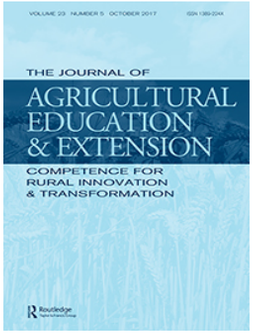

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Developing and validating a competence profile for Development Agents: an Ethiopian case study

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ABSTRACT

Purpose: Development Agents (DAs) are employed by agricultural departments to provide capacity development for farmers. In this contribution, the adjustment of a competence profile originally developed for the Province of Esfahan [Karbasioun, M., M. Mulder, and H. J. A. Biemans. 2007. 'Towards a Job Competency Profile for Agricultural Extension Instructors: A Survey of Views of Experts.' *Human Resource Development International* 10 (2): 137–151] is described for the context of the West Gojjam Zone in Ethiopia. This was necessary because 10 years' time has elapsed since the development of the profile, new insights in competence theory have emerged, and contextual variation needs to be taken into account.

Design/methods/approach: Firstly, the competence profile of Karbasioun, Mulder, and Biemans. [2007. 'Towards a Job Competency Profile for Agricultural Extension Instructors: A Survey of Views of Experts.' *Human Resource Development International* 10 (2): 137–151] was adjusted through a line-by-line conceptual analysis. Secondly, the adjusted profile was validated by 12 experts in a workshop. Thirdly, this profile was thoroughly discussed by four focus groups of DAs, each composed of eight to nine persons. Transcripts of the validation by experts and discussion with DAs were analysed using content analysis. Finally, the profile was further backed up by literature and member checks (which are done by experts in the field).

Findings: The study revealed validated competence profile for Development Agents (DAs) with 4 competence clusters and 15 underlying competencies for the Ethiopian context: knowledge on adult education, extension management, communication, and professional ethics, among others.

Practical Implications: DAs' recruitment and selection, performance evaluation, and training programmes can be developed using this new competence profile.

Theoretical Implications: This study confirms the context-bound, indivisible, interrelated, and developmental nature of competencies which refutes the behaviouristic-functionalistic conceptualization of them.

Originality/value: This contribution is a contextual variation and update of the study of Karbasioun, Mulder, and Biemans. [2007. 'Towards a Job Competency Profile for Agricultural Extension Instructors: A Survey of Views of Experts.' *Human Resource Development International* 10 (2): 137–151] and shows that different contexts of investigating competencies uncover different results.

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1. Introduction

Development Agents (DAs) provide advisory and training services to farmers. However, in many situations, current training and advisory services offered by them are not followed by empowerment (Davis et al. 2010) or capacity development and yield/hectare improvement of the farmers (Gautam 2000; Girma, Tadesse, and Seid 2012). One of the reasons for these disappointing results could be the level of competence of the DAs themselves (Davis et al. 2010) which impede them to stimulate innovation with multiple actors and organize innovation platforms (cf. Klerkx, Van Mierlo, and Leeuwis 2012). To be able to assess the level of DA performance and provide input for the DA training institutes, the competencies DAs should possess are investigated in this study.

2. Theoretical framework

The theoretical perspectives on agricultural innovation have broadened over time (Klerkx, Van Mierlo, and Leeuwis 2012). Diffusion of innovations (Rogers 1995) is the first perspective. Yet, this theory was criticized for paying little attention to client–farmers who are involved in the innovation process, and for not sufficiently including the socio-cultural history and economic interests of the actors in the process.

The second stage in extension theory (Pretty and Chambers 1993) is the transfer of technology in a two-way communication mode. This stage is characterized by the view: farmers are seen as sources of information and technology design; knowledge is created in cooperation with farmers and transferred to users; and, agro-ecological and farm-economic context is considered in an integrated way to achieve the intended outcome of farming system fit (Klerkx, Van Mierlo, and Leeuwis 2012).

The third stage in extension theory starting from the 1990s is the agricultural knowledge and information systems (Klerkx, Van Mierlo, and Leeuwis 2012). In this stage, farmers are supposed to contribute their indigenous knowledge and play experimenter role. It is characterized by participatory research and extension, joint production of knowledge and technology, demand-pull from farmers, and interdisciplinary research including sociologists and farmer experts.

The fourth stage in extension theory starting in 2000s and onwards is called the agricultural innovation systems (Klerkx, Van Mierlo, and Leeuwis 2012). In this stage, institutional change is considered a 'sine-qua-non' for innovation and farmers are supposed to play entrepreneur, innovator, and partner roles. It is also characterized by trans-disciplinary, holistic systems perspective, and multiple actors involvement with the intended outcomes of capacities to innovate, learn, and change. This theoretical perspective emphasizes shared vision, coordinated linkages, and information flows among private and public actors, incentive mechanisms, sufficient market, legislative, policy environments, and well-developed human capital (Spielman et al. 2008) to solve farmer problems.

Being a DA; therefore, is key enabler for innovation system performance and protector of capabilities failure by making extension a learning praxis leading to innovation and transformation (Moschitz et al. 2015). That is to say, s/he has to play the roles of innovation broker and systemic facilitator (Leeuwis and Aarts 2011) to maximize capacities to innovate, learn, and change.

The capacity development perspective leads to the emergence of the concept of competence in the teaching–learning process (Mulder 2016). The divide between knowledge and practice became the core of competence theory which showed that being knowledgeable does not necessarily mean demonstrating capability (Mulder 2014). Here, capability is seen as the core of competence theory that tries to answer the question what role competence plays in realizing effective performance. The current development within extension science, hence, requires the centrality of a competence-based approach in defining what competencies DAs need to perform effectively.

However, the link between competence and professional practice differs by the way in which competence is defined (Mulder 2014). He distinguishes three broad approaches of competence and professional development: competence and behaviouristic functionalism, competence and integrated occupationalism, competence and situated professionalism *(Appendix Table A1)*. In this study, the concept of competence is defined as follows:

> competence is the integrated performance-oriented capability of a person or an organization to reach specific achievements. These capabilities consist of clusters of knowledge structures and cognitive, interactive, affective and where necessary psychomotoric skills, attitudes, and values, which are conditional for carrying out tasks, solving problems and effectively functioning in a certain profession, organization, position and role. (Mulder 2001, 152)

The definition underlies holistic (comprehensive) conceptualization of competence which recognizes the developmental and situated nature of professional practice (Wesselink 2010).

Thus, acknowledging the field of extension science has reached its fourth stage and conceptualizing competence, the following research question is posed: *what competencies are necessary for a DA to perform well (leading to farmers' capacity development and yield improvement/hectare)?*

3. Design and methods of the study

This study took place in West Gojjam Zone, in the Amhara State, Ethiopia. This zone (province) had thirteen rural *Woreda*s (districts) and two urban administrations with a total population of 1,921,893 (91.23%) and 184,703 (8.77%) respectively. This study focused on the rural *Woreda*s composed of 357 *Kebeles* (localities) with 437,789 rural households and 1277 DAs. The context of the West Gojjam Zone was selected for the development and validation of the competence profile for DAs. Firstly, it produced crop dominantly; secondly, it had dense population as compared with other zones in the Amhara state (BOFED 2013). Also, agricultural extension work began in the early 1950s (Belay 2003).

To answer the research question, theoretical and empirical explorations and validation activities took place. A competence profile developed for extension workers (Karbasioun, Mulder, and Biemans 2007) was adjusted by the first author through conducting a line by line conceptual analysis of competencies descriptions based on two rationales: (a) the purpose of developing comprehensive competence profile; and (b) the context of the study area. Second step was experts' validation of the adjusted version in a workshop. Third step was focus group discussions with DAs themselves. Transcripts of the discussions with experts and DAs were analysed using content analysis method (Carley 1992).

Based on the inputs from the DAs and experts, the final profile was developed and backed up by literature and member-checked by experts. These steps were deemed necessary to be conclusive about the set of competencies for DAs in the twenty-first century in the context of the study area. In the following section, each method is described thoroughly.

3.1. Theoretical exploration (adaptation of previous competence profile)

To identify DA competencies in the study context, we consulted relevant study to help us to increase credibility (Guba 1981). Three competence clusters were identified for Iranian extension workers (Karbasioun, Mulder, and Biemans 2007): *General Course-Related Competencies* made of 10 competencies and 1 sub-competency; *General Competencies* made of 8 competencies and 3 sub-competencies; and *Technical Competencies* made of 2 competencies and 3 sub-competencies. The competencies and sub-competencies were adjusted through repeated iterative reading of their descriptions which included analysing and refining to the study context. We did this to start empirical exploration of DA-related individual competencies and with two aims: to be able to identify important DA-related competencies as they are perceived in practice; and, to scrutinize whether the DA-related competencies that are derived from adaptation of earlier profile are also considered to be important by experts and DAs in the extension services. Thus, the validity of Karbasioun, Mulder, and Biemans (2007)'s competence profile was examined in another context.

3.2. Empirical exploration (validation: workshop and FGDs)

The empirical validation of the adjusted profile was done: (a) in a workshop by 12 experts; (b) in 4 Focus Group Discussions (FGDs), each composed of 8–9 DAs. We followed these approaches since we first needed to identify relevant competencies as a starting point; secondly, we needed to know the competencies to be accepted, rejected, modified, or added by experts and DAs. The experts were selected from Woreda and Zone department of agriculture in order to find a basis for validating the adapted competencies in the study context. We selected them based on their working experiences, field of specialization, and level of education (Table 1). To corroborate trustworthiness of our study, we ensured that the experts were well-informed about the goal of the research project. Also, we displayed to them four questions and an instruction using power point presentation read as: which competencies do you: (a) accept? (b) reject? (c) modify? (d) add? and (e) make a description for them. We formed groups randomly and distributed the adapted document. We told them to validate the competencies and answer (a–e). Each group presented relevant set of competencies and their descriptions using flip chart papers for 30 minutes. Experts gave comments and consensus was obtained. We controlled the negative effects of group dynamics by: 1. asking every individual for his/her reflections; 2. explaining that FGDs do not mean group consensus; 3. audio taping each participant's reflection with codes (Exp.1, … , Exp.12) to avoid difficulty of discriminating the voices of individuals during transcription.

With the aim of data triangulation and to achieve credibility (congruence of findings with practice) and dependability (in-depth investigation of the issue), we organized 4 FGDs with DAs in 4 *Woredas* which covered 33 *Kebeles*. We took name lists of them

Table 1. Demographic characteristics of experts and DAs.

Variables	Experts (Exp.)		DAs	
	N = 12	%	*N* = 33	%
Sex				
Male	10	83.3	26	78.8
Female	2	16.7	7	21.2
Age group				
Early career (23–35 years)	6	50	32	96.97
Mid-career (36–55 years)	6	50	1	3.03
Late-career (56–75 years)	0	0	0	0
Highest level of education				
First university degree (BSC)	12	100	18	54.55
Diploma (10 + 3) from ATVET colleges	0	0	15	45.45
Field of specialization				
Agricultural economics	2	16.7	1	3.03
Rural development	7	58.3	5	15.15
Agriculture extension	1	8.3	1	3.03
Natural resources management and economics	1	8.3	7	21.21
Sustainable agriculture and resources management	1	8.3	0	0
Agribusiness	0	0	1	3.03
Plant science	0	0	17	51.51
Crop science	0	0	1	3.03
Work experiences				
2–12 years	8	66.7	31	93.94
13–23 years	3	25	2	6.06
24–34 years	1	8.3	0	0

from those *Kebeles* and selected 33 DAs using lottery method of simple random sampling (Table 1). Like experts, we communicated the questions and instruction stated above (a–e) to them. We distributed to them the revised document made by experts. We told them to validate the competencies and answer (a–e). We also controlled negative bandwagon effects using steps (1–3) above and codes (DA.1, … , DA.33) to differentiate the voices of each DA during transcription and verbatim analysis.

3.3. Content analysis

Competence profiles should be concised and condensed. Laundry lists of competencies should not be applied (Osagie et al. 2016). Instead, a discrete-level of contextualization (Johns 2006) should be applied. That means, the context should be described as concrete as possible. Therefore, a coding scheme was developed based on the definition of competence in our study. We performed two tasks: finding out what other people did in the past (Osagie et al. 2016; Le Deist and Winterton 2005); and, specifying constructs carefully as: (a) cognition, knowledge, and understanding; (b) job-related skills and know how; (c) individual operational effectiveness in relation to other people; and, (d) personal conceptual attributes and values (e.g. reflection and learning to learn). This was done in line with the aim of our theoretical and empirical explorations. This coding scheme was used to analyse the content of competence descriptions made by Karbasioun, Mulder, and Biemans (2007), experts and DAs. We used a domain analysis using Le Deist and Winterton (2005)'s model of competence to group relevant statements and built a multi-dimensional framework for work-related competencies. This framework is based on the comprehensive approach to the concept of competence. It recognizes many recent interpretations of it to the developmental and situated nature of professional practice

(Le Deist and Winterton 2005; Wesselink 2010). Also, it illustrates the interrelatedness of four domains of competence for professional effectiveness: cognition, functional, social, and meta-oriented competence domains (Osagie et al. 2016). These competencies [domains] are not fixed and may put influence on to one another, develop, stabilize, and decline in a specific context (Le Deist and Winterton 2005). They argued for the possibility of separating each domain conceptually. Yet, professionals must be able to activate and use the four domains simultaneously and effectively to be competent professionals. Therefore, we selected statements that reflect a common competence domain and grouped them to develop the profile.

3.4. Literature back-up and member checks

To increase the trustworthiness of the final profile: (a) it was compared with past studies (Silverman 2000) to see to what extent the finding was congruent with it; (b) member checking is made to bolster a study's credibility (Lincoln and Guba 1985). Experts in the field checked and approved that: (i) the changes made were in line with their ideas; (ii) finding was free from bias.

4. Results

In the next sections, the results of theoretical and empirical explorations, competencies and their definitions, exemplar quotations from participants and references to corresponding literature will be presented.

4.1. Results of theoretical exploration: adaptation of previous competence profile

Based on the profile of Karbasioun, Mulder, and Biemans (2007), the corresponding descriptions of competencies were refined to ensure applicability and recognizablity into the study context. This resulted in acceptance of all 20 competencies and 7 sub-competencies; only the accompanying descriptions were adjusted through a line by line conceptual analysis to the study area. However, the synthesis of the accepted competencies and sub-competencies based on the comprehensive approach to the concept of competence (Le Deist and Winterton 2005; Biemans et al. 2009; Wesselink 2010) revealed eight DA-related competencies (Table 2).

4.2. Results of the empirical exploration: workshop with experts and FGDs with DAs

Experts identified 11 new competencies and corresponding descriptions: agro-ecological competence, entrepreneurial competence, adaptive management competence, cultural competence, social competence, leadership competence, ethical competence, competence to understand the interaction between gender and extension, competence to understand the interaction between HIV/AIDS and extension, institutional problem solving competence, and competence to assess farmer's competencies. Besides, DAs identified three more competencies along with their corresponding descriptions: the competence to

Table 2. Competencies synthesized from Karbasioun, Mulder, and Biemans (2007)'s profile.

No.	Competencies	Emphasized competence domain
1.	Understanding and organizing subject matter for farmers' learning	Cognitive
2.	Using principles of adult training and development to facilitate the learning process of farmers	Cognitive
3.	Using learning methods and intellectual versatility to advance the understanding of farmers of farming practices	Cognitive
4.	Understanding extension-related regulations, research and research findings, and technology	Cognitive
5.	Agricultural extension management competencies	Functional
5a.	Programme planning and objective preparation competencies	Functional
6.	Demonstrating multi-production farming practice competencies	Functional
7.	Realizing extension communication and relation building processes	Social
8.	Reflecting on personal extension advising views and professional experiences: self-knowledge	Meta

identify model farmers, health management competence, and commitment and persistence competence. Based on the comprehensive approach to the concept of competence, we synthesized seven DA-related competencies. For cultural and health management, social, and leadership competencies, refer categories (8), (12), and (10a) respectively (Tables 3 and 4).

4.3. Synthesis of results

The synthesis of findings from the theoretical and empirical explorations revealed 15 individual DA-related competencies. All experts (12) and DAs (33) approved them. Based on the competence domain they emphasized, their definitions were given below.

4.4. Literature back-up and member checks

DA-related competencies and supporting exemplar quotations extracted from the transcripts of the workshop and FGDs were presented below along with references to corresponding literature as integrated result. Also, the final profile was exposed to member checks. And, no significant changes were processed (Table 5).

Table 3. Competencies synthesized from experts and DAs.

No.	Competencies	Emphasized competence domain
9.	Understanding agro-ecological farming practices	Cognitive
10.	Understanding strategies of adaptive farming management	Cognitive
11.	Providing/implementing rural advisory services based on entrepreneurship principles	Cognitive
12.	Understanding the interaction among gender and extension; HIV/AIDs (health of farmer) and extension; systems and subsystems	Cognitive
13.	Understanding human behaviour and individual differences (knowledge about farmers)	Cognitive
5b.	Extension leadership competencies	Functional
14.	Applying extension advisory-facilitative personal characteristics and affective attributes in extension advising context	Meta
15.	Extension professionals' ethical competencies	Meta

Table 4. Competencies and their definitions.

Domains	Competencies	Definitions: The DAs must (should) be able to …
Cognitive competence domain	(1) Understanding and organizing subject matter for farmers' learning	Demonstrate knowledge on content, instructional and assessment strategies, importance and feasibility of a given topic being delivered;
	(2) Using principles of adult training and development to facilitate the learning process of farmers	Demonstrate knowledge on theories and methods of adult education since most of the farmers are adults;
	(3) Using learning methods and intellectual versatility to advance the understanding of farmers of farming practices	Demonstrate knowledge and wisdom on how to use transformative learning methods (bringing to light *first order* and *second order experiences* of farmers);
	(4) Understanding extension-related regulations, research & research findings, and technology	Demonstrate latest knowledge on government regulations and policies, research findings and use of Information Communication Technology (ICT);
	(5) Understanding agro-ecological farming practices	Demonstrate knowledge on conceptualizing favourable agro-ecological conditions of farming (soil, plant, climatic factors);
	(6) Understanding strategies of adaptive farming management	Demonstrate knowledge on contextualizing professional practices through identifying uncertainties and complexities;
	(7) Providing/implementing rural advisory services based on entrepreneurship principles	Demonstrate knowledge on providing rural advisory services based on entrepreneurship principles;
	(8) Understanding the interactions among gender and extension; HIV/AIDs (health of farmer) and extension; systems and subsystems	Demonstrate knowledge on psychological, emotional, linguistic and cultural constructs; interactions of systems and subsystems influencing farmers;
	(9) Understanding human behaviour and individual differences (knowledge about farmers)	Demonstrate knowledge on tracking and describing farmers' behaviours and competencies they have;
Functional competence domain	(10) Agricultural extension management competencies	Demonstrate the ability to manage human, financial, physical, natural resources ; social and knowledge capitals;
	(10a) Extension leadership competencies	Develop a vision for extension services and be able to give direction through setting implementing strategies;
	(10b) Programme planning and objective preparation competencies	Design appropriate plans for advising/training activities and objectives to be achieved;
	(11) Demonstrating multi-production farming practice competencies	Give general support to farmers in the different aspects of their multi-production farms (in collaboration with subject matter specialists);
Social competence domain	(12) Realizing extension communication and relation building processes	Possess a good public relations and networking skills through effective use of extension communication methods;
Meta-competence domain	(13) Applying extension advisory-facilitative personal characteristics and affective attributes in extension advising context.	Possess certain personal character traits and attitudes in order to transform the business as usual farming practices of farmers; for example, commitment;
	(14) Reflecting on personal extension advising views and professional experiences: self-knowledge	Possess the ability to recognize and challenge his/her own work habits and assumptions through the use of self-evaluation skills; and,
	(15) Extension professionals' Ethical competencies	Apply extension professionals' ethical principles while delivering advising/training services.

Note: NB: For more detail definitions of the competencies, the corresponding author can be contacted.

5. Discussion and conclusion

In this section, discussion of findings, conclusion, implication for theory and practice will be presented briefly.

Table 5. Integrated results.

Competencies	Exemplar quotations	References
1. Understanding and organizing subject matter for farmers' learning	'Subject matter competency is core to be a successful county agent'	Cooper and Graham (2001, 4)
	'DAs should be knowledgeable about animal keeping, breeding, and resource management'	Workshop participant, Exp.1
2. Using principles of adult training and development to facilitate the learning process of farmers	'Adult learning becomes a specific field of study and research'	Knowles (1973, 40–59)
	'DAs should demonstrate sufficient knowledge on adult education, theories, and methods'	Workshop participant, Exp.5
3. Using learning methods and intellectual versatility to advance the understanding of farmers of farming practices	'Learning is an evolving, continuously renewed set of relations'	Lave and Wenger (1991, 50)
	'Farmers prefer practical advising or training'	Workshop participant, Exp.4
4. Understanding extension-related regulations, research & research findings, and technology	'Extension work; crucially, depends on understanding broader policy environment '	Anderson and Feder (2004, 45–46)
	'DAs fail to update themselves on research findings and innovations. Their curriculum should include participatory research methods and extension'	Workshop participant, Exp.9
5. Understanding agro-ecological farming practices	'Ecological understanding helps to improve management and guide development'	Holling (1978, xi)
	'DAs should possess sufficient knowledge on plant features, water needs, soil characteristics, and climatic factors'	Workshop participant, Exp.2
6. Understanding strategies of adaptive farming management	'No generally applicable agricultural development model exists. Agricultural systems should be flexibly adapted to their environment'	Leeuwis and van den Ban (2004, 4)
	'DAs should be able to understand the local context to help farmers'	Workshop participant, Exp.3
7. Providing or implementing rural advisory services based on entrepreneurship principles	'DAs require entrepreneurial, agribusiness, marketing, and credit training in the curriculum. Also, they need in-service training '	Davis et al. (2010, 51)
	'We don't have knowledge on entrepreneurship. We need training'	Focus Group Discussion-3
8. Understanding the interactions among gender and extension, HIV/AIDs (health of farmer) and extension, systems and subsystems	'If Sub-Saharan Africa is to improve household food security, raising the productivity of women farmers must be the centrepiece of agricultural strategy'	Saito and Weidemann (1990, vii)
	'Only divorced or widowed women farmers are receiving advisory/training services. DAs should be aware of gender and HIV/AIDS issues'	Workshop participant, Exp.3
9. Understanding human behaviour and individual differences or knowledge about farmers	'The first step in planning and developing extension programmes is need assessment'	McCaslin and Tibezinda (1997, 1)
	'Extension professionals need various competencies in the areas of understanding human behaviour'	Martin and Bin Sajilan (1989, 68)
	'From the experience of our *Woreda,* we learnt that DAs should be able to identify and prioritize the needs/ interests of farmers'	Workshop participant, Exp.10
10. Agricultural extension management competencies	'There is increasing interest in farm management as a specialization in extension and a need to develop farm business management skills among extension workers and farmers'	Kahan (2013, 1)
	'DAs should possess knowledge on financial issues; ability to organize farmers to deliver trainings, and store data on farming incidences'	Workshop participants, Exp.1 &11 &8

(*Continued*)

Table 5. Continued.

Competencies	Exemplar quotations	References
10a. Extension leadership competencies	'There are at least *four* primary ways in which people can act as change agents: catalyst, solution giver, process helper, and resource linker'	Havelock and Zlotolow (1995, 8).
	'DAs should be able to set the vision and mission of their extension work '	Workshop participant, Exp.12
10b. Program planning and objective preparation competencies	'*Program planning, implementation,* and *evaluation* are included by panel of experts to use in extension employees evaluation system'	Cooper and Graham (2001, 1–11)
	'DAs are busy of routine activities. They should be trained on planning and setting achievable objectives'	Workshop participant, Exp.9 &2
11. Demonstrating multi-production farming practice competencies	'Majority of DAs have basic technical expertise and theoretical knowledge. Farmers interviewed; however, demanded specific skills from them'	Davis et al. (2010, 24)
	'Knowledge on crop cultivation, fruits and vegetables growing, and animal rearing is needed by farmers. DAs should encourage farmers to diversify their farming'	Workshop participant, Exp.12 & 9
12. Realizing extension communication and relation building processes	'Communication workers need knowledge on media potentials, methods, facilitation, and information on the media use and preferences of stakeholders'	Leeuwis and van den Ban (2004, 276)
	'Indigenous channels offer opportunities for participation by local people in development efforts'	Mundy and Compton (1991, 2).
	'Establishing relations with model farmers, religious leaders, non-government actors, and community-based organizations helps to convince farmers'	Focus Group Discussion-3
13. Applying extension advisory-facilitative personal characteristics and affective attributes in extension advising context	'Extension should shift towards stimulation of discussion geared at linking research and practice'	Enters and Hagmann (1996, 13)
	'Facilitation skill is important for extension workers'	Röling and Jiggins (1998, 244)
	'Extension service needs much commitment, compassion, and persistence. But, no incentives to motivate us'	Focus Group Discussions: 2 &4
14. Reflecting on personal extension advising views and professional experiences (self-knowledge)	'communication workers engage regularly in critical (self-) reflection'	Leeuwis and van den Ban (2004, 45)
	'DAs need to develop skills from workplace learning. They do need participatory monitoring and evaluation skills'	Workshop participant, Exp.4
15. Extension professionals' ethical competencies	'Professional ethics is among core competencies at individual level'	GFRAS (2016, 13)
	'DAs should be sympathetic, authentic, and be able to show high personal integrity'	Workshop participant, Exp. 12 and 7

Note: NB: For additional exemplar quotations and references, the corresponding author can be contacted.

5.1. Discussion

For the effective delivery of extension services, 15 competencies for each individual DA were synthesized. Based on the framework produced by Le Deist and Winterton (2005), it is learnt that these competencies are interconnected and can be applied in an integrated

manner during extension services. Extension training (advisory) services should be a combination of cognitive, functional, social, and meta-competence domains. The finding informs us that DAs should possess these underlying competencies in a holistic manner; that is, demonstrate competence in the integrated performance-oriented capability manner to achieve specific objectives. Based on the multi-dimensional framework for work-related competencies, nine underlying competencies (60%) belong to the cognitive domain and two underlying competencies belong to the functional domain (13%). Social and meta-competences with one and three underlying competencies constituted 7% and 20% respectively. Cognition-oriented competence domains are discovered largely. For effective professional performance, DAs should be educated largely with knowledge, comprehension, and understanding components of competencies. The finding is a good indicator to extension training/advisory services. Because, a holistic extension service needs to combine the four domains of competence in practice. That is, DA's effectiveness at work needs possession of not only underlying knowledge, functional skills, and appropriate social behaviours but also facilitative (cf. Röling and Jiggins 1998), critical self-reflection (cf. Leeuwis and van den Ban 2004), stimulating discussions to link research, policy, and practice (cf. Enters and Hagmann 1996) and applying ethical principles (cf. GFRAS 2016).

The study finding reveals that DAs should be well-equipped with the 15 DA-related competencies to play innovation broker and systemic facilitator roles (Klerkx, Van Mierlo, and Leeuwis 2012) which confirms the advancement of competence-based education as new perspective to improve the roles of extension science in the rural/agricultural development process. It is learnt that DAs must consider broader network of actors and institutional factors to enhance collaborative knowledge creation. It provides a good insight to capacitate farmers and improve yield/hectare through integrated practice of the competencies and making extension practice a learning praxis (Moschitz et al. 2015).

Experts identified competencies that can be categorized to the four competence domains: agro-ecological (cf. Fageria 1992); adaptive management (cf. Holling 1978); entrepreneurial; and skills to solve institutional coordination problems (cf. Davis et al. 2010); knowledge about farmers (cf. Martin and Bin Sajilan 1989); leadership (cf. Havelock and Zlotolow 1995); ethics (cf. GFRAS 2016); and feedback (Lave and Wenger 1991). Similarly, DAs identified the importance of health management (cf. Brinkman et al. 2007); model farmers identification (cf. Swanson 2008) and commitment and persistence competencies (cf. Cooper and Graham 2001). Further research is needed to check DAs' possession of these competencies and their relevance to improve yield/hectare.

5.2. Conclusion

For DAs to play the roles of innovation broker and systemic facilitator (Klerkx, Van Mierlo, and Leeuwis 2012), they should possess the 15 competencies identified in this study. Recruitment and selection, assessment, individual development planning, and training curriculum design should be guided by these competencies. The existing curriculum being offered to DAs is skewed towards technical skills (Davis et al. 2010). However, in current innovation systems thinking, technical knowledge is not sufficient to support innovation. To enable true innovation, other factors need to be taken into account, such as organizational capacity, policy-making, development of infrastructure, incentive

mechanisms, securing funding, fulfilling markets need and creating linkages among heterogeneous actors (Kilelu et al. 2011). That is, DAs should see their services as an integral and dynamic part of the open smallholder farming system and be responsive to changing contexts and patterns of interaction.

Researchers in the future may employ this competence profile to: 1. evaluate the professional capability of DAs, 2. explore the potential of introducing competencies in the present curriculum of DA education, 3. critically examine the teaching–learning processes and assessments being provided by current agricultural universities and ATVET (agricultural–technical and vocational education Training) colleges, and, 4. assess the competencies being transferred to farmers and their production performance.

The study findings are also valuable for further development of competence theory for agriculture extension within developing countries since competency theory thus far is prone to western theories of work and learning. Elaborating competence theory by bridging notions of extension, capacity and human resource development may be promising for enhanced agricultural innovation and performance (Davis et al. 2010; Klerkx, Van Mierlo, and Leeuwis 2012). This is particularly pertinent to Sub-Saharan African countries, where population, land shortage, climate change, food insecurity and educational quality and inequality are pressing issues. It also invigorates the attention of policy-makers to align agricultural development, agricultural educational innovation, curriculum adaptation, introducing active teaching–learning processes and authentic and formative assessment strategies.

Finally, it can be expected that the development of the comprehensive typology of competencies presented in this study can help DAs and agricultural departments to improve performance assessment and accountability systems in order to increase the quality of extension services. Theoretically, it adds value to the holistic systems perspective of human resources development to improve performance in the agricultural sector.

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Appendix

Table A1. Perspectives on competence and professional development.

Perspectives	Main emphasis	Pitfalls of the approach
Competence and behaviouristic functionalism	To specifically determine the discrepancies between actual and desired competence leading to training of sometimes miniscule skills;	It over-specifies and fragments learning. Reflection on action is better than training small skills;
Competence and integrated occupationalism	To integrate knowledge, skills and attitudes in the curriculum, teaching, learning and testing procedures; To align education and work place learning (labour market);	Undermines autonomy of educational institutions and their innovations; Labour market would define education;
Competence and situated professionalism	To provide education/training based on context and realize professional action and interaction in that context; stress that knowledge is situated; Social-constructivist learning theory is important for professional education and development; To design authentic learning and competence assessment in professional learning arrangements;	Not all learning is necessarily depending on a real context. There is possibility of knowledge transfer if tasks are similar; Learning by abstraction is possible, if concrete examples are given; Holism, when details of competence are covered under generic expressions of abilities of people;

Notes: 'The link between competence and professional practice differs by the way in which competence is defined. Three broad approaches of competence and professional development are distinguished', Mulder (2014, 107–137). This table is compiled from Mulder (2014, 107–137).