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COLLABORATIVE LEARNING OF WATER CONSERVATION PRACTICES: CULTIVATION AND EXPANSION OF A LEARNING NETWORK AROUND RAINWATER HARVESTING DEMONSTRATION SITES IN THE EASTERN CAPE, SOUTH AFRICA.

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ABSTRACT

Learning together in mediated voluntary networks can mobilise skills and innovations that help to facilitate learning and uptake of rainwater harvesting and conservation practices. It boosts extension capacity while at the same time growing farmer capabilities, tapping on the distributed cognition. These practices help to heal wicked problems of drought and global change challenges affecting marginalised farmers in South Africa. South Africa has water, nutrition and food security challenges, especially the Eastern Cape Province where there is a relatively high level of poverty. These challenges place heavy pressure on the agricultural sector as it is the main user of the allocated water in the country. In this paper, the learning of and agency for rainwater harvesting and conservation practices are explored as responses to these challenges. Despite existing cultural histories of such practices among the amaXhosa people, information on these practices is not readily available to small-scale rural farmers who thus struggle for the want of knowing. This research forms part of a Water Research Commission project, Amanzi for Food, whose intention is to mediate collaborative and co-engaged learning among networked farmers, extension workers, researchers and agricultural educators through course-mediated use of Water Research Commission rainwater harvesting and conservation materials.

Key words: Agricultural extension, education, Rainwater harvesting, Collaborative learning, Networks

ABBREVIATIONS AND ACRONYMS

CHAT	Cultural Historical Activity Theory
NQF	National Qualifications Framework
RWH&C	Rainwater harvesting and Conservation
WRC	Water Research Commission

1. INTRODUCTION

This paper is based on formative interventionist and generative research carried out primarily in the Amathole District of the Eastern Cape Province of South Africa over a period of seventeen months from May 2014 to October 2015. The aim of the research was to explore learning and agency in a voluntary learning network of agricultural actors drawn from the extension services at Alice and Middledrift, an agricultural college, farmers associations

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around Alice, Middledrift (in Nkonkobe Local Municipality) and Keiskammahoek (in neighbouring Amahlathi Local Municipality), a local University, and Agricultural Research and Development Institute, and the Nkonkobe Local Municipality's local economic development arm. This 'Imvotho Bubomi' learning network was established through a project of the Water Research Commission (WRC) of South Africa called 'Amanzi for Food' (project period from 1 April 2013 - 31 July 2016). The project is executed by Rhodes University's Environmental Learning Research Centre as part of an action oriented strategy to disseminate rainwater harvesting materials developed by the WRC. The authors therefore acknowledge the WRC for funding the above project and enabling this study.

This study set out to answer the following question:

- How do facilitation and collaboration in a learning network help to establish agricultural water innovations through rainwater harvesting and conservation demonstration sites and to expand learning among agricultural players especially extension support in a rural setting?

Water conservation practices have been explored as a response to water challenges in agricultural activities by the WRC. The WRC have produced many resources over several years of research in rainwater harvesting and conservation (RWH&C) practices, but dissemination of these materials has neither been wide nor effective (Backeberg, 2009; Lotz-Sisitka, 2013). Hence, information on these practices is not readily available to agricultural educators, trainers and rural farmers. The WRC Amanzi for Food project aims to strengthen the knowledge around RWH&C practices and disseminate the WRC materials more widely for them to inform agricultural activity.

2. CONTEXTUAL BACKGROUND

South Africa has water, nutrition and food security challenges, especially the Eastern Cape Province where there is a relatively high level of poverty (Altman, Hart & Jacobs., 2009; HSRC, 2014). These challenges are compounded by cultures of socio-economic practice that have historically dislocated people, especially the young, from working the land and valuing farming. Furthermore, these challenges have absented the knowledge practices around farming (Westaway, 2012). Institutions of agricultural education, research and extension in South Africa and elsewhere have foregrounded technicist solutions to water scarcity through promoting irrigation systems that are not always available or accessible and are thus disempowering to small-scale farmers (Easterly, 2013). These challenges in turn place heavy agro-ecological and socio-economic pressure on the agricultural sector as it is the main user of the allocated water in the country (NWRS, 2013). The post-apartheid government has endeavoured to transform the agricultural sector by developing policies and conducting policy and evaluative research to inform practice and to re-dress inequities and social injustices in the sector (NDA, 2004; DAFF, 2008; Tregurtha & Vink, 2008). Research outcomes such as a weak extension service, alienation of youth from agriculture and the need to develop alternative water are also supported by other independent research in South Africa and elsewhere (Williams, David, de Satgé, Epstein & Semwayo, 2008; FAO, 2009).

Conventional agricultural training and teaching practices took on a one dimensional, top down approach where agricultural information was passed down to farmers and the farmers were expected to adopt and implement new agricultural practices into their activities (Backeberg & Sanewe, 2006). A move from this top down approach to a more multi-voiced approach is suggested. Hagmann, Chuma, & Murwira (1996) and Engeström (2005)

emphasise the need for this shift. A more participatory, collaborative and multidisciplinary process can strengthen the capacity of farmers to improve their practice (Hagmann et al. 1996). For instance, farmers need to be included in the decision making on which practices to implement into their community's training programmes. However, approaches in doing this still need to be explored. The Amanzi for Food project's aim was to position farmers' knowledge and experience centrally in the learning network for collaborative decision making towards solutions to their problems.

3. THEORETICAL FRAMING OF THE STUDY

This study was informed by third generation cultural-historical activity theory (CHAT) as a lens to frame the activity systems of the different actors coming together in a learning network centred around developing productive rainwater harvesting demonstration sites. Activity system theory was initiated by Lev Vygotsky and his Russian colleagues Leont'ev and Luria (Engeström, 1999). The theory was further developed by Yrjö Engeström in Helsinki into the CHAT tradition evolving from the first to the third generation of activity (*ibid*). This paper will not be able to explain this move in the limited scope it has. The second and third generation of activity are however explained below. Using these theoretical lenses, we used an activity system in this paper to denote a systemic whole of human activity characterised by production (labour), distribution and communication or exchange between system elements, for example the subject and object (Engeström, 1987). This is illustrated using a triangle as shown in Figure 1 below for the farmer's water supply activity system.

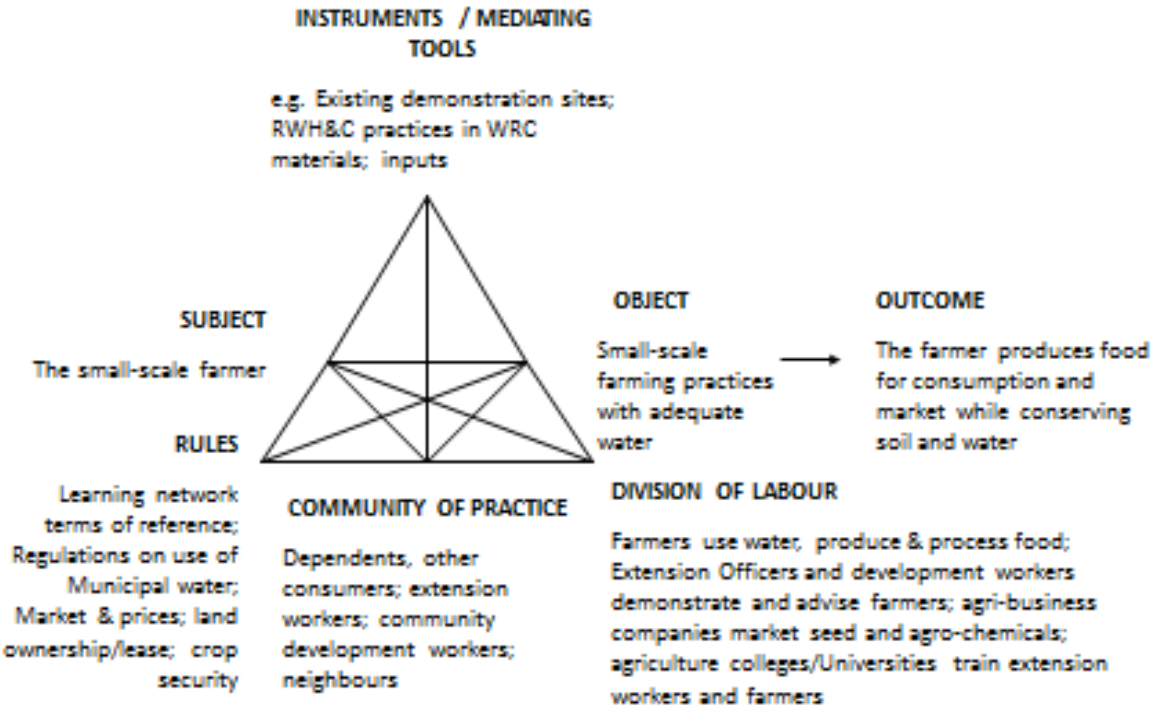

Figure 1: Small-scale farmer agricultural water supply activity system (adapted from Engeström, 2001)

In Figure 1 the activity system is made up of the subject (e.g. farmers), community (those other actors that interact with them such as extension workers), the division of labour they share, the tools they use to mediate learning, and the object of activity. In the farmers' group

their object of activity or problem space at which their activity was directed was found to be sufficient accessible agricultural water which is transformed into activity outcomes.

The third generation of CHAT helped us to clarify the descriptions and aspirations of the various actors in the learning network by connecting the activity systems of the various actors. Figure 2 below shows a third generation activity system showing how the different agricultural actors meet to negotiate a common object of activity/practice.

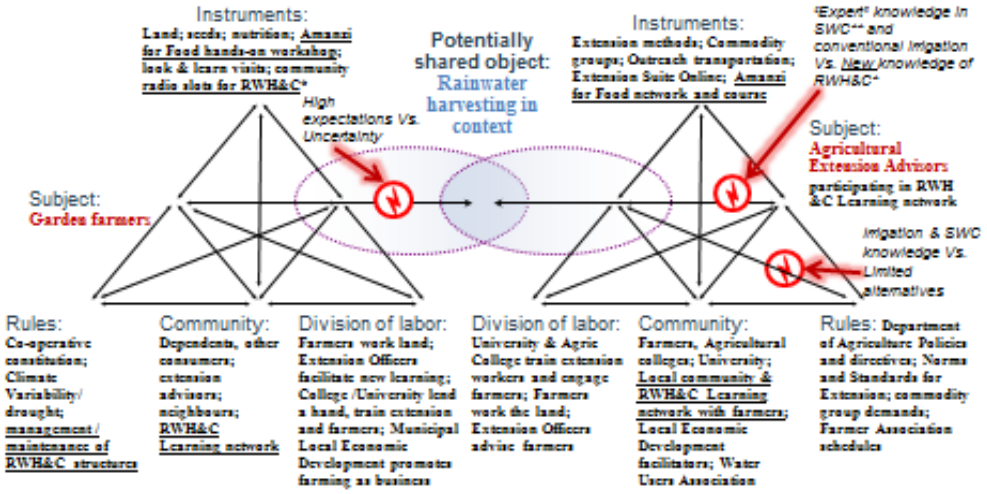

Figure 2: Third generation activity system: farmers negotiating with agricultural extension officers for a common object of activity, and some emerging contradictions (⚡) (Adapted from Engeström, 2001).

This study was designed as a formative interventionist case study as this orientation helped to generate mutual understanding of the aspirations of a network of agricultural actors. The approach also assisted us to explore agentive actions taken by the participants to achieve their aspirations. Formative intervention research is a methodology that engages research and development participants in iterative processes of questioning their historical and current activities by identifying contradictions in their practices in order to jointly find, test and implement solutions. An expansive learning cycle was used to scaffold a common object of activity that would justify and motivate enhanced and sustained collaborative learning among the agricultural actors mentioned above.

In order to track the development of the practice of rainwater harvesting within a learning network, a community of practice lens was used. A community of practice is defined as a group of people with a shared concern and passion for an activity and engage regularly to discuss their activities and build on their knowledge and skills (Wenger, 1998). The communities of practice lens are borrowed from Wenger (*ibid),* providing indicators for cultivation of a learning network embedded within the practice of collaborative development of rainwater harvesting demonstration sites. These indicators are derived from some of the dimensions and characteristics of a community of practice as described below and in Table 1:

- **What it is about** – its joint enterprise as understood and continually renegotiated by its members
- **How it functions** - mutual engagements that bind members together into a social entity

- **What capability it has produced** – the shared repertoire of communal resources (routines, sensibilities, artefacts, vocabulary, styles, etc.) that members have developed over time. (Wenger, 1998).

Additionally, the theory helps to gauge levels of engagement, participation and learning through understanding the dimensions of the learning network (Wenger, 1998).

The CHAT articulates to a needed (although incomplete) extent with the communities of practice theoretical lens in that the 'common object of activity' is paralleled with the 'shared domain of interest' foregrounded by communities of practice (Guldberg, 2010; Engeström, 2007). There is also a potential to expand learning and improve practice in both approaches through regular engagement. The key limitation of the communities of practice lens is its ahistorical forms of analysis embedded in an apprenticeship type of 'legitimate peripheral participation'. This centres knowledge in an expert within a clearly bounded framework with membership criteria which can structurally limit participation and agency by other groups (Engeström, 2007). The communities of practice lens therefore served to deploy only selected ideas compatible with CHAT which served as guidelines for indicators of development and scaling of rainwater harvesting (see Table 1) anchored in a cohesive learning network. This way the former would not impose its limitations to the democratic and emergent nature of expansive learning processes in the learning network.

Table 1: Guidelines for indicators of development of productive rainwater harvesting demonstration sites and expansion of the practices through the network

Dimensions/ characteristics of a community of practice		**Articulation with cultural historical activity system perspective**	**Qualitative indicators of development of rainwater harvesting demonstration sites in a learning network**
Joint Enterprise-Common practice	What it is about?	Follow the object of activity	• Evolution of new agricultural water practices leading to rainwater harvesting practices • Demonstration sites • Change in available water for watering crops/livestock/pasture
Mutual Engagement-Community	How it functions?	• Mediating tools and rules as drivers of functions • Division of labour in communities of practice	• Events and participant engagements • Development of new relevant governance arrangements of rainwater harvesting knowledge practices
Shared Repertoire-Learning and resources	What capability has been produced?	• Resolution of challenges (e.g. contradictions) through regular expansive learning meetings • The emerging 'germ cell' producing rainwater harvesting agency out of the shared repertoire evolved over time	• Shared resources and learning in demonstration site • Development of culturally accepted new human activity through historical reflection and testing • New ways of working together on rainwater harvesting demonstration sites

Methods for generating and analysing data are described in the section below, using a methodology that resonates with the theoretical framing described above.

4. METHODOLOGY

We used a qualitative case study research design as it allows for an intensive description and analysis of a social context (Merriam, 2002). This research is interventionist in nature where the Amanzi for Food research team introduced a training of trainer's course to the agricultural players in the case study area. This course was used to engage participants to explore challenges and contradictions in their agricultural water supply systems. It was also used to inform participants about and build knowledge on rainwater harvesting as a possible alternative agricultural water solution. Expansive learning workshops were used to scaffold and expand learning of water conservation practices among the network partners in establishing productive rainwater harvesting demonstration sites.

The research participants that we engaged with in this case study were purposively chosen to represent the agricultural sector and its complexity. All stakeholders that we encountered in the agricultural sector were invited to join the Amanzi for Food course and to engage with rainwater harvesting and conservation practices in their agricultural activities. The participants all joined on a voluntary basis, there was no pressure to join unless they found value in participating in the course activities. Data was generated over the seventeen month period through various events and engagements with research participants. Course session observations and reports, progress in demonstration sites, participant interviews and assignment progress were used as data. Some of this 'mirror data' was reflected back to farmers sitting alone initially, and then sitting together with extension workers and agricultural educators in a series of what were known as "change laboratory workshops" (Virkkunen & Newnham, 2013).

The data analysis was informed by the CHAT and Communities of Practice theoretical frameworks to validate the results and findings in this case study. The exploration of challenges, joint modelling of solutions, testing and implementation described above borrow ideas from developmental work research methodology (Daniels & Warmington, 2007). This methodology was also used to develop tools to seek answers to the research question and specifically to model solutions to the joint object of activity. This methodology is geared to respectfully work with and alongside (rather than work on) agricultural actors as knowledgeable and purposive knowers and drivers of their own development (Engeström, Pasanen, Toiviainen, & Haavisto, 2006; Kumbamu, 2009). A strategic planning learning network meeting led by the participants themselves was used to generate some of the data on consolidation of expansive learning and sustainability of rainwater harvesting demonstration sites in the network.

The community of practice lens was used to review the process of establishing rainwater harvesting demonstration sites as an accepted practice in the growing learning network (Wenger, McDermott, & Snyder, 2002). Three dimensions of a community of practice were used to identify how and when the collaborative learning of rainwater harvesting practice was establishing itself within a learning network, namely, joint enterprise, mutual engagement and a shared repertoire.

Developmental work research methodology helped to ground the findings by facilitating and exploring processes concretising the abstract ideas of rainwater harvesting. This was done by

linking currently known but rapidly disappearing histories of rainwater harvesting (e.g. *gelesha*) with new knowledge emerging from the WRC materials. The translation of this knowledge into practice was explored as possibilities for transformative agency. In this study transformative agency was seen as the capability to identify and implement rainwater harvesting demonstration sites as an alternative to the problematic methods of supplying agricultural water. This is done without necessarily abandoning direct solution seeking to the existing problems. Participatory extension approaches resonate with the developmental work research approach we applied (Adhikarya, 1994; NDA, 2005; Hagmann et al. 1996; Caister, 2012). Participatory agricultural extension sees agricultural extension and research professionals as facilitators rather than top down experts of knowledge transmission (NDA, 2005). Facilitators in this case are members of the learning network community who give life to the mediation artefacts by scaffolding collaborative expansive learning. Collaboration in the expansive learning network in this study, incorporating the participatory extension, farmer to farmer and cross-sectoral contexts, is viewed as joint formation of a common object of activity (Engeström et al, 2006).

5. FINDINGS

The research findings are presented by highlighting the key constraints and tensions and demonstrating how facilitation took place in a learning network and how it led to collaborative establishment of rainwater harvesting demonstration sites. The findings will then show how collaboration took place in establishment of the demonstration sites. We will then tie facilitation and collaboration together to demonstrate how and when they led to expansion of learning in establishing and developing demonstration sites and some of the challenges faced.

The key constraints and tensions around sustainable agricultural water from agricultural extension services point of view were limited knowledge practices and skills regarding alternative sustainable agricultural water and therefore poor capabilities to advise farmers. There were also tensions found in how extension supported farmers with inputs in support of crop production, whereby inputs were determined from higher offices rather than from the grassroots, and did not always meet grassroots demands as expressed by an Extension officer (personal communication, 15 July, 2014). This has created expectations among farmers characterised by entitlement to inputs supply, creation of dependency and poor commitment to farming.

The findings show that there are several ways in which facilitation was achieved within a learning network context, which can be summarised as:

- Agricultural extension officers have the opportunity to work differently not just as ‘experts’ but also as learners in a learning network context that acknowledges, respects and uses distributed cognition;
- Learner-led activities in the Training-of-trainers course to mediate collaborative learning and use of WRC materials on rainwater harvesting across boundaries of institution, sector, and ‘comfort zone’ (transgressing established ways of doing business-as-usual);
- Inter-institutional support of each other’s rainwater harvesting sites was done in various ways such as
    - the local university volunteered to bring a tractor and disc which opened diversion furrows for a community village garden cooperative,

- agricultural educators from the local agricultural education college visited a local farmer and jointly assessed appropriate rainwater harvesting practices to implement as demonstration and production.

The facilitation capabilities for rain water harvesting have been manifested among some of the participants as a result of the course and expansive learning workshops in a number of ways. One example is from a learning network member from the Nkonkobe Economic Development Agency who made the initiative to mobilise interns working in the agency to work with a farmer in the learning network. The aim of the work was to establish a rainwater harvesting demonstration site at the farmer's plot which is expected to feed into a local income generating project linked to a local market, and also to train the interns hands-on.

Reclamation of disappearing indigenous knowledge of soil and water conservation

Gelesha is an indigenous water conservation technique that has been practiced by the amaXhosa. The technique involves post-harvest ripping of the soil usually during the winter to spring period to conserve the moisture still in the soil and mulched by the crop residue (Denison & Wotshela, 2009). However from the data it is clear that only two members out of the 54 (3.7%) multi-stakeholder learning network members had knowledge of *gelesha* when they entered the learning network. The two farmers in the formative learning network who knew about the practice were actually using it as a continuation of a heritage from their parents. When the practice was introduced to the learning network members through the course, it appeared to stimulate some excitement because of its indigenous origins. This is shown by the reference to it in course-based assignments as part of:

> What we gained from being part of the learning network was [knowledge of] different RWH&C practices that we did not know before e.g. Gelesha. …Gelesha is considered appropriate for small scale and large scale (subsistence and commercial) farming contexts (NQF Level 6 Group assignment, July 2015).

> The Nkonkobe farming communities can embrace … Gelesha – This method of RWH&C is the most suitable for the small scale farmers in Nkonkobe when considering the nature of the land which is relatively sloping to undulating (Community Development Facilitator, NQF Level 5 assignment 1, October 20, 2014.

It is clear that extension training largely excludes learning emanating from local and indigenous ways of knowing such as *Gelesha* which have the potential to improve real struggles that small-scale farmers are grappling with around water, and which conventional training offers little usable solutions. A learning network forum, which could be built out of existing farmer associations, helps to mediate co-engaged boundary crossing learning which extension officers can use. This need is global, as indicated below by Hall (1995: 33, emphasis provided),

> In some cases, the *extension workers have more to learn from farmers than to teach to them, but unfortunately they're not learning. No one is taught at university to listen to farmers, or attempt to understand their priorities or problems or to explore their potential.*

Development of shared facilitation

There was a clear development of knowledge, skills and agency of RWH&C as shown by the participants' progress in course-based assignments, development and use of rainwater

harvesting demonstration sites and independent collaborative activities in implementing rainwater harvesting, peer support and extension of the learning network. Knowledge was regarded a shared resource right from the beginning, with farmers' local and indigenous knowledge (e.g. *gelesha*) being valued as highly as the RWH&C from the WRC texts. The learning network encouraged farmers to interact with a wide range of agricultural practitioners which they wouldn't otherwise and also allowed them to be the teachers in some situations and reach a greater understanding of RWH&C agricultural practices which they had not been exposed to before. The farmers had an opportunity to self-reflect on the meaning of their own farming practices and how they could develop their own water resources affordably amid a group of practitioners to whom they had neither dependency nor entitlement, and where extension officers where cushioned from undue demand. It was not easy for some of the farmers to shift their mind-set from a state of back-seat dependency to one of leading from the front, but the capacity building approach provided an enabling environment especially for the serious and determined farmers.

With the external facilitators of training being English - speaking it was found critical to have an interpreter into IsiXhosa and the best such candidate was found among the learning network members. From the training of the first module to the last module it became the norm to co-facilitate with the interpreter, which developed confidence in others to stand in front or speak from their places and share their knowledge, skills and experiences, while at the same time it developed the interpreter's internalisation and meaning making of rainwater harvesting.

Collaboration in a learning network on the other hand was achieved through:

- The learning network, over time, negotiated an enterprise that is shared amongst members, and in doing so they formed relationships and bonds sharing their resources and their history of learning about water conservation practices.
- Participants within the same organisation working together to review agricultural water and selecting rainwater harvesting as a possible solution among others,
- Participants from different organisations working together to test and establish rainwater harvesting demonstration sites on the farming plots of other network members,
- Radio shows with different groups from the network on the panel where many contributed to the live broadcast from their experiences with rainwater harvesting practices.
- Participation in agricultural shows where information was shared with other farmers and trainers.

The common object of activity was negotiated to be collaborative development of multi-purpose productive demonstration sites of rainwater harvesting in a learning network. This was done through negotiated processes over a long period of time and through successive workshops that kept reviewing the history, the current status and the expanded future of the object as described in the methods section.

Emergence, use and valuation of rainwater harvesting demonstration sites and skills in an expansive learning network

This learning network has enabled the support and expansion of the learning of rainwater harvesting and conservation practices in a number of ways. The mediation tools that were innovatively applied included a participatory, applied training of trainers' course and the hands-on learning in the establishment of demonstration sites. These tools were introduced

through agreement as a way of clarifying the challenges and collaboratively developing solutions. Expansive learning included use of WhatsApp, Facebook, Amanzi for Food website, community radio as emerging mediating tools catalysing information sharing. New external and internal links with other networks such as with farmers' associations and participating in agricultural shows and the development of a water-secure food production strategy by the learning network have contributed to valuation of rainwater harvesting models.

The use of community and commercial radio as a medium of disseminating rainwater harvesting knowledge, engaging farmers and agricultural educators, and the general community has had some interesting results for participatory extension. The radio has been a means of sharing experiences by farmers and extension advisors, as much as it has been a means for informal education for the general public. Responses have been motivating to the participants on the radio panel and to the audience as discussed below. An extension officer going on a radio panel alerted a member of the local farmers association who after listening to the radio made the initiative to seek for capacity building with the intention of establishing rainwater harvesting at her homestead farm plot and to disseminate the knowledge across her farmers' association.

The use of radio, personal, family and professional relationships are together contributing to expansive scaling of rainwater harvesting. Several arms have been observed to grow spontaneously from the formative body of the learning network in the form of individuals and groups joining the learning network. These are growing like 'tentacles' seeking to attract the next willing friend who either hears or beholds rainwater harvesting practices in action in a *mycorrhizae*-like fashion (Engeström, 2007).

During agricultural shows, an Amanzi for Food exhibition with rainwater harvesting materials (posters, pamphlets and books) generated interest in rainwater harvesting and conservation practices. It is evident that there is an emerging demand for more training in agricultural water practices.

A strategic action planning session by the learning network revealed that three new members have joined the network, one of whom was an executive committee member of the Nkonkobe Farmers Association. This member felt that the Association needed to be trained urgently at committee and at household levels so as to act as peer demonstrators.

The reasons why the processes of facilitation and collaboration in developing rainwater harvesting demonstration sites took the directions they did and the limitations of the study are discussed in the next section of this paper.

6. DISCUSSION AND LIMITATIONS

The selection, development, implementation and fit of rainwater harvesting and conservation practices were primarily done during the training of trainers' course by those participants who attended. The space was provided for group work sessions. The identification and implementation of rainwater harvesting solutions were observed from the implementation of selected rainwater harvesting practices at three sites. These sites emerged from historicized collaborative assessments from interviews and in the subsequent training of trainers' course; being a farmers' garden cooperative, an individual farmer's plot and an Agricultural College farm. A fourth demonstration site emerged at the site of one of the learning network members

and leader of the area farmers' association as the result of own collaborative initiatives not facilitated by the Amanzi for Food project facilitators.

The demonstration sites at the village garden cooperative received water from winter rains (July) which were observed being used to water the vegetables using watering cans and buckets. The elderly women members indicated that they were "very happy" (Personal Communication, Executive Committee Member of garden cooperative, July 2015) with the rainwater harvesting because they were "no longer having to travel long distances carrying heavy vessels full of water" (Personal Communication, Member of garden cooperative, July 2015). She went on to explain how she had observed the water flowing along the path and diversion furrows into the farm ponds, and how she had blocked diversion into the upper dams to allow water flow into dams down the slope. These agentive talks and actions indicate successful testing and implementation of the rainwater harvesting works as a solution to the wicked problems faced by the farmers around agricultural water supply.

The learning network continues to expand through communication and media channels such as the Amanzi for Food website, the blog, the Facebook page, radio broadcasts and the WhatsApp group. These platforms create ways in which the conversations around RWH&C practices continue and participants continue to implement these practices in their agricultural activities.

Collaborative learning as connections of minds, aspirations and rainwater harvesting practices

From the findings it is evident that minds aspiring for improved agricultural water were connected by the common object of rainwater harvesting demonstration sites. This is demonstrated by the working together of a farmers' cooperative together with the local university, their extension services support office and local economic development agency. These connections have been acknowledged by learning network members in all the agricultural actor groups, and may be summed up by the following quotation:

> The network comprises of members in … different entities such as Institutions of Higher learning (Rhodes University, University of Fort Hare and Fort Cox College), Government (Department of Rural Development and Agrarian Reform), private companies and Farmers with the aim of learning from each other. The interactions through this network [have] built a collaboration and partnership within the different entities. From all the meetings there was more gain and benefits from the knowledge shared amongst each other and in a way the relations between the individuals have been improved. (Agriculture College Lecturer, Assignment 3, June 4, 2015).

Through this course led activation of the learning network, farmers' knowledge and experiences becomes centrally positioned in the learning network and new relationships and engagements are established. The learning network functions as a community of practice and this platform created a space for collaborative brainstorming and problem solving around complex issues that food producers face in their day to day agricultural activities.

Limitations to the study

The biggest limitation to this study was the time frame for the study. While it has been obvious to witness the implementation of rainwater harvesting demonstration sites, it is too early to make conclusions regarding maintenance of structures and sustainability of use after a seventeen month period. Although the project aligned with their day to day occupations all

participants had their own routine work to do. Therefore, they often got pulled away from doing their training of trainers' assignments and engaging fully with the course.

7. CONCLUSION AND RECOMMENDATIONS

Participatory expansive learning research with groups of agricultural actors allowed for grounded engagement with real world concerns in this case of increasing scarcity in agricultural water. It provides tools for participatory extension for sustainable agriculture particularly in sustainable water provision. The formative intervention through facilitation and collaboration allowed for mobilisation of agency of farmers, agricultural educators, researchers, agribusiness supporters and other actors in new ways. This created new forms of human activity that are generative in that they provide extension officers with methods and tools for engaging with farmers through formative intervention rather than top down supply. The new work around the activity of establishing and using rainwater harvesting demonstration sites enabled the cultivation of the learning network and has strengthened institutional relationships. It has also supported the establishment of new one-on-one relationships and transformative agency which have played a crucial role in informal facilitation of rainwater harvesting demonstration sites in the learning network. Collaborations in the demonstration sites establishment helped bind these individual relationships where participants actively communicate with one another and work together on projects. 'Tentacles' reaching out to more farmers, youths and other key partners in the agricultural sector are continuing to grow and may for a long time after the direct course and project facilitation engagements.

It can be concluded that the connections developed between people along with the various media communication channels that were set up and one-on-one relationships have helped to continue the conversation around rainwater harvesting and conservation practices. These relationships and the media channels also enable the learning network to continue in their agricultural activities towards more rainwater harvesting and moisture conserving agricultural practices. By having a committee to organise events and activities, the responsibility will fall on certain individuals. The learning network committee is made up of college lecturers, extension officers and farmers some of whom are in the area and local municipality farmers' association committees which grounds the network in local structures thus ensuring its sustainability. In addition the local water users' association (eDikeni WUA, 2013) which falls under the municipal-level farmers' association has a water development strategy strongly linked to rainwater harvesting, which has strongly aligned with the learning network. Sustainability of the network has also been organically enhanced by the local municipality's local economic development arm whose local economy development strategy through its smallholder farmer programme is connected to sustainable and adaptive water development.

The key lessons learned from this study are indicated in the findings, and can be summarised as follows;

- the tensions that existed between extension services and farmers on one hand and extension officers and their superiors on the other can be resolved when extension officers engage with farmers as agentive individuals within a community of practice rather than as dependent recipients of aid;
- mediated boundary-crossing learning engagements linking extension officers with farmers, agricultural educators and other agricultural actors can facilitate innovative extension approaches that meet farmers where they are in an empowering way;

- multi-stakeholder dialogue bringing multiple voices to seek solutions to agricultural water problems together is an effective way of facilitating farmer learning and extension.

Innovative and caring individuals and their connections, the course, and rainwater harvesting demonstration sites provided the energy that resulted in establishment of rainwater harvesting practices in the field and lecture rooms. The authors recommend that further research be carried out to explore the collaborative learning around maintenance of rainwater harvesting structures, and productivity of demonstration sites. In addition collaborative learning visits by new interested farmers, extension officers and agricultural educators may be made to the existing demonstration sites within a networked rather than a disruptive approach.

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PERSONAL COMMUNICATIONS

Executive Committee Member of Garden Cooperative. 2015. Personal communication. July, 2015.

Extension Officer. 2014. Personal communication. July 15, 2014.

Member of Garden Cooperative. 2015. Personal communication. July, 2015.