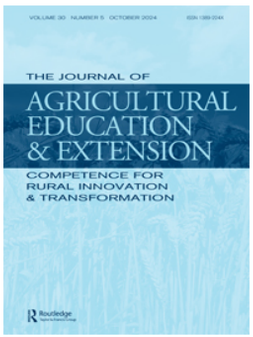

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Competences for socio-ecological stewardship: a qualitative assessment of the transformative potential of farmers' learning processes in Eastern Uganda

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ABSTRACT

Purpose: This paper identifies socio-ecological stewardship competences that smallholder farmers in the Manafwa watershed in Eastern Uganda, developed by participating in a project founded on the Participatory Integrated Planning approach.

Methodology: A case study approach was applied. Data were collected by interviewing smallholder farmers and PIP trainers; observing farm practices and PIP training sessions; and conducting focus group discussions. Data were analysed thematically, inspired by the environmental competence model of Roczen, to identify socio-ecological stewardship competences.

Findings: The study identified socio-ecological stewardship competences comprising different sustainability-related dimensions including: 'environmental knowledge' as environmental systems, action-related, effectiveness, social, and ethical knowledge; 'connection with nature' as establishing an identity with nature, appreciating the value of nature, social, and ethical attitudes; and 'ecological behaviour' as conservation and restoration, social, and ethical actions.

Practical implications: Competence dimensions are interconnected thus requiring learning environments that develop them simultaneously. Additionally, social and ethical competences are relevant for supporting stewardship action.

Theoretical implications: This study expands Roczen's environmental competence model by including social, ethical, and conservation and restoration action competences.

Originality/value: This study is the first to identify socio-ecological stewardship competences and the learning processes that can foster these competences.

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1. Introduction

Contemporary sustainability challenges such as biodiversity loss, pollution, and land-use changes call for new ways of understanding, caring, and acting for soils, water, and land (Wals 2019; Folke, Chapin, and Per 2009). Stewardship appears to be a promising concept for fostering such alternative ways of thinking, caring, and acting towards sustainability (Wals 2019; West et al. 2018). From previous studies, stewardship has yielded several definitions (Folke et al. 2016; Cockburn et al. 2019). Welchman (2012) defines stewardship as the responsible and ethical care for the natural environment that requires active protection and preservation of ecosystems, wildlife, and natural resources to benefit current and future generations. This definition connotes sustainable relationships between humans and the environment which ensure that peoples' and the Earth's needs are sustainably catered for by good-willed people (Bennett et al. 2018). Thus, the practice of stewardship arises out of moral concerns and values (Nyamweru et al. 2023) next to the knowledge for action (Kevany 2007), and the agency to engage in collective action and influence change (West et al. 2018).

Socio-ecological stewardship is a form of stewardship focusing on enhancing ecosystem resilience and sustainable provision of ecosystem services for human beings. Founded on the transformative stewardship style (Mathevet 2018), the socio-ecological stewardship stance suggests that the resilience of a system can be enhanced through science and social learning. This stewardship typology focusses on stakeholder values, norms, well-being, and socio-ecological interdependencies which promote a plurality of perspectives (Mathevet 2018). Barriers to engaging in socio-ecological stewardship include a general lack of stewardship competences such as environmental knowledge (Kevany 2007), a connection with nature (Roczen 2011), and adequate resources (van den Berg et al. 2021). Learning processes that enhance environmental knowledge, attitudes to care, and pro-environmental behaviour are therefore critical for securing stewardship competences that guarantee sustainable inter-dependence between, for instance, farmers and the environment and enable connection with nature.

Moreover, such a transformative stewardship style requires the development of new mindsets to undertake appropriate collective actions for stewardship, thus the need for interventions to explore the value system of potential stewards (Mathevet 2018). Although rural communities are expected to be stewards of the natural l resources within their surroundings (Cockburn et al. 2019), existing literature on environmental stewardship (e.g. Welchman 2012; Folke et al. 2009; Bennett et al. 2018; Cockburn et al. 2019) does not identify the competences required by communities to participate as stewards or the processes by which these competences can be developed. This study attempts to address this knowledge gap by exploring the socio-ecological stewardship competences using the experiences of farmers who participated in a project that utilized the Participatory Integrated Planning[1] (PIP) approach to restore a degraded environmental catchment.

The Manafwa Watershed Restoration and Stewardship (MWARES) project applies the PIP approach to develop socio-ecological stewardship competences among farmers within the Manafwa watershed in Eastern Uganda. PIP constitutes a non-formal learning approach that supports farmers in learning to address socio-ecological sustainability challenges in their context through awareness raising about their current situation and inspiring collective actions to address these challenges. The PIP learning processes

focus on enabling farmers as individuals and as a collective to become better stewards of their land (Kessler, van Reemst, and Nsabimana 2020).

There is evidence that the PIP approach enables farmers to become competent stewards of their land (Misanya et al. 2023). However, the specific competences developed and how these competences are cultivated remain unclear. This study therefore aims to identify socio-ecological stewardship competences developed by PIP farmers and the process by which they are developed, by utilizing and further building on the environmental competence model of Roczen (2011). This model focuses on the connections between 'environmental knowledge', 'connection with nature', and 'ecological behaviour'. Three sub-research questions are thus used to unravel the socio-ecological stewardship competences developed by farmers who participated in the PIP learning processes: (1) What new knowledge do smallholder farmers develop? (2) What new relational attitudes do smallholder farmers cultivate? and (3) What new/improved behaviours do smallholder farmers exhibit?

This study applied a case study approach to analyse stewardship competence development among smallholder farmers. These farmers and their trainers (JAs) participated through interviews, focus group discussions, and observations. The study provides ingredients for reflection by educators, educational researchers, and practitioners, regarding socio-ecological stewardship competences and the transformative process by which these competences can be developed.

2. Theoretical framework

As stated earlier, this study draws inspiration from the environmental competence model of Roczen (2011) as a conceptual lens to guide the exploration of socio-ecological stewardship competences developed by smallholder farmers through the PIP learning processes. This model was utilized because related key works on stewardship did not reveal other more appropriate models for analysing socio-ecological stewardship competences. For example, existing works focus on; sustainability competences (Bianchi 2020), competences for agricultural change-agents (Nyamweru et al. 2023), competence framework for improving productivity of smallholder farmers (Tarekegne et al. 2021), biosphere stewardship (Folke et al. 2016), analytical framework for local environmental stewardship (Bennett et al. 2018), principles of ecosystem stewardship (Folke et al. 2009), and social-ecological stewardship (Mathevet 2018). We further selected Roczen's model because its three competence dimensions of 'environmental knowledge', 'connection with nature', and 'ecological behaviour', align well with the PIP dimensions of learning to know, learning to care, and learning to do (Wals 2019; Misanya et al. 2023). Also, Roczen's model is a tested model created from an empirical study of environmental competence development. This model is inspired by the general environmental competence model of Kaiser et al. (2008) and can accommodate socio-ecological stewardship competences. Roczen's model conceptualizes 'ecological behaviour' as an outcome of 'environmental knowledge' and 'connection with nature'. Thus, these dimensions are interconnected and interdependent (Roczen 2011).

'Environmental knowledge' provides an intellectual basis for a 'connection with nature' and 'ecological behaviour' (Roczen 2011). From this perspective, the study investigated what farmers were taught and learnt about stewardship. Roczen uses three

'environmental knowledge' competences as categorized by Kaiser and Fuhrer (2003) namely; *systems knowledge*, *action-related knowledge*, and *effectiveness knowledge*. *Systems knowledge* captures knowledge regarding how the environmental system and natural processes operate, hence an individual's ability to make connections between and among environmental aspects. *Action-related knowledge* includes knowledge about alternative actions required to address ecological challenges. *Effectiveness knowledge* includes knowledge about how to best achieve resource conservation and make choices of actions from several options – choosing effective 'ecological behaviour'.

'Connection with nature' is conceptualized as care and relational values (West et al. 2018; Enqvist et al. 2018) that espouse peoples' predispositions and mindsets towards connecting with other human beings and the natural environment. 'Connection with nature' forms the motivation to seek more 'environmental knowledge' and engage in (positive) 'ecological behaviour' (Roczen 2011). This connection appeals to an individual's appreciation of nature and ecological ethics (Cockburn et al. 2019). 'Connection with nature' is underpinned by *appreciating the value of nature* (inherent and instrumental value) and *establishing an identity with nature* (the feeling of being part of nature) underpinned by the perceived values of nature (Schultz 2002). 'Connection with nature' inspires one to seek (more) environmental knowledge and to act (Roczen 2011).

'Ecological behaviour' entails environmental-related actions that individuals decide to undertake or not as influenced by general 'environmental knowledge' and 'connection with nature' (Roczen 2011; Bennett et al. 2018). In the MWARES project context, stewardship actions refer to activities, practices, or initiatives farmers engage in to conserve and restore the Manafwa watershed. Vice versa, 'ecological behaviour' can trigger the search for 'environmental knowledge' and enhance a 'connection with nature'.

3. Materials and methods

3.1. Study context

The PIP approach focuses on participatory, transformative, and dynamic vision-building, and multi-generational learning between farmers (Kessler, van Reemst, and Nsabimana 2020). Through the vision-building process, the approach facilitates farmer households to map their current and desired farm and household situations, which motivates them to engage in action-planning to achieve their desired situation. The vision-building process is guided by principles of collaboration, empowerment, and integration to support farmers to transform their lives, engage in sustainable practices, and become stewards of their resources (Kessler, van Reemst, and Nsabimana 2020).

The first generation[2] of PIP farmers (G1s) is selected by community members and trained by project staff (Junior Agronomists – JAs) to make an integrated plan for the farm/household. After completing the PIP learning cycle, each G1 must train 8–10 farmers who form the second generation (G2s). G2s also select and train – the third generation of PIP farmers (G3s). Guided by the theoretical framework presented earlier, this study considered the 3 PIP farmer generations as units of analysis to decipher the socio-ecological stewardship competences cultivated through the PIP approach.

The study was conducted in the Manafwa watershed in Bududa district located in Eastern Uganda. The study sites were the three villages of Nekoshe, Elgon, and

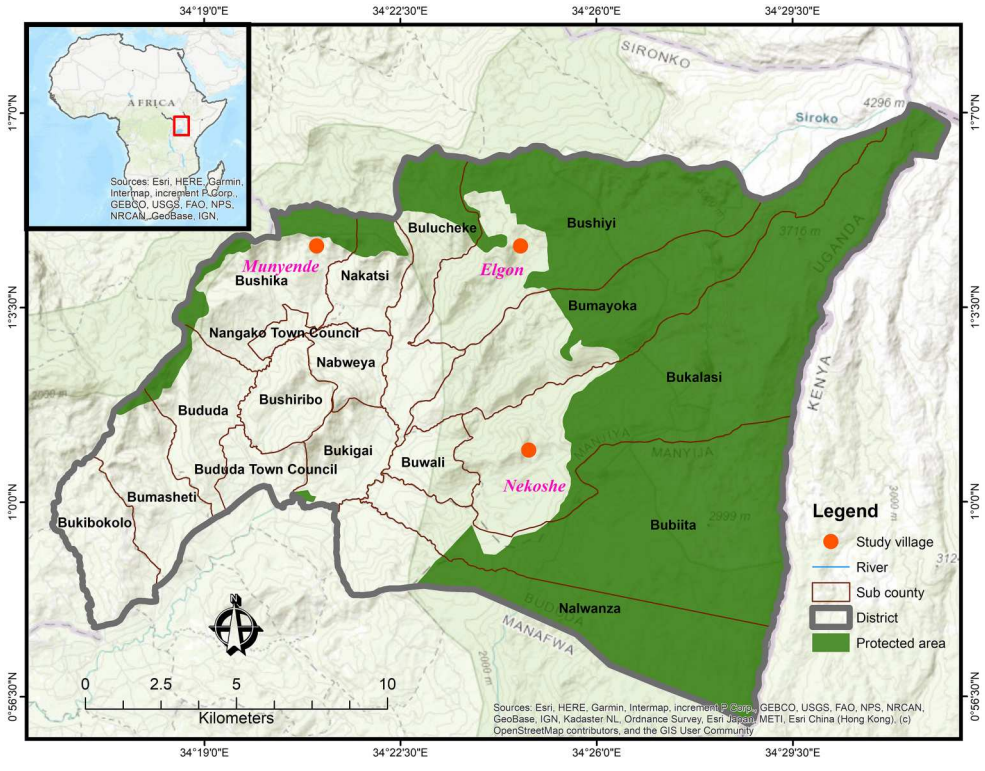

Figure 1. Map of Bududa District showing areas of study 'near here'.

Munyende (Figure 1) where the PIP approach has been implemented for three years by the MWARES project. At the time of this study, the PIP approach was the only known non-formal learning intervention in the study sites.

3.2. Data collection

A qualitative case study approach (Peel 2020) was applied in the investigation. The data collected aimed to assess MWARES project's impact on farmers' stewardship competence development. The assessment was based on the MWARES project baseline report (MWARES 2020) and feedback from key stakeholders (experiences and perceptions of farmers and PIP trainers) elicited from a combination of tools namely semi-structured interviews, observations, and focus group discussions.

Eighteen farmers (six from each of the three PIP generations) were purposely and conveniently selected from the three villages to participate in the study through semi-structured interviews. The initial selection was based on their observed engagement during PIP trainings and sensitization workshops. It was anticipated that these farmers had a rich experience of the PIP approach and were thus well positioned to share insights. Although most farmers were actively engaged, geographical accessibility eventually influenced their participation in the study. Using semi-structured interviews, we harnessed the personal experiences of the selected farmers by asking them questions about environmental knowledge development, relational attitudes, and the different

actions they were engaging in because of PIP learning processes. G1s were interviewed first, then they identified the G2s to be interviewed. The G1s and G2s identified G2s and G3s respectively, from their trainees based on geographical accessibility, and active participation in PIP trainings. Additionally, the three project JAs (trainers) were interviewed about their experiences regarding the training content, the learning process, and the outcomes of the trainings. Each interviewee endorsed an informed consent form. After interviewing 12 farmers in two villages, data from 6 farmers in the 3rd village seemed repetitive but confirmatory. Thus, data saturation (Saunders et al. 2018) had been achieved. All interviews were recorded and transcribed, while those conducted in the local language were translated into English.

One hundred and eighty (180) farmers were observed in six PIP training sessions (25-35 farmers per session) to gain a deep understanding of the learning context and establish the knowledge and attitudinal competences being cultivated as well as the process by which these competences are cultivated. Also, observations of farm practices were made to validate farmers' claimed individual and collective learning.

In each village, a focus group discussion (FGD) was conducted with 6–12 G1 farmers to triangulate information obtained through interviews and observations. G1s were selected for FGDs because they had completed the PIP learning cycle and started to implement some practices. Twenty-eight farmers participated in three FGDs during which we engaged participants to determine their perspectives about the new/improved environmental knowledge, new/improved connection with the watershed, and the new/improved practices that they developed by participating in PIP training. FGDs were recorded, transcribed, and translated into English. Because we did not aim to trace data from FGDs to particular participants, we generally refer to these participants as farmers while quoting them in the results section.

FGDs, observations, and interviews with farmers and JAs were broadly aimed to ascertain individual and collective perspectives about what farmers learnt and features of the PIP approach that supported that learning.

3.3. Data analysis

Thematic data analysis (Peel 2020) was used, guided by the environmental competence model (Roczen 2011) earlier introduced within the theoretical framework section. Data analysis focused on scrutinizing the data set to identify stewardship competences within the three dimensions of 'environmental knowledge', 'connection with nature', and 'ecological behaviour'. For each dimension, the identified competences are, partly, those already suggested in the theoretical framework and partly those that emerged from data coding and analysis. We identified codes from interview transcriptions of similar statements from several farmers and JAs, FGDs, and observation notes. These codes were categorized into themes describing socio-ecological stewardship competences.

4. Results

Based on analysis of data from interviews, FGDs, and observations, this study categorized socio-ecological stewardship competences developed by farmers into the dimensions of

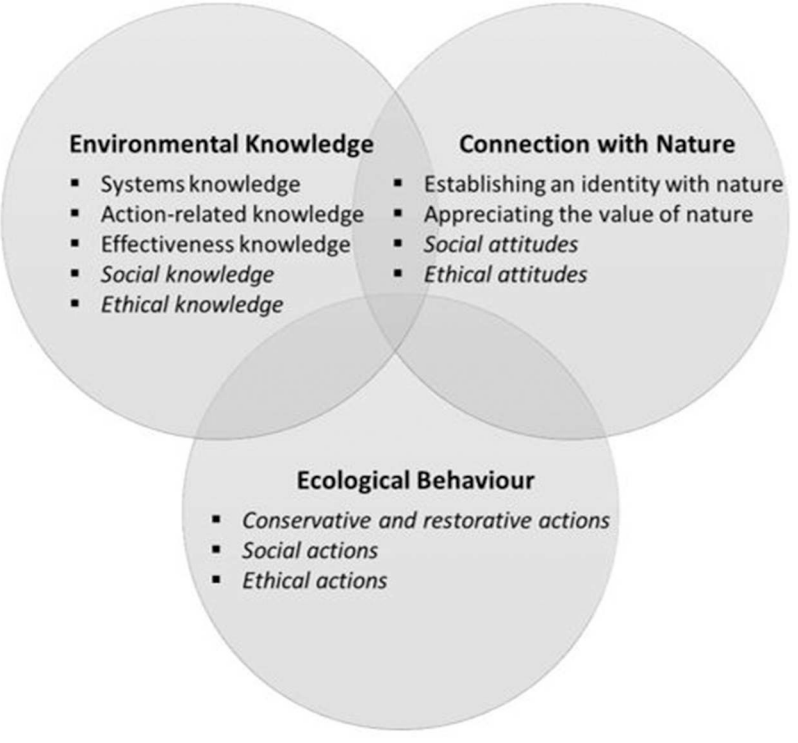

Figure 2. Competences for socio-ecological stewardship (near here).

'environmental knowledge', 'connection with nature', and 'ecological behaviour'. In addition to the existing competences within those dimensions, this study identified *social* and *ethical* competences, and *conservation and restoration actions* as integral socio-ecological stewardship competences. These competences are presented in Figure 2 below.

4.1. Environmental knowledge

Under this dimension, smallholder farmers engaged in learning to know and developed competences as summarized in Table 1.

These competences are explained below.

Table 1. Environmental knowledge competences.

Environmental knowledge competence	Competence description
Systems knowledge	Knowledge of the general environmental context and the relationship between different environmental aspects and natural processes.
Action-related knowledge	Knowledge about conservation and restoration alternatives.
Effectiveness knowledge	Knowledge about choosing the most effective ecological behaviour (environmentally suitable actions).
Social knowledge	Knowledge about collaboration and collective actions.
Ethical knowledge	Understanding and applying moral principles and values (discipline towards self, towards others, and the environment).

4.1.1. Systems knowledge

During FGDs, farmers repeatedly indicated that they developed knowledge about the importance of conserving the watershed and how the watershed affected their farms. Interviews with farmers and JAs showed that farmers developed knowledge about the causes, effects, and mitigation of Manafwa watershed degradation. Farmers also expressed awareness of their contribution to degradation through their farming and sanitation practices. For example, G1_15 said

> We now know that the way we do farming has spoilt the river … if we do not make trenches on our farms, erosion will become much and continue spoiling the river … .

The participatory awareness-raising sessions that characterized PIP trainings contributed to farmers' development of *systems knowledge*. These sessions enabled farmers to verbalize their ecological challenges, a process through which they discovered the interconnections between different aspects within their context thereby transforming their viewpoints about the watershed. Further, awareness-raising about soil erosion (causes, consequences, management), connections between farming methods and watershed pollution, and how the watershed also affected their farms, supported the development of *systems knowledge*.

4.1.2. Action-related knowledge

Action-related knowledge included restoration knowledge, alternative livelihood knowledge, action-planning knowledge, and farming knowledge. Restoration knowledge included knowledge for regenerating the watershed (making trenches, planting trees/grass, and sanitation/hygiene practices). Knowledge of alternative livelihood strategies was aimed at reducing dependence on crop farming. This knowledge ranged from crop diversification and integration on the farm to engagement in non-crop growing activities (beekeeping, poultry keeping, cattle raring). During PIP trainings, it was observed that farmers were facilitated to learn about action-planning (goal/target setting, resource identification, and task/role allocation) to achieve their plans. Farming knowledge comprised proper farming and land management practices. From FGDs, farmers mentioned practices including mulching to conserve soil moisture, making trenches to control soil erosion, processing and applying organic manure, and integrating crops and livestock on the farm. On integration, a farmer narrated,

> I did not know that I could do so much with my small piece of land until I learnt about integration, I realized that I could plant crops that support each other, rear animals, keep poultry, and ensure that these activities benefit from each other (G1_17).

During PIP awareness-raising sessions, it was observed that farmers learnt about their contextual challenges and participated in generating solutions for them. The sessions featured experience sharing that boosted most farmers' enthusiasm to practice with new knowledge. Training sessions on SWOT analysis supported understanding of the farm situation while sessions on action-planning triggered most farmers to generate ideas for alternative livelihoods, plan for household income management, and envision an improved future for their households and the watershed.

4.1.3. Effectiveness knowledge

Effectiveness knowledge comprised knowledge to identify and propagate indigenous/non-indigenous trees appropriate to the local context; integrate on the farm to maximize productivity while enhancing soil quality; process and apply organic manure; articulate benefits from new/improved farming practices (e.g. during interviews, many farmers indicated a reduction in river bank erosion due to collective restoration activities); identify their responsibility towards restoration; seek knowledge and articulate their learning needs towards better watershed stewardship. Regarding seeking knowledge, a farmer said,

> We know from the training that we should be people who seek knowledge on the crops that we plant, where we sell our produce, the seeds we plant, and other aspects of our farms (G1_08).

Opportunities for experience sharing, exchange visits, peer-to-peer consultations, and technical training, enabled farmers to reflect on their practices and start identifying and experimenting with (proven) practices for restoring the watershed and improving their livelihoods. For example, farmers learnt to identify, propagate, and care for indigenous tree species to enhance the green cover of the watershed. Similar to observations, interviews and FGDs showed that farmer-to-farmer training enhanced knowledge for making suitable trenches.

4.1.4. Social knowledge

Social knowledge was observed as farmers actively generated ideas during vision-making and action-planning, and further re-echoed during FGDs where G1s narrated that they had learnt the significance of teamwork for addressing socio-ecological challenges. Yet, farmers said that before engaging in PIP training, there was minimal effort to collaborate for watershed conservation and restoration. Farmers and JAs thus indicated knowledge development on the need to collectively undertake restoration activities, build mutual trust, share knowledge, offer peer support, and the motivation to participate and create impact. Over half of the farmers acknowledged the need to work together as no one can singly make a trench. On collective restoration activities, G1_15 emphasized,

> I have learnt that watershed restoration does not concern me alone but all of us … each of us needs to contribute to improving the watershed.

Social knowledge developed by farmers was founded on the PIP principle of collaboration. The PIP approach inherently targets the sensitization of farmers about the value of building trust and synergies for collective action. During interviews and FGDs, farmers indicated that learning about collaboration facilitated knowledge-sharing, appreciation, and utilization of diverse experiences/knowledge, reflection on their experiences, and envisioning possibilities to accomplish seemingly overwhelming tasks through peer support and collective action. *Social knowledge* strengthened farmers' determination to make and implement action plans and undertake collective restoration activities.

4.1.5. Ethical knowledge

Ethical knowledge espoused the knowledge on making a personal decision to care for the watershed and indulge in environmentally friendly habits (proper waste management,

avoiding deforestation, using fuel-saving mechanisms), keeping a cooperative relationship with others (peer support, respectful communication), being committed and responsible for restoration (as opposed to thinking that it is the government's responsibility), and protecting the river from pollutants. To demonstrate responsibility, G3_02 said that they learnt about their responsibility of caring for the watershed and further acquired *action-related knowledge* from PIP training sessions that bolstered their confidence to execute that responsibility,

> I know that I am responsible for implementing what I have been taught in PIP for watershed restoration … I cannot just sit on such knowledge.

PIP awareness-raising sessions regarding the value of the watershed, land degradation, and landscape restoration within the watershed made the relationship between watershed and human wellbeing more apparent and fostered critical reflection among the farmers. Farmers became aware of their contribution to watershed degradation and their attendant responsibility for its restoration. By fostering reflection, these sessions enhanced farmers' *ethical knowledge*, thereby transforming their focus to increased responsibility towards the watershed.

4.2. Connection with nature

Under this competence dimension, farmers engaged in learning to care and developed relational attitudes as summarized in Table 2.

These competences are further elaborated

4.2.1. Establishing an identity with nature

Establishing an identity with nature espoused feelings of pride and confidence in restoring the watershed and being associated with it. For example, identifying with the river was expressed by a farmer during an FGD,

> I know that the river is ours and that water is our life. When this river flows, there is some fresh air that it brings us each morning and it feels nice, I cannot explain the feeling … I am more dedicated to caring for the river.

The PIP vision-building process of mapping the current and desired situation of the community within the watershed and, place-based learning (from the watershed itself) triggered farmers' awareness and feelings of empathy towards the dilapidated state of the watershed. Additionally, learning about the affordances of the watershed to their well-being enabled farmers to comprehend the watershed

Table 2. Connection with nature competences.

Connection with nature competence	Competence description
Establishing an identity with nature	Development of feelings of being part of the environment (nature)
Appreciating the value of nature	Development of feelings based on the inherent and instrumental values of the watershed
Social attitudes	Willingness to work with others for watershed restoration conservation
Ethical attitudes	Discipline towards self, towards others, and maintaining a good relationship with one's environment

as an integral part of their lives with which they could proudly identify. Consequently, farmers verbally expressed enthusiasm and commitment to restoring the watershed.

4.2.2. Appreciating the value of nature

Appreciating the value of nature captured feelings of care towards the watershed. Through interviews and FGDs, farmers expressed more determination and willingness to care for the watershed than before. Appreciation and care developed from the knowledge of the geographical scope of the watershed, going to the river and observing its state, appreciation of the benefits of the watershed to livelihood aspirations, and knowledge of potential risks if restoration actions are not undertaken. Like many other farmers, G1_11 pledged,

> Now I have to be more friendly with the river so that it doesn't take my soil to Butalejja and … if this river is not looked after, its continuous contamination or flooding can kill us.

From PIP awareness-raising sessions, farmers broadened their view of the scope and contribution of the watershed to their sustenance. This made farmers realize a deeper appreciation of the watershed and were willing to seek knowledge and undertake actions for watershed restoration.

4.2.3. Social attitudes

Social attitudes were illuminated during PIP trainings in which farmers were observed as becoming more sociable and willing to engage in collaborative actions (peer support/consultation, knowledge sharing, and being empathetic) to restore the watershed. For example, during the training on village vision-building and action-planning, farmers contributed ideas for improving the watershed. Emphatically, a farmer expressed,

> After the training, for us uphill, we started to think about how what we do affects our watershed and our friends down there (G1_17).

PIP training sessions on collaboration, peer support, and community cohesiveness contributed to *social knowledge* which in turn facilitated the development of *social attitudes*. More farmers were willing to support their spouses and to work with peers towards watershed restoration.

4.2.4. Ethical attitudes

Ethical attitudes were captured through interviews when farmers expressed determination, a sense of ownership, and responsibility for watershed restoration. For example, during an interview, G1_11 said

> Nobody will come from down there to take care of it … it is us who have the responsibility to restore this watershed.

Ethical attitudes were fostered by the development of *ethical knowledge,* inspirations from the PIP training, and experience sharing (positive stories). Consequently, most farmers expressed determination to restore the watershed and committed to etiquettes such as not excreting near/ in the river, monitoring the actions of others, and reporting

to authorities those who engage in river-degrading activities. Further, farmers acknowledged their contribution to watershed degradation and thus developed attendant responsibility and willingness to take on restoration roles.

4.3. Ecological behaviour

This competence dimension encompassed what farmers learnt to do based on their developed 'environmental knowledge' and 'connection with nature' influenced by engaging in PIP training, summarized in Table 3.

These competences are elaborated.

4.3.1. Conservation and restoration actions

These actions comprised farming actions sub-categorized into land management practices (use of organic fertilizers, mulching, digging trenches, agroforestry) and crop management practices (crop spacing, animal/crop integration, pest/disease management). In Elgon village, some farmers had started practicing mulching and making trenches to control erosion. From interviews, G2_01 explained,

> Back then, I planted my crops anyhow, but now I plant in lines, and my garden is very organised. Even when it rains, water has a path. I have made good trenches, and I expect a good harvest …

Conservation and restoration actions were supported by the development of 'environmental knowledge' and 'connection with nature' competences. Change in practice is further linked to aspirations, action plans, and enhanced enthusiasm to implement action plans for the improvement of their farms and the watershed. For example, from observations, most farmers had started limiting cultivation within the recommended distance from the river and utilising energy-saving stoves to reduce deforestation.

4.3.2. Social actions

Based on observations during PIP training, farmers freely shared experiences about farming challenges and possible solutions. At the farm level, farmers exchanged tools, knowledge, seeds/seedlings, and labour. The G1s collaborated with peers to train the G2 farmers. Collaborative training enabled farmer trainers to morally support each other and ensured the dissemination of lessons learnt. As a *social action*, farmers established a tree nursery to propagate indigenous tree seedlings. Social and collective actions further manifested at the household level as a farmer explained

> There are activities I would leave for my wife, but as I went on learning, I started getting involved with the knowledge that home duties require us to help each other. I now support her fully (G1_08).

Table 3. Ecological behaviour competences.

Ecological behaviour competence	Competence description
Conservation and restoration actions	Practices undertaken to conserve and restore the watershed
Social actions	Collective actions and the support extended to/received from peers
Ethical actions	Actions undertaken based on moral principles to restore and conserve the watershed.

Social actions were facilitated by training about collective actions towards a common cause. This knowledge facilitated the development of synergies, community cohesiveness, and *social attitudes* (peer support and empathy) that influenced farmers to engage in actions such as jointly making a village PIP, opening community roads, and making trenches.

4.3.3. Ethical actions

By *appreciating the value of nature*, acknowledging their contribution to watershed degradation, and understanding connections between different environmental aspects, farmers developed *ethical attitudes*. As indicated by interviews and observations, farmers subsequently engaged in *ethical actions* by expressing commitment, determination, and deciding to engage in watershed conservation and restoration.

Ethical actions were fostered by *ethical knowledge* and *ethical attitudes,* both of which were fostered through PIP awareness-raising sessions. Thus, more trained PIP farmers started to engage in *ethical actions* including, reporting, respectful communication, and being exemplary/inspirational.

5. Discussion

In this section, we discuss the interconnected nature of socio-ecological stewardship competences, emergent socio-ecological stewardship competences, and the transformative potential of the PIP approach.

5.1. Competences for socio-ecological stewardship

By conceptually drawing from the environmental competence model (Roczen 2011), we identified socio-ecological stewardship competences and nested them under the three dimensions of the model. As elaborated below, we confirm that the (interconnected) environmental competence dimensions of Roczen are significant for socio-ecological stewardship.

Our study findings resonate with existing literature which proposes that persistent and wicked sustainability challenges require stakeholders to develop new ways of understanding, caring, and acting (Wals 2019). The PIP approach attempts to develop these new ways by fostering 'environmental knowledge' and nurturing a 'connection with nature' among smallholder farmers, through contextual awareness raising, and supporting farmers to practice with new/improved knowledge. Since learning to know facilitates the process of in-depth knowledge-building around ecological, social, and governance issues (Misanya et al. 2023), it carries the potential to support conservation activities thereby underscoring the centrality of 'environmental knowledge' in influencing stewardship action (West et al. 2018). Similarly, a study undertaken in Ethiopia (Tarekegne et al. 2021) indicates that knowledge acquisition supports farmers' innovativeness to inquire, create, and experiment with new ideas. Besides, ecosystem stewardship requires continuous learning, knowledge generation (Folke et al. 2016), and mindset change (Kessler, van Reemst, and Nsabimana 2020) to enhance adaptability to changing ecosystems. Even so, the change in attitudes and practices is driven by knowledge sharing and reflection on one's relationship/connectivity with nature. The PIP approach supports

continuous learning and farmer-to-farmer knowledge sharing through participatory awareness-raising which subsequently reinforces knowledge development (Kessler, van Reemst, and Nsabimana 2020; van den Berg et al. 2021).

This study shows that the development of 'environmental knowledge' reinforced the competence of *appreciating the value of nature* which prompted farmers to develop aspirations and make action plans to undertake restoration actions such as the planting of indigenous trees. Also, increased environmental awareness motivated farmers to seek more knowledge, establish a connection with nature, explore alternatives to address ecological challenges, and experiment with new practices. Similarly, literature shows that diverse forms of environmental knowledge create a higher 'connection with nature' and trigger positive 'ecological behaviour' (Roczen 2011). Thus, knowledge increases awareness and creates an appreciation of the connection between sustainable livelihood, well-being, and care for the environment. Arguably, the development of relevant knowledge (Kevany 2007), can underscore the ability to engage in *conservation and restoration actions*. For example, this study showed that *systems knowledge* increases farmers' appreciation and recognition of the value of the watershed, and concern about its degradation. This activated their willingness, hitherto absent, to take responsibility for restoration.

The combination of 'environmental knowledge' with 'connectedness with nature' competences facilitates the collaboration and communication necessary for socio-ecological stewardship, and creates sustainable 'ecological behaviour' (Enqvist et al. 2018) Thus, we posit that the propensity to take on ecological actions arises from sufficient and relevant environmental knowledge that challenges dominant worldviews on the centrality of nature within sustainable well-being. Therefore, the interest to act is rooted in 'connection with nature' which facilitates a positive attitude and motivates further knowledge acquisition and action (Roczen 2011).

In practice, utilising the PIP approach for promoting stewardship actions in socio-ecological contexts implies learning processes that simultaneously develop environmental knowledge and shape attitudes, norms, and habits. In addition to 'environmental knowledge' and 'connection with nature', stewardship action should be reinforced by considering the unique contexts that influence the implementation of ecological ambitions. For example, literature (Bennett et al. 2018; van den Berg et al. 2021) shows that local stewardship action is influenced by the availability of local assets including social/cultural, financial, human, institutional, and physical capital assets that capacitate individuals or collectives to act. Therefore, in addition to developing competences simultaneously, there is the overarching need to initiate resource mobilization from a local level.

5.2. Emergent competences for socio-ecological stewardship

This study identified *social, ethical, and conservation and restoration action* competences as emergent competences that can expand and position the Roczen model as an analysis model for socio-ecological stewardship competences in rural settings.

Effective stewardship requires a departure from the ethic and ideals of stewardship held by individuals (and groups) to tangible actions based on that ethic (Cockburn et al. 2019). Thus, individual and collective actions comprised of corresponding 'ecological behaviour' (Folke et al. 2016) are necessary for addressing wicked ecological

challenges. Stewardship practice focuses on voluntary actions where people participate in natural resource management (Cockburn et al. 2019). In this study, the majority of smallholder farmers engaged in *conservation and restoration actions*, broadly categorized as land and crop management practices which are comparable to creating protected areas, replanting trees, restoring degraded areas, and reducing pollution which are encouraged for environment care (Bennett et al. 2018). For practice, learning processes should build upon and expand prior environmental knowledge, motivate, and facilitate the development of learners' self-efficacy (Sewell et al. 2017) to engage in, even seemingly small, stewardship actions that contribute to restoring and preserving their environment.

This study identified *social* competences that manifest in effective farmer-farmer interaction and cooperation (Tarekegne et al. 2021). Farmers revealed that through the PIP learning process, they developed collaborations to care for their watershed and undertake restoration actions. Relatedly, earlier literature (Folke et al. 2016; Kessler, van Reemst, and Nsabimana 2020) recommends multi-level collaboration that features a shared vision, guided by proper institutions where participants continuously learn, gain experiences, and build capacities to live with change, adapt, and transform their practices. Based on our study, farmers learnt to work as a team, support and be supported, and learn with and from others. Collaboration for collective restoration actions and environmental care is ingrained in shared morals and values (Welchman 2012) that underpin *ethical actions*. Farmers reiterated that individual actions, peer support, and cooperation would significantly contribute to watershed restoration. This is relatable to the inherent power in the synergy from collective efforts that yield positive ecological results given that the knowledge of degradation can be overwhelming for individuals (Wals 2019). Besides, learning together creates opportunities for dialogue (Sewell et al. 2017) around ecological challenges and subsequently fosters a shared moral responsibility for environmental care. Such learning should reconnect people with nature, change individual behaviours, and promote collective actions by integrating a range of values and responsibilities (Mathevet 2018). Moreover, a study undertaken in Burundi (Nyamweru et al. 2023) indicates that collaboration starts with the development of strong social ties and empathy. Through the PIP approach vision-building and action-planning processes, collaboration amongst farmers was fostered and farmers argued that without peer collaboration, positive ecological efforts would likely be hindered. The significance of *social* competences notwithstanding, collaborative/*social actions* significantly rest on an individual's inherent motivation and resource capacity to address their needs (Bianchi 2020)

At the centre of care and knowledge lies ethics (Enqvist et al. 2018). According to Welchman (2012), stewardship is not merely a practical matter, it is deeply rooted in ethics whereby human beings are morally obliged to utilize resources in consideration of future generations. Yet, stewardship depends on individual/group capacity and ethical motivations to act (Bennett et al. 2018) manifested by moral responsibility and commitment to environmental conservation (Nyamweru et al. 2023). *Ethical actions* require knowledge building in environmental-related ethics which underpin one's co-existence in nature with integrity. Without ethical knowledge, ethical deficiencies can arise, featuring disconnection from others, nature, and the core self (Kevany 2007). This ethics gap can be remedied by cultivating *ethical attitudes* and enacting values including taking responsibility for the environment and others (West et al. 2018;

Welchman 2012). Arguably, *ethical knowledge* and moral virtues (or *ethical attitudes*) contribute to modelling 'ecological behaviour' (Welchman 2012). This suggests the need to encourage ethical behaviour among stakeholders for effective stewardship practices (Folke et al. 2009). Consequently,, this study recommends further exploration of social and ethical concerns (co-existentiality, responsibility, proportionality, solidarity)to enhance socio-ecological stewardship.

Although implicit, *social* and *ethical* competences comprise core sustainability competences (Bianchi 2020); *social competences* resonate with the collaborative/interpersonal competences and further connect with the significance of collective efforts for effective stewardship (Cockburn et al. 2019) while *ethical competences* are captured under the normative competence that permeates other competences and emphasizes sustainability values, principles, goals, and targets. The importance of ethical competences also features in the works of Nyamweru et al. (2023) who describe stewardship competency as comprised of moral responsibility and commitment to environmental conservation.

5.3. The transformative potential of the PIP approach

This study expands the environmental competence model by suggesting innovative strategies for cultivating socio-ecological stewardship competences using insights from the PIP approach. The PIP transformative potential resides in the nature of the learning process which starts with awareness raising to transform farmers' knowledge regarding environmental interactions and the impacts of those interactions. For instance, farmers developed awareness of the impact of farming practices on the watershed and how the watershed impacts their farms. Further, PIP fosters *action-related knowledge* that engulfs various restoration options and opportunities for farmers to transform their actions. Also, the participatory training sessions, support from the trainers, farmer-to-farmer training, and experience/knowledge sharing, enable farmers to reflect on their pre-existing knowledge and consider other more *effective knowledge*. Moreover, farmer-to-farmer training is known in the literature (van den Berg et al. 2021), to facilitate farmers' transformative learning and farm improvement.

The vision-building and action-planning tool (Kessler, van Reemst, and Nsabimana 2020) distinguishes PIP from approaches such as the Farmer Field Schools. From our study, the visioning process in which farmers generate aspirations prompts them to reflect, verbalize, and map the current situation concerning their environment, relationships, and actions. The tool further supports generating aspirations, and mapping desired situations individually at the farm/household level and collectively at the community level. Mapping their situation creates uncertainties about the future and is therefore central to stewardship (Folke et al. 2009). Action-planning comprises setting goals and strategies for achievement (Cranton 2002). This tool thus enables farmers to envision possibilities for transforming their lives and improving their environment. For education practice, we suggest the application of the visioning and action-planning tool in rural contexts to nurture mindset changes towards more sustainable ones that spark agency for stewardship action.

The PIP approach develops farmers' *social knowledge* by emphasizing collaboration and collaborative activities that cultivate diverse knowledge forms and viewpoints

different from their own. This finding relates to the study by Sewell et al. (2017) who argue that collaborations create a sense of belonging, opportunities to learn from other farmers' successes and failures, and self-efficacy that stimulates farmers to apply new/improved knowledge. The synergistic outcome of such collaborations can underpin the motivation to care for nature. Besides, the diverse knowledge forms prompt farmers to critically reflect on their pre-existing knowledge and assumptions (Cranton 2002), a reflection that can bolster appreciation for reality and the development of new ways of thinking and acting (Wals 2019). In this study, farmers demonstrated new ways of thinking through enhanced enthusiasm to participate in improving their lives, the community, and the watershed.

5.4. Policy implications

Uganda's National Environmental Management Policy (NEMP) of 1994 emphasizes the need to protect, conserve, and restore ecosystems and biodiversity by engaging stakeholder communities (MWE-Uganda 2018). To facilitate such engagement in socio-ecological stewardship, we propose to strengthen environmental literacy programmes. This can be done by focussing on the development of *social competences* through the promotion of collaborative activities among stakeholders, *ethical competences* through ethical education, and *conservation, and restoration action competences* through the facilitation of *action-related knowledge*. Strengthening environmental literacy programmes would foster the implementation of the PIP approach in other socio-ecological contexts and support stewardship action.

The aforementioned emergent competences should be developed next to the competences in the environmental competence model (Roczen 2011) to generate a hybrid model for developing socio-ecological stewardship competences. Thus, a robust environmental policy should augment socio-ecological stewardship by boosting environmental awareness and steering community participation to achieve policy objectives embracing biodiversity conservation, climate change mitigation/adaption, sustainable land management, and forest conservation.

Furthermore, there is a need to institute monitoring strategies (van den Berg et al. 2021) to warrant the trustworthiness, currency, relevance, and impact of environmental information during awareness raising. This will enhance an appreciation for environmental information and elicit stewardship action in similar socio-ecological contexts.

5.5. Limitations

We acknowledge that our study approach had biases; (1) we lacked a reference standard as we did not undertake a baseline assessment of the stewardship competence level among farmers. Instead, we relied on the MWARES project baseline report (MWARES 2020) which is implicit on farmers' competence level. We focussed on farmers' and trainer's perceptions and feedback thus creating an experimenter bias. This bias can be averted by making a baseline assessment of competences, which was not possible because farmers had undergone several PIP trainings before this study; (2) Although most farmers demonstrated active engagement during PIP trainings, geographical accessibility influenced

participant selection for interviews. Expanding the study to include all participants could yield more robust results. Geographical barriers can be addressed using telephone interviews which we did not use due to poor network connectivity, (3) only 3 farmer generations and trainers were engaged in the study. New insights would have been obtained if the study had included other farmer generations. However, we worked with data saturation, and given that we did not aim to compare generations, we focussed on the 3 generations that had fully undergone PIP training.

6. Conclusions

We drew inspiration from the environmental competence model to interpret data from interviews, observations, and FGDs. Subsequently, we identified socio-ecological stewardship competences, and the process by which these competences are fostered among smallholder farmers hitherto not addressed in stewardship and competence studies. Moreover, our study confirms the relevance, interconnectedness, and interdependence of the three dimensions of the environmental competence model. Another innovative aspect of this study is the further expansion of the model to include *social, ethical, and conservation and restoration action* competences for socio-ecological stewardship. *Social and ethical competences* are found across the three competence dimensions while *the conservation and restoration action competences* are found within the 'ecological behaviour' dimension. *Social* and *ethical* competences add an extra yet explicit layer of the people dimension to the Roczen model by underscoring the significance of moral principles (towards self, others, and the environment) and collective actions for socio-ecological stewardship.

Although the environmental competence model was developed for Western contexts targeting children and youths, the additional competences arguably position it as a reliable framework for exploring farmers' stewardship competences in rural contexts. Future research could explore how these additional competences enrich the stewardship potential of smallholder farmers and other stakeholders.

Furthermore, the interconnectedness within the competence dimensions creates a cycle that continuously spirals towards stewardship action. Consequently, this study recommends that educators need to shift attention from facilitating learning for specific competence development to creating learning spaces that develop learners' competence development across dimensions. Such spaces should feature continuous learning, foster interaction and discovery, and nurture a sense of flexibility, reflective learning, and action-taking. Moreover, fostering such a learning process necessitates a relational approach that cultivates competences in their interconnectedness, where the whole is more than the sum of its parts. This reminisces the notion of learning ecologies (Jackson and Barnett 2019) which also requires capacity-building which underscores a holistic cultivation of socio-ecological stewardship competences.

This study contributes to stewardship literature by drawing inspiration from the PIP approach as a transformative learning intervention to suggest strategies for developing socio-ecological stewardship competences. For instance, by facilitating place-based and context-specific awareness raising, facilitating vision-building and action-planning processes, fostering relational attitudes, and steering motivation for participation Thus, the PIP approach as utilized by the MWARES project can be applied in similar contexts to advance learning for socio-ecological stewardship.

Notes

1. Participatory Integrated Planning formerly known as the Integrated Farm Planning approach.
2. A generation within the PIP approach refers to a cohort of learner farmers (Kessler, van Reemst, and Nsabimana 2020).

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