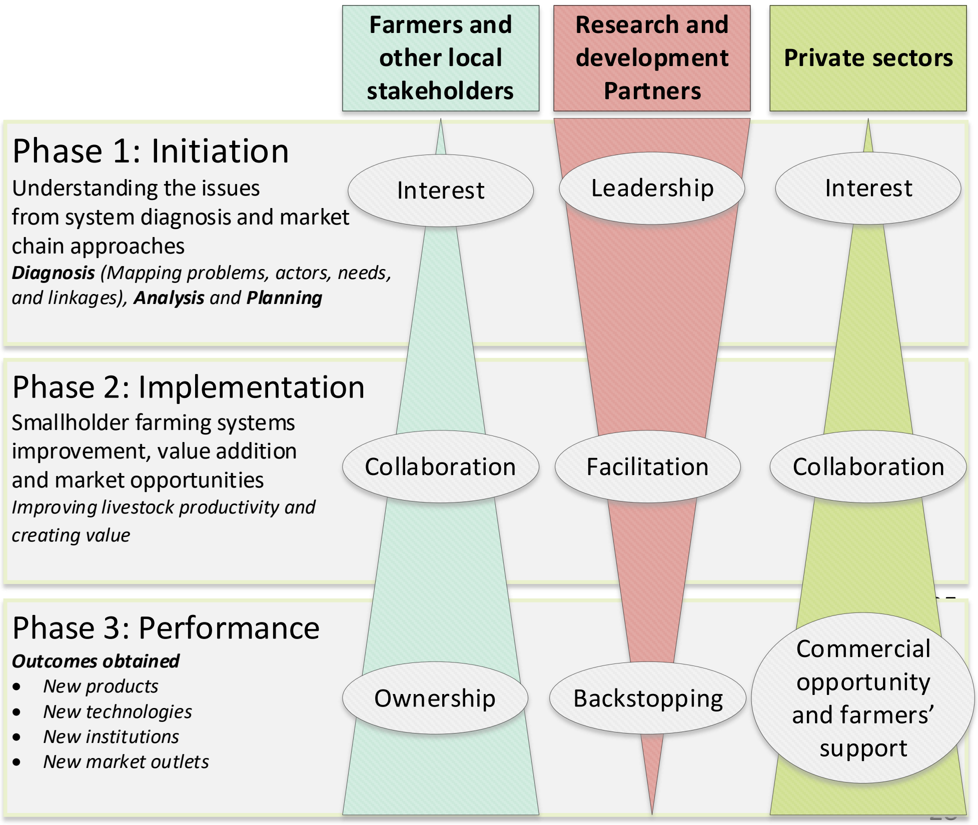

Figure 2. Phases of IPs and the expected changing roles of farmers, research and development agencies and private sector. The width of the triangle emanating from the group suggests the level of involvement, which in some groups grows and in others diminishes as the IP matures through its phases of development. Source: Adapted from (Bernet et al., 2006)

3. Case description and research methods

3.1. Multilevel IPs of Africa RISING

The Africa RISING project is collaborative research for development (R4D) initiative in the Ethiopian Highlands and it was led by the International Livestock Research Institute (ILRI) and involved nine CGIAR centres. The project's objective was to identify and validate solutions to the problems faced by smallholder crop-livestock farmers through sustainable intensification. It was established in eight kebeles (the lowest administrative units in Ethiopia) across four woredas (or districts): Basona Worena, Sinana, Lemo, and Endamehoni in the Amhara, Oromia, SNNP, and Tigray regions, respectively.

To enhance engagement with farmers and other stakeholders, the project established a multilevel structure of IPs which connected the IPs established at higher (national and woreda) levels are linked with IPs established at lower (kebele) levels (see details for IP structure and governance in Lema et al., 2021). Kebele level IPs managed up to nine Farmer Research Groups (FRGs) which were established to test and validate solutions on their farms through on-farm experimentation. Each IP organised iterative learning events that involved cross-level participation and exchange of information.

For this research on farmers' inclusion (Figure 1) in the innovation process (Figure 2) the study focus is the national-level IP, and the IPs of two woredas (Lemo and Basona Worana) and of their respective kebeles. The two woredas selected represent two regions that capture the set of actors involved, the diverse nature of the livestock technologies and activities implemented by the project. Lemo woreda is in the Hadia Zone in the Southern Nations, Nationalities, and People's Region, and its two intervention kebeles were Jawe and Upper Gana. Basona Worana woreda is in the North Shoa Zone of the Amhara Region, and its two intervention kebeles were Gudo Beret and Goshe Bado. The administrative centre (town) of each of these woredas corresponded with that of the encompassing zone, thus offering a unique opportunity for the woreda-level IPs to collaborate with key zonal government organizations, including universities, research centres, NGOs, private sector actors, and local government agricultural offices.

The farmers in both woredas were operating a mixed crop-livestock farming system, which is the dominant system in the Ethiopian Highlands. The major crops of wheat, barley, and faba beans were dual-purpose for food and animal feed. In Lemo, farmers also grow Enset (*Ensete ventricosum*) as the main food and cash crop. Farmers in both woredas also keep livestock of mainly indigenous cattle breeds, as well as sheep, poultry, and donkeys. Livestock are highly valued by these farmers as they provide multiple benefits of draft power, animal products, transport, assets for security, and income. The characteristics of the farmers are largely similar across the kebeles, and all farmers interviewed for this study own livestock; on average they held 6.9 tropical livestock units each. Most farmers keep local-breed livestock, which are mainly for subsistence use and rely on crop residues and grazing lands for the livestock feed.

3.2.Case study methods

Following Yin (2013), a single case study research design was identified as appropriate for providing in-depth analysis of farmers' inclusion in the innovation process. To this end, the study mapped the important events within the process facilitated by the multilevel IP onto a multi-year timeline and used the timeline to analyse and evaluate farmers' level of inclusion and their roles in the different stages of the innovation process (Kilelu et al., 2014; Klerkx et al., 2010). While the multilevel IPs focused on the broader system of crop-livestock issues, the case study was narrowed to livestock innovation to enable a sharper focus on a subset of specific innovations and enable more in-depth analysis of how farmers were selected to participate, their level of inclusion, and their changing roles in the innovation process.

3.3.Data collection and analysis

Our data collection methods aimed to reveal how farmers were involved in the innovation process, starting from their initial participation in diagnostic studies to identify problems, all the way to their involvement in the identification of technologies for scaling up during the performance phase (Figure 3). During the five-year project, a timeline analysis of important IP events (see Figure 3) was used to identify and map IP activities undertaken during each phase of the innovation process.

Data were collected from September to December 2018 (Table 1). This was two years after project support for the multilevel IPs had ceased. Focus group discussions (FGDs) and key informant interviews (KIIs) were used to collect data from study participants, with each method involving a different semi-structured schedule of questions (see Table 1). The participants in the FGDs and KIIs were recruited based on their role, representing the diversity of the IP membership, including farmers, government, NGOs, and private sector actors due to their high involvement at one or more IP levels during the project lifespan.

Table 1. Summary of data collection methods and information gathered in the study areas.

Methods/Data collection instrument	Number of FGDs or KIIs			Data gathered
	Lemo	Basona Worana	National	
KIIs using semi-structured question schedules with stakeholders representing five groups*	9	10	5	Individual views on their level of participation and interaction with farmers and their role in designing and leading the co-innovation process and engaging farmers during the three phases.
FGDs using semi-structured question schedule with representatives of lower-level and woreda IPs (6-8 participants per IP)	3	3	n/a	Collective members' views on farmers' participation and roles, level of interactions between farmers, farmers with other IP member groups (researchers, NGOs, government, and university), and utilization of innovation.
KIIs using semi-structured question schedules with farmer participants in FRGs	11	12	n/a	Individual farmer's views and their experiences with community and higher-level IPs, and their level of adoption and use of innovation outcomes.
FGDs using semi-structured question schedules with farmers not participating in FRGs (6-8 participants per kebele)	2	2	n/a	Collective views of farmers not participating in FRG on access to information about innovation/s and their experience in adopting and utilizing the innovation.

* Groups representing farmers, research, government, NGOs, and universities.

FGDs were conducted with farmers not participating in FRGs in each kebele, using a semi-structured questionnaire to assess accessibility and *Inclusion of Adoption* (Level 2) of the innovation for farmers not involved in IPs. The FGDs and KIIs took from one to two hours each to complete, were audio-recorded, translated, and fully transcribed into English from the local Ethiopian dialect.

Additionally, a review of secondary data sources, including project documents, was undertaken to identify key events during the initiation, implementation, and performance phases of the innovation process, and to assess farmers' levels of inclusion in each event.

Reports of diagnostic studies and IP events were included into the reviewed documents. These documents together with lists of attendance (with minutes where applicable) at national-, woreda-, and kebele-level IP review and planning meetings, farmer field days, and exchange visits were used to develop timeline analysis. Drawing from various data sources, the authors assessed major IP activities and evaluated levels of farmer inclusion in key decision-making process during the three phases of the innovation process, utilising the five sub-steps of Arnstein's ladder explained in section 2.

These secondary data and other information enabled validation of the primary data sources through triangulation and aided in constructing a multi-year timeline of activities. NVivo© software was used to code data into themes relating to each phase of the innovation process and analysed using the thematic analysis steps of Braun and Clarke (2006), to examine farmers' inclusion in the co-innovation process.

4. Results

4.1. Farmers' representation in IP learning events

Here we present quantitative representation of farmers compared to other stakeholders. Despite consistently low participation of female farmers across the three IP levels, compared to male farmers, the decentralised structure facilitated a substantial 55% involvement of smallholder farmers in kebele-level IPs (Table 2). This high percentage representation of farmers is due to each FRG has a minimum of two representatives at the kebele IP meetings. The data also revealed that woreda-level IPs were more diverse, involving a broader range of actors than the other IP levels. Nevertheless, farmer participation at woreda-level IPs remained low at an average of 13%, with the remaining 87% of participants consisting of non-farmer stakeholders, private and R&D partners representing different administration levels.

Table 2: Farmers' participation at major IP learning events (2014 to 2016), see Figure 3.

Level of IP	*Average total no. of IP participants per event*	*Average no. of farmer participants per event (women)*	*Farmers as a % of all participants (women)*
National IP (1 IP)	50	0 (0)	0% (0%)
Woreda IPs (2 IPs)	38	5 (1)	13% (2%)
Kebele IPs (4 IPs)	33	18 (6)	55% (18%)

A closer examination of woreda-level IPs (Table 3) demonstrates an increase in farmer participation, rising from 10.5% during the initiation phase to 19.5% during the implementation phase. Also, the number of events organised and learning activities facilitated decrease along the three phases, with more activities during the initiation and less during the performance phase.

Table 3. Farmers' participation in woreda-level IP meetings

Planning and review woreda IP meetings	*Average total no. of IP members per meeting (women)*	*Average no. of farmers per meeting (women)*	*Farmers as a percentage of all participants*
Initiation Phase			
1st (Feb. 2014)	38 (2)	4 (0)	10.5%
2nd (Feb. 2015)	43(3)	5 (1)	11.6%
Implementation Phase			
3rd (June 2015)	41(6)	8 (2)	19.5%
Performance phase			
4th (July 2016)	24(3)	4 (1)	16.6%
Average	38(5)	5.25 (1)	14.0%

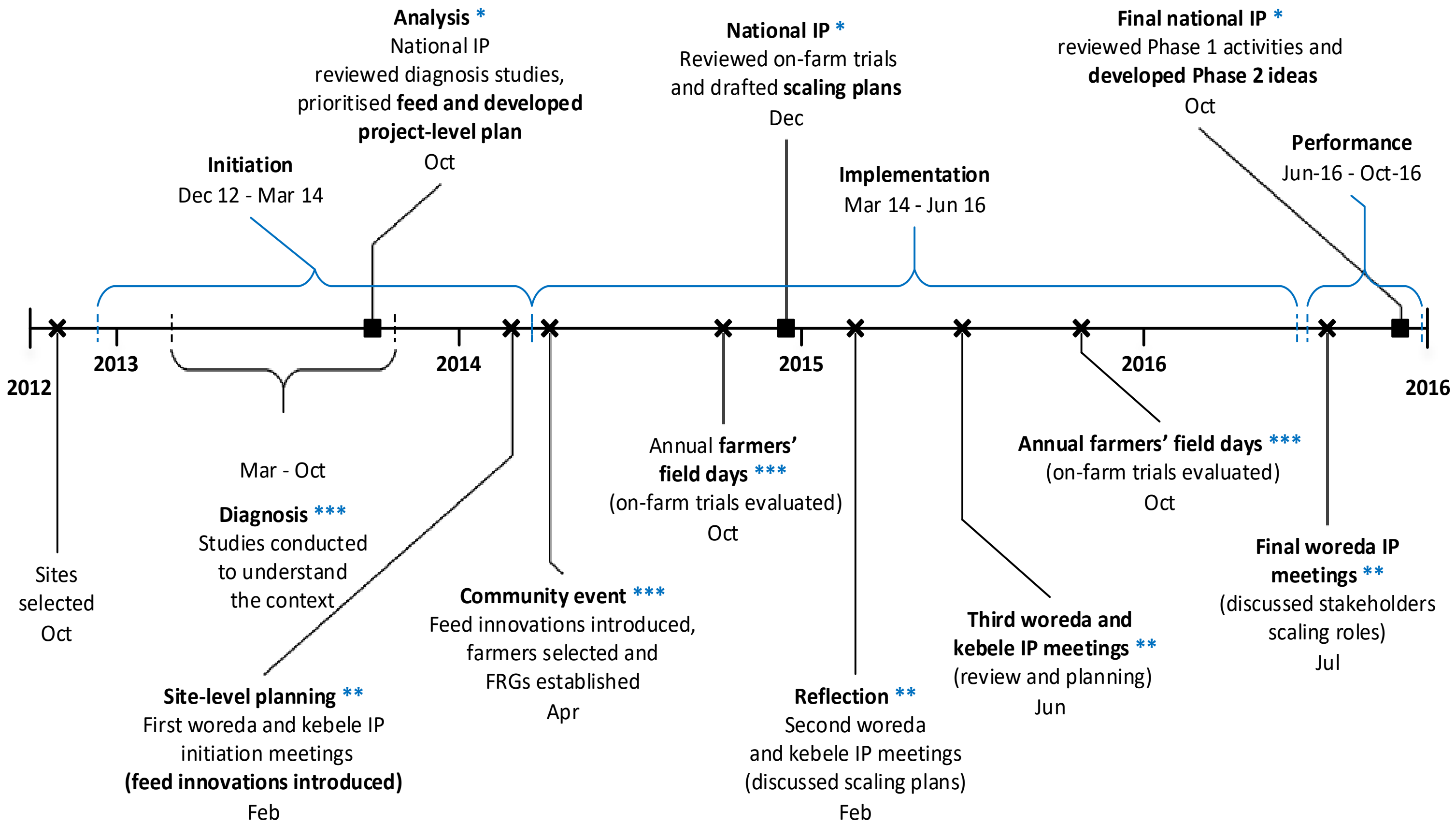

*Figure 3. Timeline of the Africa RISING multilevel IPs activities used to map and evaluate the farmers' inclusion between 2012-2016. The * symbol indicates the level of farmers' inclusion during each major activity: *** ~ high inclusion = when farmers are empowered and controlling, ** ~ moderate inclusion = farmers are collaborating, * ~ low inclusion when farmers are only being informed.*

*The ■ symbol indicates national-level IP events, while the **X** symbol indicates events conducted by woreda and kebele IPs along the line*

4.2. Farmers' inclusion in the livestock innovation process during the three phases

Below, based on the above quantitative analysis on participation and other qualitative and secondary data collected, we present the findings of a thorough thematic analysis of farmers' level of inclusion in the livestock innovation process under each of the three phases (themes). Figure 3 shows a timeline of key learning events across the three IP phases (initiation, implementation, and performance). It also provides authors' qualitative assessments of farmers' inclusion levels in the innovation process, ranging from *low (*)* to *high (***)* based on the three categories of their participation level in decision making process as outlined in Section 2.

(i) Initiation phase

During this phase, three major activities within the livestock innovation process were undertaken (Figure 3). The first involved participatory diagnostic studies conducted in project sites, which identified interconnected challenges experienced by smallholder farmers along the value chains. CGIAR researchers led multidisciplinary teams at the woreda level, including representatives from regional research institutions, universities, NGOs, and woreda-level government officials. These team members later joined the multilevel IPs as technical team and supported the facilitation of innovation activities across the three phases.

According to the interview results and review of secondary data, the diagnostic studies involved participatory community analysis (PCA) and the Feed Assessment Tool (FEAST). FEAST is a participatory approach which involved farmers in assessing local feed availability to inform project interventions (Duncan et al., 2023), while PCA engaged diverse groups of 30-40 farmers per kebele in identifying context-specific issues and opportunities (Ellis-Jones et al., 2013). To improve the livestock systems interviewed farmers prioritized beef, dairy, and sheep as commercial enterprises and identified interlinked barriers such as access to improved feed, health services, breeding facilities, and marketing. Livestock preferences aligned with traditional gender roles, with women farmers favouring cows for milk and butter, and men preferring oxen for land preparation. The diagnostic results informed subsequent value chain analyses for the identified livestock enterprises, enabling the mapping of key actors and opportunities in a site-specific manner.

Over 50% of interviewed farmers actively engaged in diagnostic studies, finding them inclusive of their diverse needs and perspectives. The woreda-level multidisciplinary team involved spoke of how the participatory approach used in the diagnostic studies enabled them to place farmers at the centre to identify their aspiration and challenge. They also spoke of how the new approach enhanced their inclusive capacity and how their local knowledge contributed to understanding complex farmer needs before designing interventions. Thus, our assessment of farmers' inclusion using the evidence, including from secondary data sources, showed the balanced representation of diverse farmer groups and their perspectives during the diagnosis activities as part of the initiation phase resulted in a high-level of farmer inclusion (***), where farmers were empowered to identify issues and priorities, and influenced the diagnostic study outcomes.

As shown in Figure 3, the second key activity in this phase was the national review and planning meeting. During this event, the national-level IP reviewed the findings from the diagnostic studies and prioritised thematic areas to guide the development of innovation across the sites. Despite the high level of farmers' inclusion in the diagnostic studies, we found that farmers' level of influence during this activity was limited. For the livestock systems, the *feed and forage development* theme had been prioritized during this event to address the feed scarcity issues across the project intervention kebeles. This led to selection and grant funding for CGIAR researchers who proposed technical solutions to test feed interventions through on-farm experimentations. Through interviews with different groups varied perceptions on the inclusion of farmers were observed including those conducted with farmers. Most KII participants at national and woreda level agreed that the feed scarcity issues prioritised for all intervention kebeles were informed by the diagnostic studies, but kebele-level IP and FRG members nevertheless felt this activity was less inclusive. Researchers coordinating the project attributed the lack of maintaining farmers' inclusion to the difficulty they experienced in balancing the resource-intensive nature of inclusive processes with the challenge of achieving project milestones. Overall, we rated farmers' inclusion in influencing the outcome at this national event as low (*), as no direct participation and they were only informed of the outcome of the national IP decisions.

The final key activity involved site-level planning, involving initiation meetings to establish woreda and kebele IPs. Following Africa RISING team's presentation of the draft purpose and roles within the multilevel IP structure to enable collaborative approach, CGIAR lead researchers, with grants for proposed solutions, presented technical solutions they planned to test to address feed scarcity using two strategies. The first focused on enhancing existing feed quality and reducing losses through improved feeding troughs and storage sheds. The second focused on introducing new forage crops to increase high-quality feed availability. Researchers expected peer-to-peer learning during farmers field days and exchange visits to facilitate stepwise adoption of both strategies among farmers for addressing feed scarcity issues.

We reviewed meeting minutes to assess the participation of farmers and private sector actors in terms of who attended, asked questions, and provided insights. We found that only four men farmers, including kebele chair and "model farmers" participated in crucial decision-making (Table 3), with no private sector actor involvement. These farmers included the kebele chairmen and "model farmers" (who tend to be advanced in adopting new technologies and favoured by the Ethiopian agricultural extension system as "early adopters" for disseminating technologies to other farmers). The farmers and local actors' perception on farmers' inclusion was positive and appreciative because farmers and most multilevel IP members, as per meeting minutes, indicated their 'newness' to the IP concept and valued their involvement in jointly planning, comparing it with their prior experiences with predominantly top-down government interventions. Thus, we rated the farmers' level of inclusion in site-level planning as moderate (**) because the farmers collaborated with researchers to inform the planning to implement on-farm experimentations.

In summary, our thematic analysis highlighted three key activities during the project's initiation and assessed the extent of farmers' inclusion in each. While diagnostic studies were inclusive, the subsequent decentralised process faced challenges, hindering comparable inclusivity due to time and resource constraints in achieving project outcomes. Consequently, the national IP prioritised feed and forage development across sites, allocating funds for identified technical solutions by researchers, with lower-level IPs supporting implementation. The site-level planning phase showcased improved collaboration, primarily with a specific group of "model" farmers engaged in on-site learning and planning activities. Overall, the level of farmer involvement in decision-making during the initiation phase was assessed as moderate.

(ii) Implementation phase

During this phase, several learning events were conducted such as community events to introduce innovations to farmers, review and planning meetings, workshops, training, and field days. Figure 3, Tables 2 and 3 all show a trend of higher inclusivity for those activities organised at community-level, including farmer field days. About 200 farmers per kebele were invited to the community events through kebele-level development agents, government-employed agricultural extension specialists supporting farmers. At these gatherings, researchers presented the innovations to be tested and outlined the criteria for farmer participation in FRGs. For livestock feed innovations, criteria included farmer interest, livestock ownership, willingness to allocate resources for trials, and access to irrigation (for testing irrigated fodder for sheep fattening in Lemo woreda). Farmers who volunteered to test technologies formed five to nine FRGs per kebele.

Our thematic analysis KIIs and FGDs data on farmer selection revealed mixed views on the process of inclusiveness. The IP technical groups facilitating the selection process were uncertain whether self-nominated farmers had a genuine interest in feed technologies or were attracted to project support. The criteria guiding the process did not, for most livestock feed innovation types, consider a farmer’s preference for a specific livestock enterprise (beef, dairy, or sheep), due to limited connection to the diagnosis results. Development agents indicated they mostly invited "model" farmers to community meetings, perceived as more experienced and well-resourced to demonstrate on-farm trials and ensure project “success”. The fact that the project provided free inputs to FRG members to complete the on-farm trials, led non-participating farmers (non-FRGs) we interviewed to question about the selection criteria. One non-FRG farmer from Gudo Beret kebele noted the following during an FGD, with other participants agreeing.

> *The selection of participating farmers would have been convincing if resource-poor livestock farmers were selected to be supported by the project. They can demonstrate to us, and we can adopt the technologies at our own cost.*

In contrast, the national-level researchers during KIIs evaluated farmer involvement in the FRGs as participatory and inclusive. One such researcher observed:

> *What I like most is the way the technology ideas were introduced to farmers. Farmers were allowed to choose which technology they would like to participate in, due to them having been given enough information about the resources each project required and its benefits. It was not imposed on farmers.*

After forming each FRG, members selected men and women representatives for the kebele-level IP. All FRG members received project inputs and on-farm training from the technical groups to establish the on-farm trials. A routine of IP review and planning meetings, field days, and other learning events was established (see Figure 3) to involve farmers in the innovation process further. To demonstrate and evaluate the on-farm trials annual farmer field days organised and attended by FRG, non-FRG and IP members. IP members viewed these field days as effective for engaging and gathering feedback from a diverse farmer audience. Improved forage crops were often adopted by non-FRG members, facilitated by easily obtaining free seeds from participating neighbours. In contrast, adoption of feed troughs and storage sheds was limited to FRG members who received project support, as non-FRG members found these technologies costly to construct and did not attempt adoption.

Aside from these field days, kebele-level IP meetings were identified as highly effective for farmer inclusion due to proximity of meeting location, especially for women farmers who face cultural barriers to travelling outside their kebeles (Table 2). During these meetings, farmers raised important issues they had encountered during the on-farm trials, particularly those resulting from researchers failing to incorporate farmers' knowledge into the research design. The minutes of the second kebele-level IP meetings in 2015, for example, showed farmers reporting issues related to the poor quality of tree lucerne seedlings, late distribution of planting seeds, and frost effects. The Jawe kebele second IP report in 2015 mentioned a lack of a feedback mechanism to incorporate inputs from lower-level IPs:

> *Farmers mentioned that there is a perfect time they plant when water logging is finished. … They suggested that researchers should combine [farmers'] local knowledge with that of the research activities and supply inputs on time.*

We found two main reasons for why reflexive learning had been hindered. Firstly, there was a lack of mechanisms for integrating farmers' local knowledge and practices with scientific knowledge to drive innovation. Secondly, despite farmers sharing their knowledge and insights during kebele-level IP meetings, the limited participation of national-level researchers in these meetings constrained the incorporation of farmers' knowledge into their research agenda. This occurred even though site coordinators claimed to collect and communicate farmers' feedback and inputs through reporting and presentations at high-level IP learning events.

Other major events were the review and planning meetings held by the woreda-level IPs. Although farmers' inclusion in these meetings was low in terms of actual numbers (Table 2), it did double from four to eight farmers during the final woreda-level IP meeting (Table 3). A review of IP meeting notes revealed reflections from stakeholders on how the short project period, coupled with finite resources and constrained interaction with and participation of farmers, hampered reflective learning and restricted flexibility in adapting the efforts of IPs to emerging farmer needs. This review also revealed that there were fewer instances of farmers asking questions or raising ideas at the woreda-level compared with the kebele-level.

The influence of farmers on the type of interventions and the focus of the IPs was limited due to the limited number of farmers represented on them and their limited power to challenge other actors. Conversely, woreda-level government officials have power to influence the types of innovation to be implemented within their jurisdiction so that it aligns with their existing government agenda. For instance, government officials stopped one of the technologies planned by the project (integrating oats as a livestock feed in their faba bean crop) due to an anticipated negative yield impact for the government's food security agenda. This step was undertaken despite farmers' high interest in this technology. Based on lessons they learned in Africa RISING; the farmers started recognising the need to deal with the power dynamics working against them. As one farmer remarked during FGDs:

> *We must start expressing what we want without fear. To make our own decisions rather than being tempted by the benefits of free inputs that are given by the projects or by other benefits by the officials.*

The review of IP documents shows that the agendas for organising regular IP events were often uniformly focusing on the feed technologies and less on other issues that farmers had prioritised as interrelated. Delays in the time taking initiation phase activities meant that Africa RISING behind in meeting donor requirements. This resulted in the national-level IP developing the technology dissemination plan and encouraging the IPs at other levels to prioritise scaling out. Woreda-level stakeholders and Africa RISING site coordinators during KIIs referred to this push from the national level and how it limited the time available for engaging lead researchers in lower-level IPs so they might learn reflexively from participants' feedback. Participating farmers during FGDs and KIIs agreed on how this impacted their economic gains than they had hoped for from developing their livestock enterprises, influencing their decisions to continue investing in livestock feed innovation. For instance, the sheep fattening enterprise failed to realise the expected profit margin from feeding improved forages due to market price failure, leaving the project to compensate farmers for their losses.

In summary, the implementation phase comprised a series of IP events. These facilitated an iterative learning process of planning, testing, and evaluating livestock feed innovations through on-farm experimentations. The anticipated stepwise adoption of the feed trough and feed storage technologies beyond the FRGs was not realised since non-FRG farmers, lacked sufficient resources to invest in these technologies. While research leaders saw the technology selection process as participatory, non-FRG farmers viewed it as exclusive and favouring model farmers. The respondents in lower-level IP structure (kebele IPs and FRGs) saw limited use of farmer feedback by researchers to guide inclusive innovation.

(iii) Performance phase

The third and final phase involved two major events that marked the completion of Africa RISING (2012-2016) IP activities and commencement of the scaling agenda during 2017-2021. The fourth woreda-level IP meeting was mainly focused on scaling out plans for Africa RISING, with limited attention to sustaining livestock feed innovations introduced in original project kebeles. To meet the project donor's requirement of reaching more farmers, researchers moved their focus to new and more sites to scale out the two 'farmer-tested' feed technologies which had been adopted to some extent in Africa RISING FRG sites. KIIs with farmers observed that adoption of the cropping innovations tested through on-farm trials was more widespread than that of the livestock feed technologies. Farmers indicated that they had obtained limited noticeable economic benefits from adopting only improved feed technologies, and that complementary technologies, such as improved breeds and better veterinary and financial services, were also needed to make returns from the feed technologies sufficiently attractive.

Farmers and other stakeholders flagged that learning was the main beneficial outcome of their participation in the innovation process facilitated by the multilevel IPs. In this respect, they regarded the IP approach as more favourable than the prior technology transfer approach under which attempts to scale out technologies occurred without testing and learning under local conditions. An NGO representative from Basona Worana IP observed accordingly:

> *I think the technologies are not new, but what is innovative is the approach and the knowledge packages that aim to change the attitudes and practices of farmers and stakeholders on how to identify problems, design interventions, and test and validate technologies with farmers before wider scaling.*

These stakeholders also noted the need to change from working with only model farmers towards including more diverse farmers with different socio-economic backgrounds. A member of the Jawe kebele-level IP who was a model farmer commented along these lines:

> *…most farmers are resource-poor and never attended any IP event that happened in the kebele because 'model farmers' are usually called for such events.*

Thus, we rated farmers' level of inclusion in woreda-level IP events during the performance phase as *moderate* and in the final national-level IP meeting as *low* (Figure 3). The expected role of farmers from *collaboration* in the implementation phase to *ownership* in the performance phase as illustrated in Figure 2 occurred strongly for knowledge and technical capacity related to the specific feed technologies adopted. However, less ownership was achieved for the two livestock feed innovation strategies researchers identified to address feed scarcity through increasing biomass and minimising feed wastage. This is because farmers did not adopt the feed trough and feed storage to increase feed quality and minimise feed wastage as anticipated due to its high initial cost, especially non-participating FRG without project support.

5. Discussion

This paper set out to answer the question: Do multi-level agricultural innovation platforms support inclusive innovation. The evidence from our case study suggests that the multilevel IP structure's capacity to promote inclusive innovation varied throughout the phases of implementation and across different IP levels, ranging from local to national. To discuss key findings and explore inclusion strategies, we examine factors that either supported or impeded the multilevel IP structure in fostering inclusive innovation. Following the inclusion model of Heeks et al. (2014), we had previously conceptualised that this sub-structure (Level 5, *inclusion of structure*) operated under the broader national institutional context in Ethiopia, which may sometimes work against the inclusive and system-oriented approach that IPs are intended to embody (Cullen et al., 2014; Schut et al., 2016).

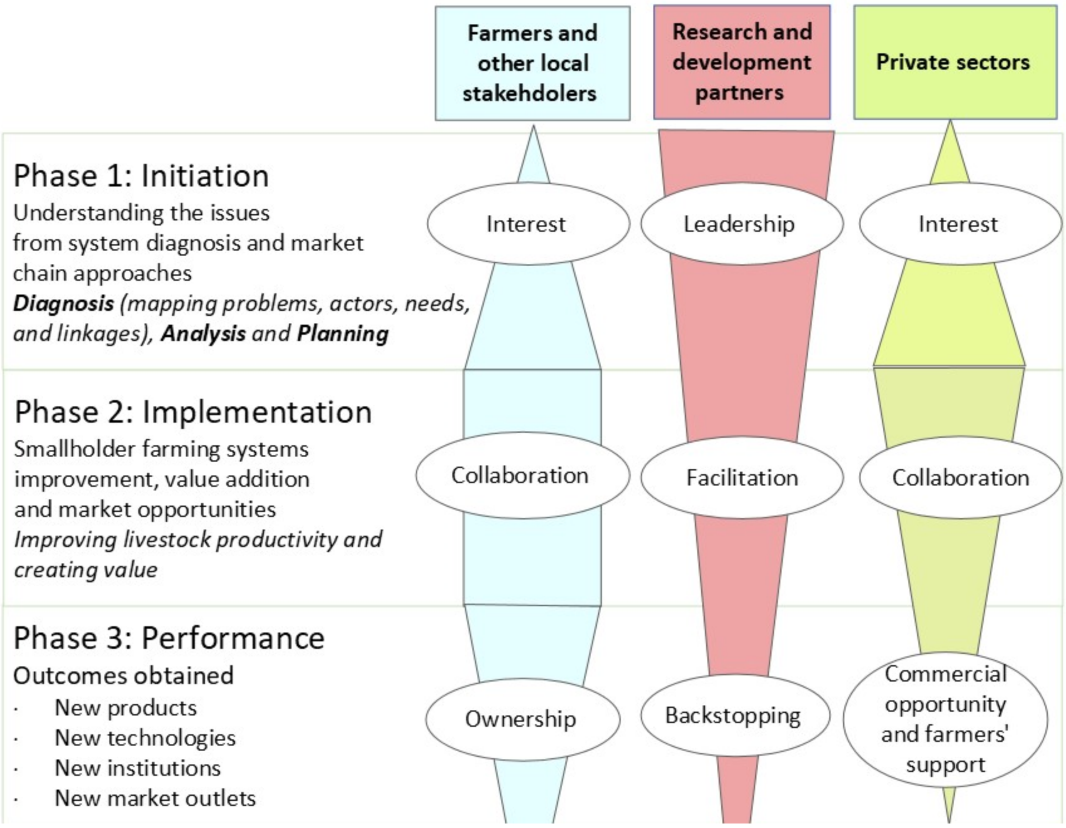

Figure 4 – Phases of the multilevel IPs and the roles of stakeholders in practice from Ethiopian case study.

Our findings suggest that participatory diagnostic approaches, partnership during initiation phase, and the decentralised structure in facilitating learning during implementation and performance phases positively contributed to the inclusion. However, various factors, including the broader institutional context, imposed limitations in attaining farmer-centric outcomes.

Figure 4 reflects the stakeholder roles as shown in Figure 2 but based on our results to examine if the expected roles were a reality in practice. While the research and development partners' role remained as expected, the roles of farmers, local stakeholders and private sector actors diminished over the three phases rather than growing as shown in Figure 2. Below, we discuss the implication of these findings by focusing on the enablers of and difficulties in maintaining the inclusive innovation across the three phases of the innovation process.

During the initiation phase, the diagnostic studies undertaken to understand the aspirations and needs of different groups of farmers and value chain actors enabled a high level of inclusion with regards to collecting inputs to inform decisions. This was accomplished by intentionally applying a systems approach and participatory tools, such as the PCA (Ellis-Jones et al., 2013) and FEAST (Duncan et al., 2023), to guide the analysis of context-specific and interrelated issues affecting farmers. Furthermore, instead of researchers independently undertaking the diagnostic studies, the project invested in hiring a consultant to lead the partnerships, and established and trained a woreda-level multidisciplinary teams composed of regional government, research, and extension actors, to jointly conduct the diagnostic studies. This intentional approach offers the advantages of building the inclusive capacity of local stakeholders in diagnosis activities by including diverse perspectives (Figure 4).

During the implementation and performance phases, decentralising the IP structure and hosting learning activities in accessible locations enabled farmer participation in kebele-level IPs. Community events organised per kebele provided farmers with opportunities to self-nominate the technologies that they wanted to test through on-farm trials. Annual farmers' field days brought IP members from across the levels and both FRG and non-FRG farmers to evaluate trials. These are some of the key advantages of multilevel IPs over single-level, such as district-level, IPs. It has been found in respect of single-level IPs that government officials tend to dominate participation (Cullen et al., 2014) and cultural barriers hinder the involvement of women farmers, in particular (Swaans et al., 2014). Thus, decentralising the learning process contributed to the enhanced farmers' technical capacity and kebele-level stakeholders in dealing with livestock feed issues collectively and locally (Lema et al., 2023).

However, sustaining the achieved level of inclusion proved challenging. As shown in Figure 4, the role of farmers and local stakeholders during the implementation phase remained collaborative and did not expand as anticipated in Figure 2. This challenge stemmed from the project's need to balance between ongoing investment in an inclusive but resource-intensive process, on the one hand, and under pressure for meeting donor-mandated project milestones, on the other. Recognizing the time and resources invested in inclusive diagnostic studies, more attention was directed towards implementing researchers-led technology-transfer projects within the IPs to meet the milestones and attain quick wins. While diagnostic study findings were centralised and utilised by the national-level IP to prioritise technological innovation agendas, the roles of woreda- and kebele-level IPs shifted towards supporting and enhancing participation favoured technological innovations. The significance of technological innovation in addressing the livestock feed scarcity issues faced by farmers was important area to focus on. However, prioritising this measure resulted in a less inclusive innovation process, impacting farmers' selection process and neglecting interrelated institutional barriers identified in diagnostic studies, including limited access to improved livestock breeds which indirectly affected continued utilisation of the feed technologies (Lema et al., 2023).

Following Quick and Feldman (2011) definitions of participation and inclusion, this suggests that multilevel IPs improved participation during diagnostic studies, enriching the inputs that then influenced decisions. However, the lack of funding flexibility weakened efforts to build inclusive practices within IP members to recognise and intentionally address interlinked institutional issues. Consequently, this curbed farmers' potential benefit from technological changes, as also noted in participatory technology development approaches (Sterk et al., 2013) and seems common limitation of IPs led by research organisations that favour researcher-led on-farm experimentations (Cullen et al., 2014; Schut et al., 2016). The actors leading IPs were often influencing its agenda according to their organisational mandate and urgency to meet project milestones, which has also been observed in government-led platforms (Seifu et al., 2022). This echoes concerns expressed by Schut et al. (2016), about the concept of "old wines in new bottles", questioning whether IPs reinforce or challenge the predominant technology-push paradigm. In the multilevel IPs we studied the established institutional mandates, funding arrangements and power imbalance prevailed, which favoured on-farm technical changes over enabling institutional conditions.

Ensuring the sustained inclusivity observed in diagnostic studies highlights the necessity not only to decentralise the learning processes, but also resource-allocation and decision-making processes to lower-level IPs. This approach is vital for enhancing farmers' inclusion and ensuring demand-driven knowledge production with complementary and ongoing role of higher-level IPs in addressing institutional challenges encountered by and beyond the capacity of lower-level IPs (Hounkonnou et al., 2018). Platform-led innovation funding to provide resources to encourage lower-level IPs to independently identify and implement their own solutions could prove beneficial in this regard, as noted by Schut et al. (2016).

Rather than exclusively depending on diagnostic studies to prioritise innovation agendas at the national IP level, it is crucial to also involve farmers in national IP meetings to enable farmers to share their challenges and emerging issues firsthand (Lema et al., 2023). In addition, allocating financial resources to facilitate the identification and strategic engagement of key decision-makers at higher levels to allow experimentation with institutional changes. For instance, key higher-level decision-makers 'champions for change', who are willing to go beyond existing structure for change, can be identified and engaged in multilevel IPs to address or modify domain-specific, such as livestock, institutional constraints or create new conditions that enable smallholder farmers to seize opportunities, as emphasized by Hounkonnou et al. (2018).

For long-term sustainability of innovation outcomes beyond short-term projects, securing continued funding for IPs established by previous projects is a valuable approach to empower local actors assume leadership role and ownership. This is demonstrated by the Humid tropics project in Ethiopia, which adopted IPs initially established by the Nile Basin Development Challenge (NBDC) project to continue addressing emerging issues in sustainable natural resource management that require long-term partnership and resources (See Lema et al., 2016).

Researchers and farmers have contrasting views on how successful the project was in terms of livestock feed innovations during the performance phase. CGIAR researchers viewed it as successful in that they received funding for scaling these technologies in the continuation of Africa RISING. In contrast, the feedback that we received from most farmers was that some of the feed technologies were unaffordable and economic return from investment in the feed technologies was unrealised. This implies the need to incorporate inclusive assessments in future IP processes, with an emphasis on capturing the perspectives of those being sought for inclusion, including women and non-FRGs, using adaptive reflexive monitoring, evaluation and learning to inform the direction of the innovation but also help to measure impact (Klerkx et al., 2010).

Our results reveal that local power dynamics influenced farmer selection in multilevel IPs, affecting the inclusivity of participation in FRGs, where technologies were not tailored to the diverse needs of farmers groups. Local government organisations, like research institutions, face pressure to demonstrate success, indirectly putting development agents under pressure to continue select model farmers they are accustomed to working with from government and other projects, a practice also observed by de Roo et al. (2019). Model farmers continue to be favoured by both research and government organizations because they are well-connected, resourceful, and often willing to take risks by experimenting with new technologies. Additionally, these model farmers possess experience working with government and other projects, making them attractive choices for collaboration, with the consequence of excluding farmers not meeting these criteria (de Roo et al., 2019).

Paying attention to such local power dynamics within a specific-country context in which the broader innovation system operates, like in Ethiopian case (Cullen et al., 2014; de Roo et al., 2019; Seifu et al., 2022), is important for understanding higher and community-level inclusion and exclusion issues. Development agents selecting farmers for FRGs, and on-farm trials applied a similar approach used in conventional research and extension, i.e., they chose “model” farmers to achieve early wins and based on the assumption that other farmers would simply follow their lead. This behaviour points to the existence of representation injustice (Rahman et al., 2023), where local participation is negotiated by non-local actors. For the multilevel IP structure to promote inclusive innovation, more attention is needed to understand local dynamics in farmer selection, avoiding perpetuating existing exclusionary patterns.

This finding on the existence of local dynamics underscores the need to strengthen feedback loops for diverse perspectives in assessing farmers’ level of inclusion by the IPs, including from non-participating farmers (non-FRGs), and expand efforts beyond existing structures and network of farmers such as model farmers to ensure fair representation of diverse social groups during farmer selection. For instance, the diagnosis activities intentionally avoided existing structure and involved diverse groups of farmers (women, youth, men) for inclusive representation to understand the challenges and opportunities facing each group (Ellis-Jones et al., 2013), and similar approach could be applied to select farmers involved in FRGs.

In our view, systems of project funding need to be adapted to allow experimentation with stronger feedback loops during the implementation and performance phases. This would address not only technological and farm-level issues, but also institutional issues identified by FRGs, non-FRGs and lower-level IPs as hindering inclusivity in the innovation process. It requires intentional and strategic engagement with key value chain actors and stakeholders, including excluded groups such as private sector actors and non-FRGs, as well as different social groups to enhance the scaling of new technologies (de Roo et al., 2019). Lamers et al. (2017) recommended rather than equal participation, focusing on compositional dynamics, where, for instance private sector actors would be involved when opportunity for business emerges, to address emerging issues effectively. Thus, we envision a multilevel IP structure (Level 5, inclusion of structure), employing adaptive management of the innovation system (Klerkx et al., 2010) and integrating a value chain approach (Ayele et al., 2012) to guide strategic stakeholder engagement and facilitate an inclusive and reflexive innovation process. The limitations of multilevel IPs in shaping the institutional context and the necessity to monitor actions for unintended consequences underscore the importance of adaptive and reflexive monitoring (Klerkx et al., 2010). This is crucial for helping platform members reassess their actions and respond to inclusion and exclusion as well as emerging issues while acknowledging the importance of incorporating diverse perspectives beyond the multi-level IP direct participants. In this approach, emerging technical issues would inform coordinated actions at the lower-level IPs, while the institutional barriers to resolving these issues would be iteratively addressed by the national-level IP as they arise. Such theoretical integration helps to support the co-evolution of diverse forms of institutional, organisational, and technological innovation (Kilelu et al., 2013).

Our interpretation of Heeks et al. (2014) inclusive model suggests that achieving inclusivity in multilevel IPs (Level 5) relies on the inclusion level achieved in the inclusion of diverse groups of farmers in innovation processes (Level 4). One of the broader implications here is that while multilevel IPs primarily serve as a means of connecting people and ideas across various levels, more attention is needed on how they simultaneously interact and are influenced by the overlooked institutional context in SSA through challenging the current predominant paradigm on technology-transfer approaches in order to effectively support inclusive innovation (Hounkonnou et al., 2012).

6. Conclusions

The Africa RISING project in the Ethiopian Highlands, and particularly its livestock feed innovation program, served as the case study for our research. In this article we examined whether a multilevel IP structure integrating lower-level and higher-level IPs succeeded within this case in supporting an inclusive innovation process. Promisingly, the innovation process commenced in an inclusive manner. Participatory diagnostic studies were completed to articulate the demands of diverse groups of farmers and value chain actors, and to identify issues on farms, within value chains and with institutions requiring attention if the innovation process were to be become truly inclusive of poor and otherwise marginalised farmers. Decentralization of learning activities facilitated by the multilevel IP structure did succeed in enhancing farmers' technical knowledge around feed and forage development. However, striking a balance between decentralized, inclusive processes and donor expectations of compliance with tight project timeframes emerged as a challenge. Sustaining inclusivity in the process was challenging given these tensions. The entrenched nature of the wider institutional context within which the multi-level IP structure operated meant that ultimately the project's focus shifted back towards a researcher-led technology transfer process and away from addressing the research priorities raised by participating farmers; namely, tackling institutional barriers to inclusive innovation, and identifying how farmers might better access value chains to benefit more successfully from the introduced technologies. Operationalizing multilevel IPs for inclusive innovation certainly requires a focus on resource adaptation, strategic partnerships, diverse farmer participation, and reflexive practice of learning. Paying attention to the limitations of the IPs in challenging deeply entrenched traditional paradigms, suggests that a deeper system-level transformational change approach aligned to the Level 6 (*post-structure*) inclusion ladder is required.

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