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Training Transfer for Sustainable Agricultural Intensification in Tanzania: Critical Considerations for Scaling-up

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ABSTRACT

Sustainable Intensification (SI) in agriculture is fronted as a promising approach to increase agricultural production in Sub-Saharan Africa countries. Technologies that can lead to realization of the SI goal are available but one of the key challenges is the low reach among smallholder farmers due to, among others, ineffective training and co-learning. In this study, a survey methodology was used to obtain data from 145 trainees in a sustainable intensification intervention in Kongwa and Mvomero districts, Tanzania, to analyze the drivers of training transfer. Hierarchical linear regression revealed that motivation of trainees, training design and delivery, and work environment (peer, extension and local institutional support) had positive effects on transfer of the training. For successful transfer of training, recommendations given were a deliberate focus on selection of suitable trainees and ensuring their motivation to learn; use of appropriate documentation, extension and training methods; strengthening farmers' networks for peer learning; and strengthening collaborations with local institutions.

Keywords: Agricultural development, Co-learning, Peer learning, Sub-Saharan Africa, Training inputs.

INTRODUCTION

Agriculture is the main source of livelihoods in Tanzania, providing employment for over 70% of the population and contributing 27% to the national GDP (World Bank, 2016). Between 1992 and 2013, poverty levels in the country declined from 72 to 44%, but the prevalence of undernourishment increased from 24 to 35% (FAO, IFAD and WFP, 2015). The Global Hunger Index (GHI) ranks Tanzania in the category of 'serious' hunger, with a score of 28.7 (IFPRI, 2016). Key crops grown in the country include cereals (maize and rice), legumes (beans), root tubers (cassava and sweet potatoes), and bananas. Production levels of these crops are low –1.6 t ha^{-1} for maize, 2.8 t ha^{-1} for rice, 0.9 t ha^{-1} for beans, 5.2 t ha^{-1} for cassava, 4.2 t ha^{-1} for sweet potatoes, and 7.6 t ha^{-1} for bananas– and way below their potential of 6 t ha^{-1} for maize, 9 t ha^{-1} for rice, 3 t ha^{-1} for beans, 20 t ha^{-1} for cassava, 12 t ha^{-1} for sweet potatoes, and 38 t ha^{-1} for bananas (Tittonnell and Giller, 2013; FAOSTAT, 2015). Moreover, post-harvest losses exceeding 40%, especially for cereals, have been reported in the country (Abass *et al*., 2014). This situation necessitates multi-pronged efforts to ensure increased agricultural productivity, thereby contributing to the problems of hunger, poverty, and undernourishment.

Sustainable Intensification (SI) in agriculture is one of the approaches suggested to contribute to addressing the problems associated with hunger, poverty and undernourishment prevalent in many SSA countries (AGRA, 2016). Although

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there is no single unifying definition of SI, most scholars tend to define it in terms of increasing food production from existing farmland without causing irreversible damage to ecosystem health and undermining future food production efforts (Asadi *et al*., 2013; Vanlauwe *et al*., 2014). Thus, SI focuses on increasing agricultural production while meeting high standards for sustainability in environmental, economic, and social terms. Pretty (2008) suggests six attributes of sustainable production systems at the production end of food systems associated with SI, namely: (i) Utilizing crop varieties and livestock breeds with high productivity; (ii) Avoiding unnecessary use of external inputs; (iii) Harnessing agro-ecological processes such as nutrient cycling, biological nitrogen fixation, and allelopathy; (iv) Minimizing use of technologies or practices that have adverse impacts on the environment and human health; (v) Making productive use of human capital in the form of knowledge and capacity to adapt and innovate and of social capital to resolve common landscape-scale or system-wide problems (such as water, pest, or soil management), and (vi) Minimizing the impacts of system management on externalities such as GHG emissions, clean water, carbon sequestration, biodiversity, and dispersal of pests, pathogens, and weeds.

A number of SI innovations and technologies have been developed, tested and validated for SSA over the years (Pretty *et al*., 2011). To ensure dissemination and scaling of the innovations and technologies via knowledge and skills exchange, training opportunities are normally organized for farmers and other stakeholders (e.g. agro-input dealers and processors) by research and development institutions. However, literature on training point at a 'transfer problem' whereby most of what is learned is not transferred (Wenzel and Cordery, 2014). In this study, we focus on training transfer in an agricultural development context, but with two caveats. First, most of the current studies on the training transfer problem have concentrated in the fields of management, human resource development, education, adult learning and psychology (Burke and Hutchins, 2007; Gil *et al*., 2016), with a few focusing on agricultural development interventions (Ataei and Zamani, 2015; Muthoni and Miiro, 2017). Second, as argued by Scoones and Thompson (2009), unidirectional transfer of training especially by agricultural extension staff is still important as part of many agricultural development investments. However, the training landscape in developing countries has evolved over the past 20 years to adapt an innovation systems approach whereby knowledge and skills are enhanced through joint learning among the various actors. For instance, farmer field schools or farmer-led trials provide an opportunity for researchers, extension staff, academia and farmers to exchange experiences and learn from each other. In addition, the increased use of Information and Communication Technologies (ICTs) has added a dimension of wider involvement in training and knowledge exchange by various actors, especially from the private sector. Thus, unidirectional transfer of training is an important dimension of agricultural development interventions.

The question addressed in this study is: what trainee characteristics, training design and delivery, and farmers' context (work environment) affect transfer of training in agricultural development interventions focusing on SI in Tanzania?

Conceptual Framework

The success of a training or development program is reflected in whether or not what is learned gets transferred or applied. In this study, we adopt the definition of 'transfer of training' suggested by Wenzel and Cordery (2014). Accordingly, transfer of training is the extent to which knowledge, skills, and abilities acquired in a training setting result in sustained change in the way work is performed. Research estimates that, due to a

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number of factors, about 62% of what is covered during training activities in general gets transferred immediately by the trainees (Saks, 2001), but the proportion decreases with time down to about 34% after one year. This implies that unless some measures are in place, training participants are increasingly unable to retain and use the information they obtained in training programs, and a significant portion of the time and money invested in training is not effectively exploited (Velada and Caetano, 2007).

Many studies have been conducted to establish the factors that affect transfer of training as summarized by Wenzel and Cordery (2014). Starting with the seminal work of Baldwin and Ford (1988), all studies state three generic factors that affect transfer: (i) Trainee characteristics, (ii) Training design and delivery, and (iii) Work environment. Baldwin and Ford (1988) suggested a model that shows how the three factors affect transfer (Figure 1). The model consists of training inputs, training outputs and conditions of transfer. Training inputs include trainee characteristics, training design and work environment whereas the training outputs are characterized by learning which occurs during the training program and retention of that material after the program is completed. Conditions of transfer involve generalization of knowledge and skills acquired in training to the context (in this case activities across an agricultural value chain from production to consumption) and the maintenance of that learning over time. Blume *et al*. (2010) specifically define generalization as the extent to which the knowledge and skills acquired are applied to different settings and maintenance as the extent to which changes that result from a learning experience persist over time. Thus, the original model on transfer of training implies that training inputs affect the process of learning and that the generalization of learning outcomes brings about transfer of training for overall performance improvement. This study mainly focuses on training inputs in the model.

Since many studies have been conducted on training transfer (e.g. Saks, 2001; Saks and Belcourt, 2006; Velada and Caetano, 2007; Muthoni and Miiro, 2016; Gil *et al*., 2016), different factors have been found to significantly apply to different contexts. In this regard, Grossman and Salas (2011) highlighted key transfer factors that have proven to be consistent, noting that not all available information is essential for those seeking straightforward recommendations on training transfer. The following components were suggested under each of

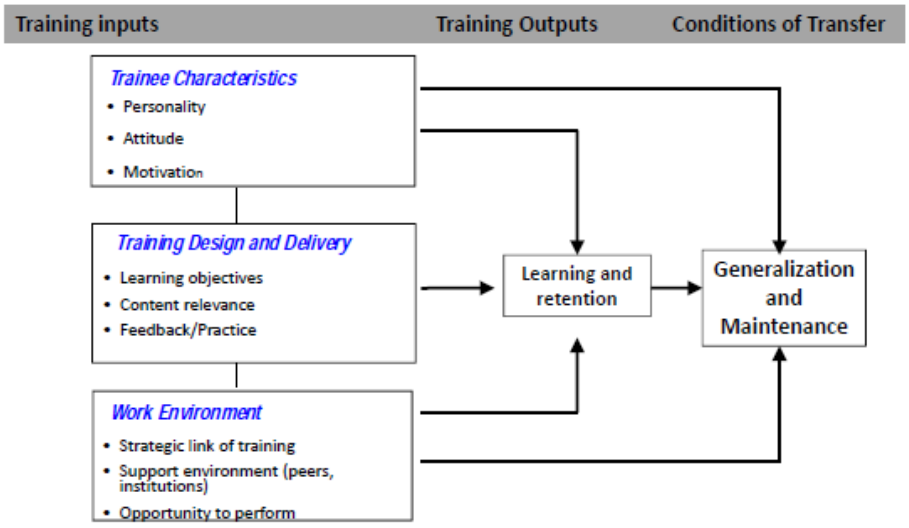

Figure 1. Training Transfer model (adapted from Baldwin and Ford, 1988).

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the factors (training inputs) as important in most cases: (i) Trainee characteristics - cognitive ability, self-efficacy, motivation, and perceived utility of training; (ii) Training design and delivery - behavioral modelling, error management and realistic training environments; and (iii) Work environment- transfer climate, support, opportunity to perform and follow-up. We principally consider these components for this study.

MATERIALS AND METHODS

Study Focus

The study was conducted in the target regions of the USAID Feed the Future (FtF) Initiative in Tanzania, where two interventions (Africa RISING and NAFAKA) were launched in 2011 to enhance agricultural productivity. The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program focuses on identifying and evaluating, through research, demand-driven innovation options for SI that contribute to rural poverty reduction, improve nutrition and equity, and improve ecosystem stability (IITA, 2015). The NAFAKA Staple Value Chains project is a development project with a goal of reducing poverty and hunger by improving the productivity and competitiveness of maize and rice value chains (ACDI/VOCA, 2014). The two interventions started working in partnership since 2014, with a focus on: (i) Introduction of improved crop varieties; (ii) Dissemination of good agricultural practices; (iii) Improving household nutrition; and (iv) Reducing food waste and spoilage. To ensure sustainability of interventions, lead farmers were trained as part of efforts to prepare them to train others in their communities. This study focused on these lead farmers as key trainees of the partnership project. By 2016, activities were being implemented in ten districts and we focused on two, namely, Kongwa and Mvomero, where the project has been operational since 2014 (Figure 2).

Kongwa district is located in semi-arid Dodoma region and lies between latitude 5.5^0 and 6.4^0 south and longitude 36.2^0 and 36.9^0 east, with an average altitude of 1,213 meters above sea level. The district has a total area of 4,041 km^2 (URT, 2003). Kongwa is characterized by a unimodal rainfall pattern of

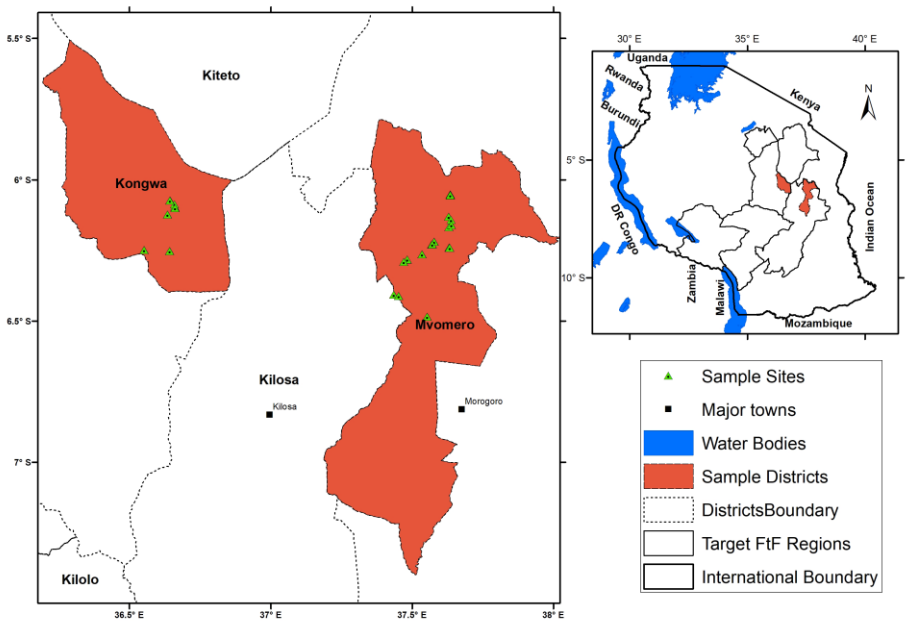

Figure 2. Study districts.

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about 500 mm per annum but with great variability and often distributed within a very short period. The mainstay of the population is crop farming with over 50% of the arable land under maize. The average land size per household is 4 hectares (URT, 2012).

Mvomero district is located in sub-humid Morogoro region and lies between latitude 5.8^0 and 7.4^0 south and longitude 37.2^0 and 38.0^0 east, with an average altitude of 640 meters above sea level. The district has a total area of 7,325 km^2 (URT 2003). According to URT (2012), the district is characterized by a bimodal rainfall pattern of about 1,200 mm per annum. The mainstay of the population is crop farming with a variety of crops grown: maize, paddy rice, vegetables, beans and cassava. The average land size per household is 1.5 hectares

Sample and Data Collection

Of the 250 trainees (farmer trainers) in the two districts, 145 were randomly selected for the study. A questionnaire was used with 30 Likert scale items (from 1, strongly disagree to 5, strongly agree) to access data on personal characteristics (motivation and resilience), trainees' experiences of the training design and delivery, and their work environment. The question on transfer of training specifically asked whether what was learned was applied by the trainees. Items in the questionnaire used were adapted from Hicks (2006) and Gillis (2009) who synthesized different training transfer measurement items to develop composite tools that can be adapted to different situations. Prior to administration of the questionnaires, informed consent and confidentiality for the respondents were respectively sought and assured. The face validity of the tools was ensured by having a panel of experts assess the items.

Data Analysis

Using SPSS, Likert type questions measuring each of the dimensions of the three training transfer factors were computed into composite scales (means) which were then used in further analysis (Boone and Boone, 2012). The Likert scale items used to compute each scale are shown in Table 1.

The Cronbach's Alpha coefficient was used to assess the internal consistency and reliability of the questionnaire and the individual items used to create the Likert scales. A coefficient of at least 0.70 is recommended, and values in the range of 0.60 to 0.69 are acceptable especially if there are only a handful of items in the questionnaire or scale (Leech *et al*., 2005). Of the 30 items for measuring the independent variables, 18 passed the reliability tests (Alpha= 0.80), and only these were considered for further analysis. The dependent variable (transfer of training) was computed from three Likert scale items (participants developing plans, which are realistic, for application of training and actually using/applying the training accessed). Regarding Alpha values for the individual Likert scales (independent variables), for the training design/delivery scale, Alpha for the four items was 0.80, which indicated that the items formed a scale that had reasonable internal consistency and reliability. Similarly, the Alpha for the work environment scale (0.74) indicated good internal consistency, but the Alpha for the scale on personal characteristics scale exhibited minimally adequate reliability at 0.65.

RESULTS

Hierarchical regression was conducted to determine the best linear combination of personal characteristics, training design, and work environment as predictors of transfer of training associated with SI interventions in Tanzania. Table 2 shows the descriptive statistics of the variables (means, standard deviations, and inter correlations) and Table 3 shows the results of the regression model.

Perceived relevance of content, motivation to learn, training design and delivery, and

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Table 1. Likert scale items used to generate the Likert scales (predictor variables) for measurement of training transfer.

Likert scale (in Italics)	Likert response items used
1a. Personal characteristics: Motivation to learn	1. I voluntarily chose to attend this training. 2. Generally, I prefer to turn away from training activities of any form. 3. I like to learn more about the topics covered by the project. 4. Generally I am enthusiastic about learning new things. 5. I give up easily.
1b. Personal characteristics: Attitude to relevance of training content	1. The training provided by the project is a waste of resources. 2. The arrangement to have demonstration sites for learning is a waste of resources.
2. Training design	1. The training atmosphere was always conducive for learning. 2. Training sessions were always well planned and organized. 3. The trainers were always knowledgeable about the topics. 4. Generally, there was a balance between trainer input and trainees (e.g. through group participation and discussions).
3. Work/Support environment	1. I share experiences of application of training from this project with fellow farmers. 2. When I share my experiences with farmers, I get useful feedback. 3. The extension staff follow me up to see how much progress I am making with implementation resulting from the training activities. 4. When I do good implementation resulting from the project training I am recognized by the extension/project staff. 5. Project and government extension staff encourage me to apply what we have learned after training 6. Project and extension staff provide constructive feedback to me regarding implementation of what I have learnt. 7. Local leadership is supportive of our efforts resulting from the training accessed.

Table 2. Means, standard deviations, and inter correlations for transfer of training and predictor variables (n= 145).[a]

Variable		Mean	*SD*	1	2	3	4
1.	Transfer/Application of training	4.48	0.452	-			
2.	Perceived relevance of content	4.28	0.772	0.176	-		
3.	Motivation to learn	4.33	0.373	0.362*	0.305*	-	
4.	Training design and delivery	4.25	0.548	0.466*	0.238	0.364*	-
5.	Work environment	4.12	0.697	0.453*	0.174	0.191	0.602*

[a] The numbers (1-4) in the columns represent the variables in the rows (e.g. 1= Transfer/Application of training, 2= Perceived relevance of content, etc.). $P< 0.05$; * $P< 0.01$.

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work environment were all significantly correlated with transfer of training as indicated in Table 2. The direct positive correlations among these variables and transfer of training imply that all the factors play a role in the process. Hierarchical logistic regression was then used to establish the extent to which these factors contribute to training transfer. The first model had two independent variables representing trainee characteristics, and only 'motivation to learn' significantly predicted the transfer of training (β= 0.339, P< 0.01). It was also worth noting that although 'perceived relevance of content' was not a significant predictor of training transfer in the model, it exhibited a low positive and significant correlation with transfer of training as indicated in Table 2 (r= 0.18, P< 0.05). The second model in which both trainee characteristics and training design/delivery factors were entered had 'motivation to learn' (β= 0.217, P< 0.01) and 'training design and delivery' (β= 0.382, P< 0.01) significantly predict the transfer of training (F= 16.487, P< 0.01). The third and last model which considered all the factors including trainee characteristics, transfer design/delivery, and work environment had all of them, except perceived relevance of content, contributing to a significant model prediction (F= 15.682, P< 0.01). The adjusted R^2 value for the final model indicated that 29% of the variance in the transfer of training was explained by the factors in the model. Looking closely at the cumulative changes in R^2 of the models all of which were significant (P< 0.01), both 'motivation to learn' and 'training design and delivery' had a significantly higher contribution to transfer of training than 'work environment.'

In addition to the significant variables, trainees noted additional constraints that affect transfer of training in practice. These included poor market prospects (25.3%), lack of household resources – land and labor (17.2%), lack of time for dedication to training peers (11.3%), and poor extension support (6.2%).

DISCUSSION

'Motivation to learn' was established as a key trainee characteristic that significantly predicted the transfer of training. Robbin and Judge (2009) refer to motivation as a process that accounts for an individual's intensity, direction and persistence of effort toward attaining a goal. Grossman and Salas (2011) emphasize the unique importance of motivation in general in relation to transfer of training arguing that trainees need to have belief in their ability to learn and that the training will lead to a change in their performance and outcomes. In their synthesis of over five studies, the authors (Grossman and Salas) confirm that

Table 3. Hierarchical regression analysis for predictor variables and training transfer in Kongwa and Mvomero districts, Tanzania (n= 145).

Variable	Model 1 (β)	Model 2 (β)	Model 3 (β)	Tolerance for Model 3	*VIF* [a] for Model 3
Perceived relevance of content	0.073	0.019	0.007	.886	1.138
Motivation to learn	0.339**	0.217**	0.229**	0.815	1.226
Training design and delivery	-	0.382**	0.212*	0.569	1.759
Work Environment	-	-	0.280**	0.635	1.575
R^2	0.136	0.260	0.309		
Adj. R^2	0.123	0.244	0.290		
F	11.129**	16.487**	15.682**		

[a] *VIF*: Variance Inflation Factor. *P< 0.05 and ** P< 0.01.

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motivation to learn is a very important predictor of effective transfer of training, together with motivation to transfer, which this study did not establish to be significant. Perceived utility of training content was not a significant predictor of training transfer in this study but had a significant low correlation with transfer of training. However, previous studies such as Ataei and Zamani (2015) established it as a very important predictor of transfer of training.

Training design and delivery was also found to be a strong predictor of transfer of training with respect to SI interventions in Tanzania. The key dimensions of this variable in this study included: (i) An atmosphere conducive for learning, (ii) Well planned and organized training sessions, (iii) Trainers being knowledgeable, and (iv) Using interactive training approaches. Our findings corroborate previous studies on transfer of training. Grossman and Salas (2011) assert that training sessions should be designed in such a way that the environment resembles the trainees' environment. This facilitates transfer of training with relative ease. In addition to a conducive training environment, as stated by Salas *et al*. (2006), the training should be organized in such a way that the trainers are well prepared in terms of the content to be delivered and the training methods used should enable trainees to easily relate the content to their situation. In addition, Taylor *et al*. (2005) emphasized the need to use training delivery approaches that utilize both trainer and trainee input as being critical for successful transfer of training as indicated by this study.

This study also established work environment factors, specifically support from peers, extension staff/supervisors and local institutions as significant predictors of transfer of training. A number of previous studies notably Salas *et al*. (2006), Blume *et al.* (2010), Grossman and Salas (2011), and Gil *et al*. (2016) suggest the importance of support to trainees as an important factor for transfer of training. Burke and Hutchins (2007) further suggest goal setting after training, combined with providing timely feedback, recognition, encouragement and rewards (also suggested by Salas and Stagl, 2009) – factors evident in the Likert scale used for our analysis – as key considerations in providing support to trainees by supervisors and peers. Although not common in many studies on work environment-related factors as a significant predictor of training transfer, the local institutional set up in developing countries is critical for transfer of training. Local institutions play an important role in providing an environment for learners to apply what they have learned – the opportunity to perform – which previous studies found to be critical for training transfer (e.g. Burke and Hutchins, 2007; Ataei and Zamani, 2015).

CONCLUSIONS

This study was designed to determine the key factors that affect transfer of training in sustainable agricultural intensification interventions in Tanzania. Three key factors associated with trainee characteristics, training design and delivery, and trainees' context/work environment were found to contribute to successful transfer of training in this regard, implying a need to consider them for effective transfer of training. On trainee characteristics, it is recommended that proven methods of carefully selecting trainees who are, among others, interested in the content and voluntarily choose to join in training activities should be used. This will enhance the potential for transfer of training. Butler and McMillan (2015), for example, suggest a number of approaches that can be used in developing country contexts to select trainees that are motivated to learn, and ultimately contribute to scaling of development interventions. The approaches range from community/training needs assessment to design, implementation, monitoring and evaluation.

The critical role of training design and delivery in effective transfer of training leads to suggestion of four

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recommendations. Firstly, competencies of trainers and development of training materials (pretested for suitability) with relevant content are worth attention. Secondly, a variety of documentation materials (manuals, Information, Education and Communication (IEC) materials, fact sheets, audio-visual materials), including integration of ICTs, should be developed to aid in transfer of training. Thirdly, during delivery of training, implementers should ensure that the training environments closely mimic the transfer environment. Fourthly, appropriate training methods and approaches that draw from the experiences of farmers (trainees) and trainers should be used, including training meetings of various forms (residential, on-farm), follow-up farm visits, group discussions, farm and exposure/exchange visits and tours.

Since support from peers, extension, and local institutions plays a critical role in transfer of training, it is recommended that development interventions for SI in Tanzania should focus on strengthening farmers' groups and organizations that can provide an opportunity for networks through which farmers can access mutual support for transfer of training. In addition, extension staff associated with development interventions should provide follow-up support to encourage trainees to apply what they have learned. Further, although local institutions in many African countries have operational and capacity challenges (Simmons *et al*., 2007), they have an important role to play in transfer of training and taking innovations to scale. However, in the context of Tanzania and many developing countries, there are a number of successful development interventions which operate in a project mode and these need to leverage the support of local institutions to sustainably scale up. It is therefore essential that, despite the challenges that the local institutions face, they should provide support to training transfer initiatives in the form of ensuring that an enabling environment exists as well as fostering mechanisms to enhance access to markets for agro-inputs and farm produce, food processing, and agricultural credit to the benefit of smallholder farmers.

One limitation of this study is that it focused only on the training inputs of the training transfer model. Additional research is necessary on other dimensions (training outputs and conditions of transfer) in the context of sustainable agricultural intensification and related interventions.

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انتقال مواد آموزشی در زمینه پایداری کشاورزی شدت دار: ملاحظات عمده برای گسترش

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چکیده

برای افزایش تولیدات کشاورزی در کشورهای جنوب صحرای افریقا، شدت دار کردن پایدار(Sustainable Intensification, SI) کشاورزی به عنوان رویکردی نویدبخش قلمداد می شود. فناوری هایی که منجر به تحقق هدف SIمی شوند موجود است ولی، افزون بر عوامل دیگر، یکی از چالش های کلیدی این است که این فن آوری ها به لحاظ ناکارآمدی آموزش و هم آموزی(co-learning) از دسترس کشاورزان خرده مالک دور است. در این پژوهش، برای تحلیل عوامل ومحرک های انتقال مواد آموزشی، از یک روش پیمایشی برای جمع آوری داده از 145 کارآموز در برنامه شدت دار کردن پایدار (کشاورزی) در نواحی Kongwaو Mvomeroدر تانزانیا استفاده شد. رگرسیون خطی سلسله مراتبی آشکار ساخت که انگیزه های کارآموزان، طراحی و نحوه برگزاری برنامه آموزش، و شرایط محیط کار(شامل حمایت همقطاران، مروجین، و نهادهای محلی) اثر مثبتی روی انتقال مواد آموزشی داشت. توصیه هایی برای موفقیت در انتقال مواد آموزشی ارایه شده که موارد زیر را شامل می شود: تاکید عمدی در انتخاب کارآموزان مناسب و اطمینان از انگیزه آنان برای یاد گیری، استفاده از مستندات درست، ترویج و روش های آموزشی مناسب، توانمند سازی شبکه کشاورزان برای آموزش یکدیگر، و تقویت همکاری با نهادهای محلی.

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