Journal of Learning for Development – JL4D
ISSN: 2311-1550
2020, Vol. 7, No. 2, pp. 142-160

Agricultural Extension Agents' use of Learning-based Extension Methods in Trinidad and Tobago

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Abstract: Agricultural extension agents are highly credited for their roles of providing advice to farmers and supporting their learning and decision-making to improve livelihoods. The use of appropriate methods to promote learning in developing countries, including Trinidad and Tobago, has often been highlighted as a development priority. Nevertheless, agricultural extension agents encounter difficulties in applying new competencies. Understanding and utilising appropriate methods based on farmers' learning needs is critical. This study sought to investigate extension agents' use of learning-based extension methods. A survey was conducted with 106 extension agents. Descriptive statistics and logistic regression analysis were used to analyse data. The findings show that male agents prefer Plant Clinics and Farmer Field School learning methods. Social influence and networking among organisations had a significant influence on the use of Discovery Based Learning methods. The positive influence of social pressure motivated the agents. The study recommends supporting facilitative conditions through a coordinated programme and to focus on farmers' learning as a critical consideration for improving the use and impact of learning-based methods.

Keywords: learning-based methods, agricultural extension, extension agent, Trinidad and Tobago.

Introduction

Agricultural extension is traditionally described as an informal educational process, providing advice and technology transfer from agricultural research institutions to solve farmers' problems and improve livelihoods. Extension services, heretofore, were provided mainly by public sector organisations. The extension agents acted as liaisons between researchers, policymakers and farmers and were responsible for communicating knowledge and information to help farmers in decision-making (Oakley & Garforth, 1997). Internationally, extension organisations are transforming from traditional public extension to a broader system of actors and stakeholders comprising research, extension, technology users, private input supply companies, non-governmental organisations and support structures, such as markets and credit (Ganpat, 2013, p. 95; Sulaiman, Hall & Raina, 2006). This new paradigm shift empowers millions of farmers worldwide, creating opportunities to increase productivity, sustainable development and food security. Furthermore, extension services have expanded using advanced methods to provide adequate responses to client needs in a globally changing environment (Helene-Collion, Alex, Byerlee & Rivera, 2004).

Globally, knowledge intensive methods and practices are being emphasised for achieving effective problem solving, collaborative learning and holistic development (World Bank, 2012; Allahyari, Chizari & Mirdamadi, 2009; Tropical Agriculture Platform, 2016). Advances in technology, changes in agents' role and clientele needs now require extension educators to rethink traditional programme delivery (Davis, 2006). Extension agents' new roles comprise adopting enhanced learning-based methods for facilitating collaborative learning and knowledge management (Ganpat, Harder & Moore, 2014). These extension methods include group participatory methods, such as, farmer-field schools and Plant Clinics, agro-ecosystem analysis, field days, and discovery-based methods used to facilitate learning and change in communities (Faure, Desjeux, & Gasselin, 2012; Davis & Sulaiman, 2014).

Farmer Field School (FFS) pioneered in the 1990s by the Food and Agriculture Organization, is a method of supporting experiential learning, where farmers meet regularly in an action learning group platform facilitated by a local extension agent to study the "how and why" of a particular topic, such as, crop or livestock, and make informed decisions (FAO, 2016; Friis-Hansen & Duveskog, 2008). Cost benefit evaluations in Kenya, Uganda and Tanzania reported that FFS positively impacted yields by 60 percent, and improved income and participation by women and low-literacy farmers (Davis et al, 2012). Discovery Based Learning (DBL) Method uses the constructivist theory of learning (Loevinsohn, Berdegué & Guijt, 2002) in which learning activities are conducted to enhance farmers' own understanding and knowledge of a topic through experience and reflection. DBL is a flexible method in which various tools (e.g., video, pictures/demonstrations) are used to engage participants in experimentation, observation and measurement, which allow them to draw their own conclusions (Van Mele, Salahuddin & Magor, 2005). Simple exercises and tools supported by DBL were very effective in stimulating learning among rice-value chain actors and helping farmers to make informed decisions for improving their livelihoods in Bangladesh (Van Mele et al, 2005). Agro Ecosystem Analysis (AESA) is a tool that helps farmers to examine their farm from the aspects of ecology and economics, as well as wider socio-political issues. The analysis is conducted by visiting the farm plots, observing and taking measurements, recording observation, and then comparing and analysing the information before deciding what to do. AESA and DBL are also used within FFS (FAO, 2016). They may be used separately, depending on the purpose of learning and development. Plant Clinic is a community based advisory method of providing plant health care services to farmers in public spaces, such as marketplaces, bus stops, cooperatives and village centres (Danielsen & Kelly, 2010). Farmers bring their diseased plant samples and a trained expert discusses how to manage the problem based on observations. Partnerships between non-profit organisations and public extension agencies for implementing Plant Clinic reported positive impacts for adoption of sustainable farming practices and improving livelihoods of over 31 million farmers in Asia, Africa and the Americas (CABI, 2019). Plant Clinic has been reported as an effective method for reaching more farmers with a timely low-cost service, and increasing adoption of sustainable plant protection practices, harvests and achieving other benefits, such as, a reduction in pesticide abuse, and improvement in food security (Bantley et al, 2010; Ghosh, Taron & Williams, 2019).

According to UNESCO (2017), learning-based education (LBE) methodology is a well-established approach empowering learners to develop competencies, reflect on their own actions and consider their current and future social, cultural, economic and environmental impacts. Effective education

methods require the adoption of action-oriented, transformative pedagogy, in support of self-directed learning, participation and collaboration. Educators must possess the necessary abilities, skills, knowledge and attitudes that promote delivery of education with a shift from teaching to learning. Therefore, extension professionals' skills, knowledge, behaviours and abilities must be clearly defined (Caffarella, 2002; Mulder, 2014). The use of learning-based, field-adapted and participation-oriented methods enhances the abilities of farmers and rural communities to make choices concerning agricultural extension programme content (Rivera, 1998).

Facilitation of farmers' learning depends mostly on agents' understanding of client characteristics, the information they receive, competencies of agents and the appropriateness of the methods used (Kantner, 1982). The Ministry of Agriculture and Food Production of Trinidad and Tobago emphasises learning-based extension methods for improving service and meeting national development goals. However, successful transformation correlates with extension agents' perception and use of these new methods of extension (Ramjattan, Ganpat & Chowdhury, 2017). In Trinidad and Tobago, there is limited evidence about extension agents' extant use of learning-based methods of extension. Opinions suggest extension agents are not operating at optimum efficiency levels (Ganpat, 2013, p. 142). The role of extension in training and dissemination of knowledge and innovation is critical to minimising the problems of poverty, hunger and improving livelihoods (Chikaire, Nnadi, Nwakwasi & Ejiogu-Okereke, 2011). Extension organisations operate as change agents at the level which directly impacts the intended beneficiaries whose livelihoods are directly reflected in the quality of services they provide (Anderson & Feder, 2007). Efforts are being made to improve the efficiency of the Ministry of Food Production by redefining the government's role in agriculture. Consequently, new strategies, alliances, technologies and priorities for extension services are outlined in the Ministry's action plan (MFPLA, 2011). Despite these efforts, farmers are not satisfied with the public extension services of Trinidad and Tobago (Qamar, 2013; Cunupia Farmers Association, 2011).

Furthermore, it is also stated that the Ministry's staff are often engaged in many administrative activities, which result in agents spending less time on actual advisory duties, rendering them unable to assist farmers in solving problems (Spence, 2010). These factors have resulted in unsatisfactory growth and development of the agricultural sector and as such its contribution to GDP remains low (Qamar, 2013). To overcome these deficits in Trinidad and Tobago, new tools and techniques are being applied. The ensuing impact is the evolution of a system that employs group and mass methods using multiple communication techniques and adult education practices.

An analysis of extension agents' extant use of learning-based methods will provide important insights for service provider organisations in the forecasting of learning-based methods and requirements for attaining the goal of service transformation. Therefore, the study sought to analyse extension agents' use of learning-based extension methods in Trinidad & Tobago, and to determine factors affecting use of learning-based extension methods.

Theoretical Framework

The Unified Theory of Acceptance and Use of Technology (UTAUT) Model (Venkatesh, Morris, Davis & Davis, 2003) was adopted for use as the theoretical framework of this study. The UTAUT model was designed to evaluate an intention to use technology, thereby, predicting the acceptance and usage of technology. In this investigation, the UTAUT model was applied to assess the intention of extension

agents towards using the four previously defined learning-based methods. In this case, the model thereby predicts the use of these methods by extension agents and, subsequently, the prevalence of these learning-based methods in extension agents' engagement with target farmers. Applying the model to this investigation allows for an understanding of implementation success rates and provides an improved prediction of adoption. As such, this model has been recommended and validated as a way of affording a basis to investigate the factors influencing extension agents' use of learning-based methods in Trinidad and Tobago.

UTAUT was created to have an integrated and unified theoretical basis which could be applied without having to collate different models and theories when studying issues in adoption. Before the UTAUT model was created, analysis of the adoption of extension method was commonly approached using the fundamental theory of planned behaviour (which provides an understanding of the determinants which inform decisions made by extension providers). The accompanying and prevailing systemic extension model was the Transfer of Technology (TOT) model, which was focused on production improvements, increasing yields, and linear handing down of advice from experts to extension agents to farmers (Davis, 2009). This type of technical knowledge transfer is no longer the focus of extension, and agencies are required to facilitate development through new approaches based in participatory methods that account for the perception and attitudes of the target farmers (Davis, 2009; Roling & Pretty, 1997). As more theories emerged (e.g., predictive persuasion theories), essential factors including expectations, such as motivation, performance and feelings were acknowledged and included as determinants of and reactions towards adoption (Bandura, 1986). These theories point to the phenomenon of different individuals in similar environments receiving, perceiving and cognitively transforming information differently due to variation in cognitive styles, mental processes and personal factors (Van den Ban & Hawkin, 1996). Eight leading theories and models were incorporated into the UTAUT model, thus rendering it a model with eight constructs.

Factors and Variables Considered

This study evaluated the eight constructs in the UTAUT model: 1) perception of external control, 2) performance expectancy, 3) perceived usefulness, 4) effort expectancy, 5) facilitating conditions, 6) networks and alliances, 7) institutional support and 8) social influence. The details of these eight constructs as they were applied to the four learning-based methods following the UTAUT model (Venkatesh, Morris, Davis & Davis, 2003) are as follows:

1) Perception of external control refers to the agents' perception of constraints to using learning extension methods because of limitations that the agents have little or no control over and perceive as obstacles to the acceptance and use of such learning extension methods.
2) Performance expectancy is used to provide an assessment of the agents' perceived benefits of using learning extension methods.
3) Perceived usefulness of learning extension methods is an instrument that assesses the agents' perceptions of the intensities of gains in job satisfaction.
4) Effort expectancy is assessed to rate the degree of ease associated with agents' competency in using learning extension methods.

5) Facilitating conditions is an estimation of the magnitude to which using innovations is expected to improve the agent's image in the extension sector. It examines the availability and accessibility of the necessary resources included to capture the discernment of the infrastructure required for the acceptance of learning extension methods used in extension work.
6) Networks and alliances associated with the use and acceptance of learning extension methods are related to agents' level of and use of collaboration and partnership arrangements. Networks and alliances occur when roles are shared, and the coordination of programmes is jointly led to the achievement of common goals.
7) Institutional support is a measure of an individual's perception of the ability of an organisation to provide adequate technical support and the necessary infrastructure to use the learning methods.
8) Social influence is a concept used to measure the use and acceptance of learning extension methods by quantifying the extent of a respondents' agreement to questions about what important methods that others believe they should use and accept.

Current literature shows that most of the studies conducted in extension methods in Trinidad and Tobago have not explored the agents' acceptance and use behaviour towards emerging extension methods, such as learning-based methods. Most extension researchers focus on the adoption of innovations by farmers. Though lesser studied, research conducted on the acceptance and use behaviour of dissemination technologies among the agricultural extension agents themselves across different organisations is of paramount importance.

Objectives

This study focuses on agents' acceptance and use of extension methods (learning-based extension methods, in particular). In addition to the eight previously defined constructs of the UTAUT model, extension agents' characteristics were also evaluated. The seven characteristics of extension agents investigated in this study are: 1) extension service provider group/institution, 2) level/category of work, 3) educational background, 4) work experience in years, 5) age, 6) gender, 7) area of expertise. It is suggested that these characteristic factors moderate the constructs in the UTAUT model. Therefore, these factors and the constructs in the UTAUT model should not be isolated from each other and ought to be analysed through holistic investigation, as attempted in this study. Other studies have explored how these two types of variables are related and ultimately influence attitudes towards, and use of, technology, such as the influence of gender on student adoption of e-Government services in Kuwait and ICT in Indian Government organisations (Al-Awadhi & Morris, 2009; Gupta, Dasgupta & Gupta, 2008).

The underpinning significance of this study is a collective investigation of the different types of factors influencing the acceptance and use of learning-based extension methods by describing the acceptance and use behaviour of extension agents.

Methods

Study Area

The study was conducted in the Republic of Trinidad and Tobago, where approximately 18,968 households were involved in agriculture on an average of less than 10 hectares each. Of this, 72.4% were involved in crop production and 16.1% in mixed agriculture while the remainder were engaged in apiculture, aquaculture and horticulture. Services are provided to farmers across eight agro-ecological zones in Trinidad, and two in Tobago by multiple organisations including public, private and state-owned organisations.

Population and Sampling

The target population comprised all the extension agents (N = 110) of the public, state-assisted and private extension services of Trinidad and Tobago employed in the sector (March to May 2015) during the survey. A purposive sampling was conducted on the official office days at each of the eight County Offices. A list of individual agents assigned to a district and responsible for an Agro-ecological zone, for which services are provided to farmers was obtained from the County Offices' records of personnel employed. A total of 106 out of the 110 agents responded to the survey questionnaire, giving a response rate of 96%.

Method of Inquiry and Collection of Data

A face-to-face structured interview was conducted, using a pilot-tested questionnaire to obtain data from respondents serving public state agencies and private extension services. The survey instrument captured demographic, socio-economic, job-related information, and technology use information in two sections; (a) seven demographic and job characteristics questions and; (b) eight variables as per the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003). Variables (summarised in Table 1) were measured using a four-point Likert scale ("strongly agree", "agree", "disagree", "strongly disagree") where strongly agree was coded as (4) and strongly disagree was coded as (1). These scales were validated by a panel of six experts in the field of extension that comprised directors and university lecturers with experience in the Trinidad and Tobago extension system. The instrument was pre-tested with ten extension agents and adjustments were made accordingly. Data were analysed using descriptive statistics and logistic regression. Four separate logistic models were run to identify the factors predisposing the use of learning methods, viz., (i) DBL (ii) AESA (iii) Plant Clinics, and (iv) FFS. The questionnaire was designed using the constructs of Unified Theory of Acceptance and Use of Technology (UTAUT).

Table 1. Description of Variables used in Regression Analysis of Factors Influencing Extension Agents Use of New Extension Methods

Explanatory variables	Levels	Specification
Perception of external control	Continuous	Four-point Likert scale
Performance Expectancy	Continuous	Four-point Likert scale
Perceived usefulness	Continuous	Four-point Likert scale
Effort Expectancy	Continuous	Four-point Likert scale
Facilitating Conditions	Continuous	Four-point Likert scale
Networks and alliances.	Continuous	Four-point Likert scale
Institutional support /Level of involvement.	Continuous	Four-point Likert scale
Social Influence to using new methods	Continuous	Four-point Likert scale
Age [a]	18 to 30 years; 31 to 45 years; 46 to 60 years	1 – If 18-30 years 0 – Otherwise 1 – If 31-45 years 0 – Otherwise
Gender	Male Female	1 – If male 0 – Otherwise
Service provider [b]	Ministry of Food production (Public); Private input suppliers; State assisted	1 – If Private input suppliers 0 – Otherwise 1 – If State assisted 0 – Otherwise
Position in organisation [c]	Managerial level; Supervisory level; Field level	1 – If Managerial level 0 – Otherwise 1 – If Supervisory level 0 – Otherwise
Education	Diploma; Undergraduate degree; Post graduate degree	1 – If Diploma 2 – If UG degree 3 – If PG degree
Experience [d]	5 years and less; 6 to 10 years; Over 10 years	1 – If 5 years and less 0 – Otherwise 1 – If 6 to 10 years 0 – Otherwise
Expertise	Crop; Livestock	1 – If crop 0 – Otherwise

Coding and Data Analysis

Coding was done using Excel to categorise and sort the data for entry into the analytical software Statistical Package for the Social Sciences (SPSS), Version 22.

Demographic information of the respondents was analysed using descriptive statistics such as means, frequencies and percentages. Logistic regression was used for predicting the outcome of the dependent variable based on the predictor variables operationalised from the (UTAUT) model of

technology use and acceptance. In this study, the dependent variable was the agents' use of learning-based extension methods. Logistic regression was used to identify and predict whether agents will or will not use learning-based extension methods. This type of analysis was suitable because it provides an estimate of observed values of the bounds within a qualitative response design.

Results

Socio-Economic, Demographic and Job-related Information Profile of Extension Agents in Trinidad and Tobago

Descriptive analysis disclosed that most agents in Trinidad and Tobago (88%) belonged to the extension service provider group; Public Extension – Ministry of Food Production (MFP), followed by Private Input Suppliers (8%) and State-Assisted Agencies (4%) (Table 2). Most extension agents were Agricultural Assistant I (47%), while 18%, 14% and 6% were Agricultural Extension Aide (AEA), Agricultural Assistant (II) and Agricultural Assistant (III), respectively.

Most of the agents attained tertiary level education, 27% possessed diplomas, 26% possessed associate degrees, 24% possessed undergraduate degrees and 18% held postgraduate degrees, while 5% had other certificates (secondary school education alone).

Some 29% of the agents had 1 to 5 years' work experience, 34% belonged to the 6 to 10 years' work experience range and 37% were in the 11 years and over work experience category.

The highest percentage of agents (53%) fit into the age category range from 31 to 45 years, 26% fell into the 18 to 30-year age category and 21% into the 46 to 60-year age category range. There were slightly more males (54%) than females (46%). Regarding the area of expertise, the highest percentage of extension workers (57%) possessed general extension expertise, while administrative and other areas of expertise were low (2%), followed by 29% expertise in crop production. Livestock production expertise was a mere 12%.

Table 2: Socio-Economic Profile of Extension Agents in Trinidad and Tobago

Parameters	Categories	Frequencies (%)
Extension Service Provider Group/Institution	Public Extension (MFP)	88
	State Assisted Agencies	4
	Private agro-chemical input suppliers	8
Level /Category of Work	**Management /Administrative**	
	Agricultural Officer I	15
	Supervisory	
	Agricultural Assistant III	6
	Agricultural Assistant II	14
	Field staff	
	Agricultural Extension Aide	18
	Agricultural Assistant I	47
Educational background	Associate degree	26
	Diploma	27
	Undergraduate degree	24
	Post graduate degree	18
	Other	5
Work experience (years)	1 to 5	29
	6 to 10	34
	11 and over	37
Age (years)	18 to 30	26
	31 to 45	53
	46 to 60	21
Gender	Female	46
	Male	54
Area of Expertise	Crops	69
	Livestock	31

Use of Learning-based Extension

The use of the four learning extension methods was compared by service providers for gender (Table 3) and education (Table 4).

The results of use by gender comparison among the three categories of service providers showed that use of Plant Clinics was highest followed by FFS. When compared, the use of DBL and AESA methods both showed lower patterns of use. Among service providers, male agents showed the highest preference for using Plant Clinics and FFS. In contrast, female agents among all three extension service providers found DBL and AESA methods suitable in meeting clients' needs and were more inclined to use it in service delivery. Among the four methods investigated, use of DBL and AESA were equally lower (58%) compared to the use of Plant Clinics and FFS methods which was much higher, 84.9% and 72.6%, respectively.

Table 3: Gender-based Comparison of Learning Methods by the Extension Service Provider

Methods	Ministry			Private			State			Total use		
	M	F	T	M	F	T	M	F	T	M	F	T
DBL%	61.2	61.3	61.2	33.3	66.7	44.4	0.0	50.0	25.0	56.1	61.2	58.4
AESA%	61.2	61.3	61.2	33.3	66.7	44.4	0.0	50.0	25.0	56.1	61.2	58.4
CLINICS%	89.8	77.2	83.8	100.0	66.7	88.9	100.0	100.0	100.0	91.2	77.5	84.9
FFS%	79.5	59.0	69.8	100.0	66.7	88.9	100.0	100.0	100.0	82.4	61.2	72.6
Sample size	49	44	93	6	3	9	2	2	4	57	49	106

M – Male; F – Female; T – Total

Agents who favoured the use of DBL (70%) held undergraduate degrees followed by 61.17 % of agents with diplomas. In contrast, the least used was (46.15%) agents with postgraduate degrees (Table 3). Similarly, for private agents, there was 66.66% use by those with UG degrees and 50% with PG degrees. The use of DBL for state-assisted agents was even less (25%) for those with UG degrees. State agents with PG degrees did not use this method. This method was the least used method of extension among all the different educational qualifications' categories. From the findings, a clear pattern emerged in the use of DBL, the agents with postgraduate degrees being reluctant to select this type of learning method. This implies that in addition to educational, demographic, and associated job factors, underlying constraints such as level of worker experience, age and institutional support influenced their choice.

On the other hand, AESA was fairly well accepted among the provider agents. Comparatively, the use of AESA varied according to educational qualifications. AESA was used by 65.38% of the agents with UG Degrees, followed by those with diplomas (59.68%), and, of the agents with post-graduate degrees, only 44.44 % were using AESA. Holders of post-graduate degrees viewed AESA as being less appropriate and thus chose other extension methods. Plant Clinics were widely used among all three extension service provider groups. MFP agents had an overall total of 91.6% who used Plant Clinics, while, for private service providers, it was 83.8%. State-assisted agents had 88.8% overall. It is apparent from the result that this method allowed greater achievement in meeting institutional goals and client satisfaction. It was found that when the organisations supported agents in their use and application of this method, increases in client satisfaction levels were obtained.

Use of FFS according to education categories disclosed that among the different agents who provide service, 69.8% of the agents with diplomas from the MFP, 50% of those with UG and 46.1% of the agents of the MFP with PG used Farmer Field School (FFS) methods. Overall the total amount of agents using FFS in extension work was 72.60%. FFS was popular among the institutions as this type

of learning initiative was found useful for enhancing collaboration, encouraging client participation and facilitating joint problem-solving. All categories of agents found FFS useful in achieving the agricultural extension objectives of greater involvement, empowerment and the strengthening of clients' capacity to learn and adopt innovations.

Table 4: Education-level Comparison of Learning-based Extension Methods by Extension Service Providers

Learning-based Extension Methods	Min. Food. Prod.				Private				State				Total			Grand Total
	Dip.	UG	PG	Total	Dip	UG	PG	Total	Dip.	UG	PG	Total	Dip	UG	PG	
DBL%	61.6	70.0	46.1	61.2	0.0	66.6	50.0	44.4	0.0	33.3	0.0	25.0	59.6	65.3	44.4	58.4
AESA%	61.6	70.0	46.1	61.2	0.0	66.6	50.0	44.4	0.0	33.3	0.0	25.0	59.6	65.3	44.4	58.4
CLINICS%	91.6	50.0	100.0	83.8	100.0	100.0	75.0	88.8	0.0	100.0	100.0	100.0	91.9	61.5	94.4	84.9
FFS%	80.0	55.0	46.1	69.8	100.0	100.0	75.0	88.8	0.0	100.0	100.0	100.0	80.6	65.3	55.5	72.6
SAMPLE SIZE (n)	60	20	13	93	2	3	4	9	0	3	1	4	62	26	18	106

Factors Influencing use of Learning-based Methods

The determinants of use of learning based methods (Table 5) show the results of the factors predisposing the extension agents use of four learning-based extension methods, (1) DBL (2) AESA (3) Plant Clinics and (4) FFS were analysed by adopting four separate logistic regression models.

DBL

The logistic regression model of extension agents' use of DBL method (Table 5) showed a good fit explaining that 54% of the variation (adjusted R2 0.545) in the dependent variable was due to changes in the independent variables. The statistically significant variables of the logistic regression model for extension agents' use of DBL were public perception, networking and alliances, social influence, supervisory level and crop expertise. DBL positively influenced extension agents' understanding of the public perception of service delivery and, as such, may have been limited only to the specific programme needs of the clients. Agents perceived DBL to be more useful when the level of collaboration and shared partnership increased among service providers and stakeholders. There was a negative relationship between social influence and use, implying that agents were not in full agreement about which methods were important to use and did not let others' beliefs inform their decisions.

Extension Supervisors credited DBL with improving the efficiency and effectiveness of extension delivery services and promoted its use to provide a relative advantage in comparison to traditional practices. The lack of motivation by agents with crop expertise to use this method could be attributed to insufficient training and technical support. Agents with crop expertise were less confident to implement programmes of this nature. There is a need for further training and a greater understanding of how to enable the transition to learning-based extension methods in programme implementation.

AESA

The logistic regression model of extension agents' uses of AESA (Table 5) proved to be a good fit with an overall accuracy rate of 86.8% and an $\chi 2$ value of 67.317. R2 value was 0.681. The public perception variable was significant; agents preferred AESA when programme outcomes allowed clients to participate. The probability of agents using AESA was positively related to observable benefits. Facilitating conditions were positively correlated to the use of AESA; this implies that agents would accept and use AESA when the necessary infrastructure was available. Administrators saw the value of this method in improving service provision; thus, they made the necessary resources available. Agents were interested to use this method when there were opportunities to solve client problems. The benefits were realised when there was programme relevance in facilitating content-specific technology dissemination. This method proved to be appropriate for specific situations but was not always applicable.

This technique was applied due to generated interest in areas where agents sought to provide hands-on field experience. However, administrators saw it as an effective tool that was seemingly superior to existing practices as tangible benefits were derived. The consensus among agents was that the level of persuasion required for fundamental reform was insufficient to enhance the uptake and establishment of this type of extension method on a much larger scale. They were unlikely to accept AESA as useful and beneficial as there was a lack of evidence for its applicability in all situations. The evidence to support AESA as a preferred method of extension was not found and, therefore, it is evident AESA did not gain widespread acceptance and use by the agents in Trinidad and Tobago.

Plant clinics

The logistic regression model of agents' use of Plant Clinic methods (Table 5) proved to be a good fit with an overall accuracy rate of 94.3% and an $\chi 2$ value of 101.547. The R2 value was 0.591. The statistically significant variables in the logistic regression model of extension agents' use of Plant Clinics were effort expectations, institutional support and gender. The model predicted that the likelihood of agents using Plant Clinics was amplified for agents interested in improving client satisfaction. Positive increases in the coefficients of the use of Plant Clinics resulted as the agents realised observable benefits and situation applicability.

This model provided evidence to suggest that such an approach was tenable and, therefore, the high emphasis was placed on the functional efficacy of Plant Clinics, which led to increased use and acceptance. It was probable that respondents who were concerned with the effort expectations were more likely to use Plant Clinics. The results observed that the necessary critical linkages and support were major enabling factors and that common interests drove agents. This method may have focused on the interdependence of the stakeholders involved and, as a result, the productive potential of this method was explored to a higher degree than others. There was a statistically significant relationship between the use of Plant Clinics and male extension agents. It was probable that respondents who were concerned with the perception of client satisfaction were more than 3.3 times as likely to use Plant Clinics.

FFS

The logistic regression model of extension agents' use of FFS (Table 5) proved to be a good fit with an overall accuracy rate of 82.1% and an $\chi 2$ value of 55.820. The R2 value was 0.510. The results revealed that five of the predictor variables showed statistical significance; facilitating conditions, networking and alliances, age categories, gender and crop expertise indicated strong linkages existed between these and the dependent variable use of Farmer Field Schools (FFS). Agents recognised that FFS requires significant investment in resources. The success of this method depended on multiple providers to achieve its objectives and was favoured more when the opportunity for partnership arose. Increases in facilitating conditions and networking positively increased the use of FFS. Farmers were offered the chance to choose which innovations were relevant for adoption in their practice when they were given necessary information, knowledge and hands-on experience using appropriate and efficient technologies. The informal and participatory nature of FFS and the hands-on approach to problem-solving improved service quality and client satisfaction. Therefore, agents concerned with service quality and client satisfaction were more likely to use FFS in situations where implementation barriers hindered use. The agents belonging to the 31 to 45 years age category were more inclined to use FFS, indicating that experience and training were factors influencing the use of FFS. Males were more comfortable using FFS, and the chances increased for the provider organisations whose agents possessed crop expertise.

Table 5: Determinants of Use of Learning-Based Extension Method

Predictor Variables	DBL		AESA		Plant Clinics		FFS	
	P values (exp β)	S.E.	P values (exp β)	S.E.	P values	S.E.	P values (exp β)	S.E.
Perception of Client satisfaction	1.104* (3.017)	.627	1.079** (3.083)	.316	1.050* (3.350)	.558	-.510 (.600)	.371
Perception of external control	.004 (1.004)	.059	.016 (1.016)	.035	.083 (1.086)	.051	.033 (1.034)	.035
Performance Expectations	-.144 (.866)	.096	.018 (1.019)	.044	.041 (1.042)	.072	.025 (1.026)	.052
Perceived usefulness	.119 (1.126)	.084	.006 (1.006)	.045	.070 (1.072)	.081	-.016 (.984)	.049
Effort Expectancy	-.027 (.973)	.068	.038 (1.039)	.034	1.12* (2.89)	.590	-.033 (.997)	.038
Facilitating conditions	-.037 (.964)	.064	-1.025* (3.975)	.553	-.023 (.977)	.052	.094** (.910)	.045
Networking and alliances	1.439* (4.215)	.560	.173 (1.189)	.214	-.352 (.703)	.343	.531* (1.701)	.288
Institutional support	.109 (1.115)	.136	-.053 (.948)	.082	1.326** (3.722)	.471	-.023 (.977)	.087
Social influence	-.138* (.871)	.077	-.005 (.995)	.042	.058 (1.060)	.080	.082 (1.086)	.051
Age 18 to 30	2.065 (7.884)	2.409	-.051 (.950)	1.376	1.625 (5.077)	1.997	3.168* (23.755)	1.762
Age 31 to 45	1.511 (4.533)	2.124	1.068* (2.911)	.939	2.173 (8.787)	1.480	2.028* (7.595)	1.093
Gender	1.380 (3.976)	1.589	-.597 (.550)	.695	-2.228* (.108)	1.187	-2.663*** (.070)	.926
State service	-.792 (.453)	4.756	.010 (1.010)	1.503	.345 (1.407)	1.435	.295 (1.342)	1.216
Private service	-.657 (.518)	3.485	-3.313 (.036)	2.273	-.857 (.528)	3.305	2.065 (7.884)	2.409
Manager level	2.930 (5.124)	4.818	2.682** (3.068)	2.551	3.315 (2.526)	3.819	2.933 (4.788)	2.932
Super level	3.540* (2.472)	2.160	-1.69 (.844)	1.055	1.551 (4.715)	1.827	1.386 (3.999)	1.469
Education	1.218 (3.380)	.921	-1.77 (.838)	.412	-.655 (.520)	.717	-.742 (.476)	.501
Experience < 5	-.974 (.378)	1.920	-1.209 (.298)	1.083	1.131 (3.100)	1.708	-.940 (.391)	1.296
Experience >10	.225 (1.253)	1.478	-.784 (.457)	.883	.342 (1.407)	1.447	-.705 (.494)	1.026
Crop Expertise	-3.264** (.038)	1.563	-.125** (.883)	.748	-1.039 (.354)	1.081	1.409* (.244)	.816
Livestock Expertise	-2.010 (.145)	1.460	-.464 (.629)	.958	-2.019 (.133)	1.500	.294 (1.342)	1.216
Constants	-24.540 (.000)	9.211	21.285 (.000)	8.721	-39.041 (.000)	9.737	41.668 (.000)	9.097

Note, *p < 0.10; **p < 0.05; *** p < 0.01; Figures in parenthesis indicate (exponential β) predicted log odds ratio. S.E = Standard errors associated with coefficient.

Discussion and Conclusion

The findings of the study add important insights into worldwide debates concerning the use of learning-based extension methods by agricultural extension organisations and the changing roles of agents. Social influence and networking had a significant influence on extension agents' use of AESA and DBL methods. This implies that agents were motivated by the positive influence of social pressures and collaborations with people viewed as important to them in encouraging the use of these methods. Agents realised that Plant Clinics could be organised quickly, providing prompt advice to more farmers. Administrators strongly supported Plant Clinics, recognising that resources could be effectively utilised when farmers came to the clinics in one place rather than an individual agent travelling great distances and meeting fewer farmers. The training of agents as "plant doctors" enhanced their capacity and boosted their confidence in pest and disease diagnosis, enabling them to provide on-the-spot reliable and practical recommendations. This improved farmers' knowledge and practice which led to positive impacts on farm productivity and income. Like impact evaluations conducted in Uganda (Brubaker, Danielsen, Olupot, Romney & Ochatum, 2013), this study found that outreach and scaling-up is required to allow accessibility for farmers in rural areas.

Overall, the use of learning-based extension methods was positively influenced by many variables. Agents who used learning-based extension methods found that they could provide more relevant service, which enhanced their clients' ability to make informed decisions. This capability to empower clientele led to a positive perception among agents towards using the methods to improve the quality of services offered. Facilitating conditions positively influenced the use of learning-based extension methods by the agents in Trinidad and Tobago. Hence, the improvement of facilitating conditions with consideration to the provision of organisational and technical infrastructure is necessary. If extension organisations are to attain the benefits of using learning-based extension methods, access to resources in the areas of infrastructure, materials, equipment and funding must be made acquirable.

The extension agents highlighted human resource development and training opportunities as limitations to the use of the extension methods. Personnel development and reskilling of staff to transform their service provision capabilities into the specific competencies necessary for effective action must be made accessible. Extension worker competence could be improved by providing training related explicitly to interactive, learner-centred service provision. It is therefore critical that administrators and policy makers conduct staff evaluations to identify gaps and provide in-service training to agents already employed, and review curricula at the tertiary training organisations to incorporate learning-based methods for individuals interested in entering a career in agricultural extension. The Public Extension service of Trinidad and Tobago has the largest number (92%) of agents employed in the country. The Extension Division of the Ministry of Agriculture is mandated to provide capacity development training for staff. It is crucial therefore to provide adequate capacity building in the area of learning-based methods for the agents of the various agencies. This must be done to ensure agents periodically upgrade their knowledge and skills to adequately address the emerging dynamics of extension service and the continually changing needs of farmers. If agents can meet the needs of the farmers through their capacity development, this would lead to synergies whereby development goals are realised.

The study indicated that middle-aged (30-45 years) extension agents were more inclined to use learning-based methods. Contrastingly, those of the 46 to 60 years' experience category were less willing to use the four methods. This suggests that technical competence is a necessity in motivating agents to use these methods. These agents were likely to be less confident in the use of learning methods of technology dissemination. As such, management practices should support continuous training that provides the necessary skills and knowledge needed for a transformation from teaching to learning.

Networking and institutional support are necessary for facilitating the conditions that encourage the adoption of learning-based methods. Extension organisations may adopt innovative strategies, for instance, the strengthening of joint coordinated programmes such as Plant Clinics and FFS, which can capitalise on the competitive advantage and help mobilise resources for the use of learning-based methods. Multiple service providers collaborating in an extension system can contribute different types of services, funding, resources and information. Greater collaboration could impact positively on the ability of service providers to sustain the use of learning-based extension methods in fulfilling the educational needs of diverse clientele and address rural development challenges.

Since social influence was responsible for extension agents' use of learning-based methods, extension organisations should organise a "share fair" or encourage agents to share experiences using social and collaborative media. Creating these types of synergies that include a wide range of actors at different levels could facilitate the sharing of knowledge and competencies. The successful implementation of FFS and Plant Clinic methods required significant investments in resources and obligations to regular routines. Bello-Bravo, Seufferheld & Agunbiade, (2011) in a study of gender-related issues in FFS, revealed that many limiting factors in agricultural societies in West Africa cause low participation of women in FFS, and extension services did not cater for the circumstances regarding womens' participation. Similarly, in Trinidad and Tobago, it was evident that these commitments proved to be limitations in programme implementation for some of the female agents. Hence, strengthening female agents' functional and technical skill, and reducing the programme activities to the critically-needed aspects of farmer learning are key enablers in improving their use of these methods. It is necessary to conduct studies to examine and understand why female extension officers are less inclined to use FFS to develop strategies to increase participation and understand the socio-economic barriers and inequalities. The extension system in Trinidad and Tobago must develop and design unique extension services to promote increased gender involvement for both clients and agents. The formation of women farmers' groups is one such strategy for changing the design of extension services to adapt to these circumstances. Women agents working with women's groups can lead to an increase in female participation in FFS and ensure higher client and agent involvement in these programmes.

This study found that there is a critical need for assessing individuals, organisations and system-level service provisions in understanding the importance of promoting the use of appropriate learning-based extension methods. It is imperative to re-define the roles of extension agents with respect to building agents' capacity and enhancing their ability to adapt collaborative learning and holistic development.

Furthermore, the need exists to undertake empirical analyses to provide valuable insights in designing policies to enable extension services in Trinidad and Tobago to be more effective, and impactful.

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Cite this paper as: Ramjattan, J., Chowdhury, A., & Ganpat, W. (2020). Agricultural extension agents' use of learning-based extension methods in Trinidad and Tobago. *Journal of Learning for Development, 7*(2), 142-160.