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Keywords

Information Communication Technologies (ICT); preferences; mediums; information; extension

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In the island nation of Trinidad, farmers have access to public extension services provided through the Ministry of Agriculture, Land and Fisheries but still struggle to get the information they need in a timely manner. Information Communication Technologies (ICTs) offer opportunities to improve the relationship between Extension and farmers. This study, guided by the Uses and Gratification (U&G) theory, sought to assess Trinidadian farmers' preferences for mobile ICTs. From a convenience sample of 200 farmers in Trinidad, results showed almost all farmers used text messaging, and most used multimedia messaging and WhatsApp. Farmers were deliberate in their selection of medium for receiving different types of information. Findings suggest two-way ICTs are contextually appropriate for communicating with Trinidadian farmers. This study highlights the importance of understanding the information needs and preferences of farmers to ensure effective extension service delivery. While many ICT mediums are available, communicators must seek to utilize those mediums that are widely accessible and adopted by the target audience. The U&G theory provided an appropriate framework to investigate farmers' preference for ICTs and allowed a critical discussion on the suitability of ICTs in Trinidad's extension system.

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Introduction

The role of extension in rural and agricultural development has expanded over the years, and this trend is expected to continue in the foreseeable future (Rivera, Qamar, & Crowder, 2001; Swanson & Rajalahti, 2010). Extension providers aim to meet the needs of small-scale farmers in an effective and efficient manner (World Bank, 2017). While the Extension Service of the Ministry of Agriculture, Land and Fisheries (henceforth referred to as Ministry Extension) is the main provider of extension in Trinidad, farmers benefit from a pluralistic extension system (Ganpat, Narine, & Harder, 2017). The Ministry Extension uses a variety of communication methods to serve farmers including farm visits, farmer training programs, short agricultural courses, demonstration farms, exhibitions, information dissemination units, and agricultural administrative services (Ganpat, 2013; Parker, 2016).

Ganpat et al. (2017) found Trinidadian farmers were less dependent on the Ministry Extension compared to other small islands of the eastern Caribbean region. Public-assisted organizations, input suppliers, non-governmental organizations, and research institutions are also key players in the Extension system of Trinidad and Tobago (Dolly, 2009; Ganpat et al., 2017; Ramjattan, 2017; Seepersad & Ganpat, 2008). In addition, the Agricultural Society of Trinidad and Tobago (ASTT), a statutory body within the Ministry of Agriculture, Land and Fisheries, represents local-level farmers' groups and facilitate extension services to all farmer members (Ramdwar, Ganpat, & Bridgemohan, 2013; Ramdwar, Stoute, & Ganpat, 2014).

While Ganpat et al. (2017) noted Trinidadian farmers had greater access to a range of mediums for agricultural information compared to other Caribbean islands, farmers preferred one-on-one farm

visits. Consequently, Parker (2016) noted farmers gave less attention to Ministry Extension since they received irregular visits from Extension officers. In contrast, farmers had higher confidence in extension services from input suppliers such as Caribbean Chemicals to deliver agricultural information because these providers were more accessible compared to Ministry Extension. Farmers indicated the information needed to address their problems was time-sensitive and irregular farm visits from Extension officers did not facilitate timely access to information (Parker, 2016). However, Parker (2016) found farmers were still willing to use Ministry Extension if the information was delivered via their preferred medium. Parker's study clearly highlighted a need for Ministry Extension to be more responsive to farmers' need for agricultural information.

While input suppliers commonly provide extension services, there are instances of information bias and discrimination in the services provided by private firms (Ferroni & Zhou, 2012; Schwartz, 1994). Ferroni and Zhou (2012) stated public extension providers served all farmers, while private agencies favored large-scale and resource-rich farmers. In addition, Schwartz (1994) pointed out input suppliers often seek to encourage chemical use by promoting their products to farmers. Input suppliers serve an important role in any country's extension system, but the public extension provider provides the best option for unbiased services to farmers. In this regard, the Ministry Extension should provide relevant content to all farmers using appropriate mediums.

Parker (2016) stated the Ministry Extension had a weakly positive source credibility due to irregular communication between Extension officers and farmers. It appears farmers turned to private agencies for extension services when Ministry

Extension failed to respond to their demand for information in a timely manner. Therefore, several studies emphasized the need for Ministry Extension to adopt efficient and effective communication methods to serve Trinidadian farmers (Ganpat et al., 2017; Ganpat & de Freitas, 2010; Ganpat, Webster, & Narine, 2014; Ramjattan, 2017). Ganpat (2013) indicated one-on-one farm-visit methods were inefficient and ineffective since one Extension officer was responsible for serving approximately 600 farmers in Trinidad (i.e. Extension to farmer ratio of 1:600).

Ganpat and de Freitas (2010) noted Ministry Extension must explore modern communication methods to serve farmers. Several studies recommended Ministry Extension adopt modern two-way Information Communication Technologies (ICTs) mobile to serve farmers in Trinidad (Ganpat, 2013; Ganpat & de Freitas, 2010; Ganpat et al., 2017; Ramjattan, 2016). According to Touray, Salminen, and Mursu (2013), ICTs relate to “technologies that are used for accessing, gathering, manipulating and presenting or communicating information” (p. 2).

The use of ICT-based solutions is categorized as Information and Communication Technologies for Development (ICT4D) and is a relatively new area of study in agriculture and rural development (Walsham, 2017). ICT4D initiatives assume universal access to information and knowledge platforms is crucial in an information age. While access to modern ICTs is common in urban areas, it is often limited in rural areas (Akca, Sayili & Esengun, 2006). ICT-based solutions in agriculture are aimed at reducing the digital divide. Yu (2002) defined the digital divide as the gap between individuals with access to technology tools and those without access. In the Caribbean, policies such as the

ICT and Connectivity Agenda were created to improve ICT infrastructure and access in rural communities (United Nations Economic Commission for Latin America and the Caribbean [ECLAC], 2007).

Trinidadian farmers’ preferences for modern Information Communication Technologies (ICTs) are unknown. An assessment of farmers’ preferences for ICTs will allow Ministry Extension to modify its communication strategies to meet farmers’ information needs. Therefore, this study sought to describe Trinidadian farmers’ preferences for modern ICT mediums and content.

Theoretical Framework

This study was guided by the Uses and Gratification (U&G) theory (Katz, Blumler, & Gurevitch, 1974). U&G is a social theory that posits human communication behavior is driven by people’s needs and desires (Katz et al., 1974). It is a user-focused approach to exploring the role of people’s motivation in their selection of different media and content (Ruggiero, 2000). Katz et al. (1974) indicated individuals use certain medium and consumed selected content to follow social activities, build social connections, or to seek information and advice on daily living. U&G provides some rationale for why audiences engaged in different forms of media (Wimmer & Dominick, 1994).

Ruggiero (2000) argued the U&G approach is more relevant now due to the emergence of modern computer-mediated communication technologies. U&G assumes media use is purposive and goal-directed, content is selected to satisfy user needs, and users are active participants who have the freedom to choose media and content (McQuail, 2010; Rubin, 2002). The theory states an individual’s needs and motivations drives his or her selection of media and content. In other words, users select media

content to gratify their needs (McQuail, 2010). Ruggiero (2000) stated U&G is well suited to answer one basic question; “Why do people become involved in one particular type of mediated communication or another, and what gratifications do they receive from it?” (p. 29).

For example, past experiences with or perceptions of different content and media can influence an individual’s preference for television over radio. If the gratification received from users’ selection of media and content meets their expectations, then their needs are satisfied (Blumler, 1979). However, users re-evaluate their selection of medium and content if either does not match their expectations.

McQuail (2010) indicated four typologies of user gratification based on user needs and motivations. These are diversion, personal relationships, personal identity, and surveillance. Diversion is the use of media and content to “escape from the constraints of routine and from the burdens of problems as well as emotional release” (Hammes, 2016, p. 30). This includes listening to music, watching movies, and reading entertainment news. Personal relationship is the use of media and content for companionship and social interaction (Hammes, 2016). This includes keeping in touch with friends and family or being an active participant in a community (e.g. Facebook groups). Personal identity is the selection of media and content to reinforce personal values and learn about oneself. A user may look for information about issues for personal reflection or to understand his/her own reality (Hammes, 2016). Surveillance is the use of media and content to seek information about relevant topics and wider issues (Hammes, 2016). McQuail, Blumler, and Brown (1972) described surveillance as information gratification and related it to the acquisition of news and information on relevant topics.

Ruggiero (2000) indicated the availability of many communication technologies presents users with considerable media choices. Users hold control over their selection of content and communication medium. In addition, users’ preferences for new forms of media are changing as technology evolves. The U&G theory guides this investigation into farmers’ preferences for modern ICT mediums and agricultural information. Farmers’ preferences for ICT mediums and digital content are theorized to be dependent on their information needs, motivations, and expectations.

Literature Review

The emergence of mobile ICTs has changed the ways farmers interact with extension, non-governmental organizations, and other organizations providing rural advisory services (World Bank, 2017). While many successful farmer-centered ICT projects exist, the literature emphasizes the application of best-fit practices to developing an ICT model for extension (Avgerou, 2010; Vignare, 2013; World Bank, 2017). Some weaknesses of using ICTs for extension are their lack of customization by end-users and the limited availability of locally relevant content (Global Forum for Rural Advisory Services, [GFRAS] n.d.). In addition, GFRAS noted a major challenge is changing user preferences. McNamara et al. (2017) indicated a mix of technologies (i.e. technology cluster) such as radio and Short Messaging Service (SMS) can sometimes be most cost-effective when accounting for situational and cultural factors. Extension providers must continuously survey users to ensure the ICT content and medium meets user needs. However, there is a lack of literature on Trinidadian farmers’ preference for two-way ICTs. While Parker (2016) indicated farmers preferred one-on-one

communication with Extension officers, it is unclear if farmers are willing to use other mediums to interact with officers. As such, Trinidadian farmers' uses and gratifications of ICT mediums and their preferences for agricultural content are unknown. Due to a lack of research specific to farmers' ICT preferences and usage in the Caribbean, a broader literature review was conducted to inform the study.

Martin and Abbott (2011) reported over half the farmers surveyed used mobile phones in Uganda. They categorized farmers' use of mobile ICTs into five themes. These were coordinating access to agricultural inputs, accessing market information, seeking agriculture emergency assistance, monitoring financial transactions, and consulting with expert advice. Similarly, many Indian farmers used telecentres (e.g., e-Choupal) to access information on market prices, learn about appropriate farming practices, and conduct trading transactions with input suppliers (Annamalai & Rao, 2003; Kameswari, Kishore, & Gupta, 2011).

Kameswari et al. (2011) indicated only a minority of farmers in India visited public extension for agricultural information, since services available via call centers were faster and more relevant to the local context. In the Himalayan region, Kameswari et al. stated many farmers used mobile phones for social media. Farmers called input suppliers and middle men for agricultural advice in the absence of a formal mobile-based service of extension. These farmers used mobile phones for post-sale inquiries with buyers, but less to access current market prices. Armstrong, Ghandi, and Lanjekar (2012) reported Indian farmers sought information on fertilizers, weather, market prices, pest management, and financial management. While the farmers had access to modern ICTs, traditional methods were mainly used to access information. Mobile ICTs were adopted by

farmers in many African countries to access similar types of information (World Bank, 2017). These farmers used mobile services to connect with buyers, specialists, extension, cooperatives, input suppliers, and to conduct financial transactions such as securing loans (World Bank, 2017).

Farmers in rural Uganda preferred voice calls over other mobile applications to access agricultural information (Martin & Abbott, 2011). Similarly, Aldosari, Shunaifi, Ullah, Muddassir, and Noor (2017) indicated farmers in Pakistan had positive perceptions of using mobile phones to access agricultural information. The farmers agreed the Internet could be a useful source of agricultural information but were mostly undecided about the usefulness of mass media sources such as television. Kameswari et al. (2011) indicated mass media is inflexible and only permits one-way information transmission. They found farmers' preferred ICT mediums because it facilitated a two-way interaction between agents and farmers.

Demographic factors also impact medium selection. Kameswari et al. (2011) indicated a need to consider the technology literacy levels of farmers. Kameswari et al. found a modern ICT project in a rural Indian state failed because farmers were unable to use most of the services offered due to low literacy levels. For example, farmers were not able to send videos or pictures of pests and diseases to extension, because they did not know how to access this feature on a mobile phone. Likewise, Thai farmers were less likely to use mobile phones and computers to access agricultural information due to its perceived unfavorable complexity (Tantisantisom, 2011). Farmers' age is another factor of medium selection. Mallenius, Rossi, and Tuunainen (2007) noted age affects the functional capacity of individuals, and is associated with impairments to vision, hearing, cognitive

skills, and mobility. Farmers may select mediums based on their expectations of complexity and their physical ability to use the medium.

Bell (2015) noted the communication medium should be linked to the type of information needed by farmers. For example, SMS can be used to link farmers to buyers and input suppliers, and provide mass updates (e.g. weather forecast, general agricultural updates). In contrast, smartphone technologies such as mobile applications, and social media can be used to provide technical advice and specialized training (Bell, 2015). The Food and Agriculture Organization [FAO] (2015) indicated a critical factor to the success of ICTs in agriculture is identifying the right mix of technologies.

Purpose & Objectives

This study sought to assess Trinidadian farmers' preferences for mobile ICT mediums and digital content. Objectives were to (a) rank farmers' current use of ICT services and the gratifications they receive from using different services, (b) rank farmers' preferences for digital content and communication mediums, (c) assess the relationship between farmers' age, education, and current ICT use, and (d) assess the most preferred content and medium for farmers with Internet-enabled smartphones. While this study bears implications and recommendations for all extension service providers in Trinidad, findings are particularly geared towards improving the communication methods of the Ministry Extension service.

Methods

This study gathered cross-sectional data from farmers of Trinidad and followed a correlational design. Crop production contributes 64% of agricultural GDP in Trinidad and is regarded by the government as the main driver of national food security (Ramroop, Lopez, & Ramcharan, 2006). Therefore, the target population of this study was crop farmers of Trinidad. However, a sampling frame was not created due to the unavailability of a reliable database on active farmers in Trinidad (Baksh, Ganpat, & Narine, 2015). Therefore, data was collected via a convenience sampling technique. Production data provided by the National Agricultural Marketing and Development Corporation was used to stratify the sample according to agricultural productivity by county. The production data was collected in 2014 and included total crop output by county.

Stratification by county ensured the sample reflected the most active agricultural regions in Trinidad. As such, there was proportionately more observations from counties with higher agricultural output compared to those with lower output. This study collected data from a sample of 200 farmers. According to McCroskey and Young (1979), a sample of 200 observations is adequate for correlational studies. Further, Looney (2018) illustrated a sample of 179 observations achieved 90% power, while Schönbrodt and Perugini (2013) proved a sample approaching 250 observations can provide stable correlation estimates. Table 1 provides the number of observations taken from each county.

Table 1
Agricultural Output by County and Corresponding Strata Size

County	Projected Yield (lbs.)	Agricultural production (% of total)	Proportionate sample of farmers
St. Patrick	27,683,347	10	20
St. George	61,230,234	21	43
St. Andrew	41,903,208	15	29
Caroni	48,010,386	17	33
Nariva/Mayaro	49,271,500	17	34
Victoria	59,028,056	21	41
Total	287,126,731	100	<i>n</i> = 200

Note: Data from NAMDEVCO (2014).

Questionnaire Design & Data Collection

A researcher-developed questionnaire was used to gather data for this study (Ary, Jacobs, Sorensen, & Walker, 2014). As a result, measurement error, and item and construct validity was carefully considered. The Tailored Design method was used to reduce measurement error (Dillman, Smith, & Christian, 2015). Closed-ended questions were matched with an exhaustive list of mutually exclusive options and were not double-barreled. Also, answer options were limited to two categories (i.e., Yes, No).

An expert panel consisting of three specialists with experience in questionnaire design, Caribbean extension systems, and extension education checked for item and construct validity. A local expert, the Dean of the Faculty of Food and Agriculture at the University of the West Indies, reviewed the questionnaire to ensure questions were culturally appropriate. The panel recommended adjustments to the flow and wording of questions and added items to several constructs. After the Institutional Review Board determined the study exempt, a pilot study with 20 farmers was done to check for face validity. Following, minor corrections were made to question wording to improve readability and face validity. Finally, the questionnaire was orally

administered to the sample by one member of our research team in May of 2018. The local expert provided information on the major farming communities in Trinidad. In each community, participants were asked to consent to the study and to identify other suitable farmers in their community. Four farmers declined to participate, resulting in a response rate of 98%. This process ensued until all farming communities were visited and the proportionate number of farmers in each county were met.

The U&G theory guided the development of the instrument and influenced the data analyses. The questionnaire gathered data on (a) farmers' current ICT use, (b) gratification received from ICT services, (c) preference for agricultural content, and (d) preference for ICT mediums. With respect to current ICT use, farmers were asked to indicate whether or not they used several ICT services via a series of Yes or No questions. ICT services examined were social media, sending and receiving messages via Short Messaging Service (SMS), sending and receiving pictures and videos via Multimedia Messaging Service (MMS), sending and receiving WhatsApp messages, email exchange, making and receiving voice calls, and making and receiving Skype calls. WhatsApp was specifically added based on

input from the local expert. While SMS, MMS, and voice calls are available on older mobile devices, WhatsApp, email exchange, and Skype calls are smartphone applications and require mobile Internet. Following, farmers were asked to indicate the gratification they received from using each ICT service. Gratifications specified in the questionnaire were (a) relaxation, (b) to keep in touch with friends or family, (c) to access non-agricultural information, (d) to access agricultural information, and (e) other.

Farmers were then asked to indicate the type of information they would like to receive from extension services via a series of Yes/No questions. Agricultural information examined were updates on

market prices, weather information, input prices, pest and diseases, financing information, requesting emergency assistance, advice from an extension officer, dates of farmer training courses, and information on agricultural equipment. Farmers were also asked to specify their most preferred medium for accessing each type of information. Mediums examined were text messaging, voice calls, face-to-face interactions, and the Internet.

Analysis

All variables were binary in nature, and this study employed descriptive analyses and correlations to address the objectives. Table 2 shows the type of analysis used by objective.

Table 1
Analytical Procedures by Objectives

Objective	Procedure	Description
a. Rank farmers' current use of ICT services and the gratifications they receive from using different services	Descriptive Statistics	Summary frequency counts based on aggregate responses. Presented as percentages.
b. Rank farmers' preferences for digital content and communication mediums		
c. Assess the relationship between farmers' age, education, and current ICT use	Point-Biserial correlation and Phi coefficient	<i>Point-Biserial correlation</i> : Shows current ICT use by farmers' mean age. Correlations indicated if there was a statistically significant relationship between age (interval variable) and current ICT use (binary variable) at $p < 0.05$. <i>Phi coefficient</i> : Describes current ICT use by educational level. Phi coefficients indicated if there was a statistically significant relationship between ICT use (binary variable) and education (binary variable) at $p < 0.05$
d. Assess the most preferred content and medium for farmers with Internet-enabled smartphones	Descriptive Statistics	Summary frequency counts based on responses. Presented as percentages.

Sample Characteristics

Most responding farmers were males (85%, $n = 170$), about 48 years old on average, and relied on farming as their main source of income (75%, $n = 150$).

Approximately 45% ($n = 90$) had at least secondary level education, 35% ($n = 70$) of farmers had primary education, 17% ($n = 33$) completed tertiary/college education, and 3% ($n = 7$) had no formal education. About 58% of farmers ($n = 116$) did not belong to a farmers' group of the ASTT. The largest portion of farmers (37%, $n = 72$) stated they never received visits from extension officers, 31% ($n = 61$) said they received visits once per year, 24% ($n = 46$) indicated monthly visits, and 8% ($n = 15$) stated they received weekly visits. With respect to ICT familiarity, 42% ($n = 84$) of farmers used Facebook, 55% ($n = 110$) used the Internet to access agricultural information, and 62% ($n = 124$) of farmers owned an Internet-enabled smartphone.

Results of this study may not be generalizable to the population of Trinidadian farmers due to the sampling technique used. Correlations provide an indication of relationships within the sample and does not imply the relationship holds true for the population. ICT services, mediums, and content were selected based on the literature review and input from the expert panel; they may not reflect all the ICTs used by farmers.

Results

Farmers' Current Use of ICT Services

Table 3 provides a descriptive overview of the types of ICT service used by farmers. Differences in rankings between ICT services listed in rows were based on frequency counts. Results showed reading text messages was most popular service among farmers (81%), following by sending text messages (74%). Receiving and sending pictures (60% and 58%), WhatsApp messages (56%), and sending videos (55%) were the third most popular services used by farmers. Sending and receiving emails and receiving and making Skype calls were the least popular services used by farmers.

Gratifications Across all ICT Services

Table 3 also shows the gratification received from using each ICT service. Differences in ranking of gratifications across ICT services listed in columns were based on frequency counts. Results indicated farmers used all services mostly to communicate with family and friends. Accessing agricultural information was ranked a distant second, while relaxation was ranked as the third reason for using the services. Lastly, accessing non-agricultural information, and "other" were ranked as the fourth and fifth reasons for using the services. SMS and WhatsApp were most popular for accessing agricultural information

Table 3
Uses and Gratification from ICT Services

Rank	Service	Use %	n	Gratification: %, n				
				<i>R</i>	<i>F</i>	<i>I</i>	<i>A</i>	<i>O</i>
1	Read text messages	81	162	25	82	33	30	26
				41	133	53	49	42
2	Send text messages	74	148	26	88	34	30	25
				38	130	50	44	37
3	Receive pictures	60	121	44	80	24	31	23

				53	97	29	38	28
4	Receive videos	58	116	44	75	22	30	28
				51	87	26	35	32
5	Send pictures	56	112	41	84	26	32	26
				46	94	29	36	29
5	Read WhatsApp messages	56	113	42	87	33	40	22
				47	98	37	45	25
6	Send WhatsApp messages	55	109	41	86	35	44	25
				45	94	38	48	27
6	Send videos	55	110	43	81	23	31	27
				47	89	25	34	30
7	Receive emails	35	69	15	70	46	33	45
				10	48	32	23	31
8	Send emails	34	68	13	69	46	35	44
				9	47	31	24	30
9	Receive Skype calls	19	37	14	76	14	24	22
				5	28	5	9	8
10	Make Skype calls	18	36	11	81	14	22	19
				4	29	5	8	7
Ranked gratification across all services				3	1	4	2	5

Note: R: Relaxation, F: Family and Friends, I: Non-agricultural information, A: Agricultural information, O: Other.

Farmers' Preferences for Digital Content

Table 4 shows the various types of information farmers seek from extension services. Differences in farmers' preferences for content were based on frequency counts. Results indicated farmers were most interested in receiving information relating to controlling pest and diseases (97%), market prices (95%), prices of chemicals (95%), advice from an extension officer (93%), weather (93%), emergency assistance (93%), and new agricultural equipment (92%). Dates of farmer training courses (87%) was ranked fifth in the type of content desired by farmers, followed by information on agricultural loans (79%).

Farmers' Preferences for ICT Mediums

Table 4 shows the most preferred mediums of receiving agricultural content.

Differences in farmers' preferences for ICT mediums were based on frequency counts. Results indicated text messages was most popular, followed by voice calls and face-to-face interactions. The Internet ranked as the least preferred medium for receiving agricultural content. Most farmers indicated they would prefer face-to-face interactions to get advice from an extension officer (57%, $n = 105$) and information on controlling pest and diseases (51%, $n = 98$). In contrast, many farmers stated they would prefer to receive weather information, dates of farmer training courses, market prices, and chemical prices via text messaging. About half the sample of farmers (50%, $n = 93$) indicated they preferred voice calls to get emergency assistance.

Table 4
Preference for Digital Content and Medium of Delivery

Rank	Information Type	Yes %	n	Medium: %, n			
				T	V	F	I
1	Controlling pest and diseases	97	192	42	40	51	37
				81	77	98	71
2	Market prices	95	188	55	41	39	36
				103	77	73	68
2	Prices of chemicals	95	188	48	38	43	32
				90	71	81	60
3	Advice from an extension officer	93	185	43	45	57	22
				80	83	105	41
3	Weather information	93	185	53	31	26	38
				98	57	48	70
3	To ask for emergency assistance	93	185	41	50	42	24
				76	93	78	44
4	New agricultural equipment	92	182	37	31	44	39
				67	56	80	71
5	Dates of farmer training courses	87	174	58	41	37	31
				101	71	64	54
6	Information on agricultural loans	79	158	41	38	49	31
				65	60	77	49
Ranking of preferred medium				1	3	2	4

Note: T: Text message, V: Voice calls, F: Face-to-face, I: Internet.

Relationships between Farmers' Age and Current ICT Use

Table 5 provides a descriptive summary of farmers' ICT use based on their age. Results indicated a statistically

significant and negative correlation between all ICT service use and farmers' age, except for making and receiving Skype calls. As farmers' ages increased, they were less likely to use the ICT services listed.

Table 5
ICT Service Use by Age

ICT Service	Mean Age (SD)		Point-Biserial Coefficient (r)
	Use	Do not use	
Send text messages	44.88 (11.52)	55.88 (10.25)	-0.40*
Read text messages	45.60 (11.60)	56.71 (10.89)	-0.36*
Send pictures	43.64 (11.05)	52.89 (11.65)	-0.38*
Receive pictures	43.31 (10.95)	54.44 (10.90)	-0.45*
Send videos	43.12 (11.27)	53.32 (10.90)	-0.42*
Receive videos	43.36 (10.97)	53.71 (11.25)	-0.42*
Send WhatsApp messages	43.39 (11.07)	52.89 (11.48)	-0.39*
Read WhatsApp messages	43.51 (10.99)	53.16 (11.55)	-0.39*
Send emails	41.15 (11.26)	51.09 (11.28)	-0.39*
Receive emails	41.45 (11.45)	51.01 (11.27)	-0.37*

Make Skype calls	44.81 (12.17)	48.35 (12.14)	-0.11
Receive Skype calls	44.62 (12.05)	48.41 (12.15)	-0.12

Note: * $p < 0.05$

Relationships between Farmers' Education and ICT Use

Table 6 shows farmers' ICT service use based on their education levels. Results indicated there were statistically significant differences in all ICT service use by educational level, except making and

receiving Skype calls. However, more than half the number of farmers within both education categories used SMS to send and receive text messages. In addition, more than half the number of respondents with secondary or higher education used all the ICT services except emails and Skype.

Table 6
ICT Service Use by Education

ICT Service (Use = Yes)	Education: % (<i>n</i>)		Phi (ϕ)
	\leq Primary	\geq Secondary	
Receive emails	13 (10)	48 (59)	.36*
Send WhatsApp messages	33 (25)	68 (84)	.35*
Send emails	13 (10)	47 (58)	.35*
Read WhatsApp messages	35 (27)	70 (86)	.34*
Send pictures	35 (27)	69 (85)	.33*
Receive pictures	40 (31)	73 (90)	.33*
Receive videos	38 (29)	71 (87)	.33*
Read text messages	65 (50)	91 (112)	.32*
Send videos	35 (27)	68 (83)	.32*
Send text messages	58 (45)	84 (103)	.28*
Receive Skype calls	12 (9)	23 (28)	.14
Make Skype calls	12 (9)	22 (27)	.13

Note: * $p < 0.05$.

Preferred Content and Mediums for Farmers with Smartphones

From Table 7, frequency counts indicated text messages and the Internet were ranked as the most preferred mediums respectively across all information types for farmers with smartphones, followed by voice calls. Face-to-face interactions were ranked as the least preferred medium for receiving agricultural content for farmers with smartphones. About half the sample of farmers with smartphones stated they would like to receive weather information (51%, $n = 60$), information on pest and diseases (50%, $n = 61$), and information on new

agricultural equipment (50%, $n = 57$) through the Internet. Most farmers with smartphones stated they would like to receive information on the prices of chemicals, market prices, weather information, dates of farmer training courses, and agricultural loans through text messages. About 49% of farmers with smartphones ($n = 57$) indicated they preferred voice calls for emergency assistance. However, most farmers with smartphones preferred face-to-face interactions for advice from an extension officer (53%, $n = 61$).

Table 7
Preference for Content for Farmers with Smartphones

Rank	Information Type	Yes %	n	Medium: %, n			
				T	V	F	I
1	Controlling pest and diseases	99	122	46	38	44	50
				56	46	54	61
2	Prices of chemicals	97	119	54	36	37	44
				64	43	44	52
3	Market prices	96	118	59	39	32	49
				70	46	38	58
4	Weather information	95	117	55	29	15	51
				64	34	18	60
4	To ask for emergency assistance	95	117	43	49	36	32
				50	57	42	37
5	Advice from an extension officer	94	116	47	41	53	29
				55	48	61	34
6	Dates of farmer training courses	93	114	60	34	29	37
				68	39	33	42
7	New agricultural equipment	92	113	37	29	30	50
				42	33	34	57
8	Information on agricultural loans	85	105	39	32	37	34
				41	34	39	36
Ranking of preferred medium				1	3	4	2

Note: T: Text message, V: Voice calls, F: Face-to-face, I: Internet.

Discussion, Conclusion & Recommendations

This study, guided by the Uses and Gratification theory, assessed farmers' preferences for ICT mediums and agricultural information. Consistent with Ruggiero's (2003) discussion on the increased availability of different communication mediums, results showed farmers engaged with a variety of ICT services. Almost all farmers used text messaging, and most used multimedia messaging and WhatsApp, a smartphone communication application. While Tantisantisom (2011) and Kameswari et al. (2011) found some farmers in Thailand and India respectively were unable to use mobile phones due to a high level of perceived complexity, Trinidadian farmers appeared comfortable and competent in using modern ICTs.

Most farmers received gratification from using ICT services to communicate with family and friends instead of accessing agricultural information. However, more than a third of the farmers surveyed used WhatsApp for agricultural information. While two-way ICTs are not well-established as a method of engaging with extension services, results showed accessing agricultural information was an important gratification of farmers' ICT use. Therefore, some farmers received gratification by using ICTs for surveillance of relevant topics; this implies farmers may be receptive to using ICTs such as text messaging, multimedia messaging, and smartphone applications for extension services. According to Ruggiero (2003), the U&G theory provides a framework to understand the type of media people use and the gratifications they receive from using the media. Overall, results indicated most farmers used mobile

phones to send text, multimedia, and WhatsApp messages to connect with family and friends. Hence, ICTs provided gratification to farmers mainly in the form of personal relationships; the use of media and content for companionship and social interaction (Hammes, 2016).

This study supports the assertion that age and technology literacy affect farmers' use of ICTs (Kameswari et al., 2011; Mallenius, Rossi, & Tuunainen, 2007). Results indicated younger farmers and those with at least secondary level education were more likely to use text messaging, multimedia messaging, WhatsApp, and emails. Still, most farmers used basic text messaging regardless of age and education. This implies text messaging may be an appropriate platform to facilitate two-way interactions between Extension officers and all farmers irrespective of their age and education level.

Consistent with Martin and Abbott (2011), results showed most farmers wanted information on all agricultural content examined. Bell (2015) and World Bank (2017) discussed matching content type to the appropriate ICT platform. Farmers preferred text messaging for market prices, weather information, and dates of farmer training courses. These types of information are easily transmitted through basic text messaging and require little effort for the end user to understand (World Bank, 2017). In contrast, farmers preferred voice calls for emergency assistance. Voice calls are appropriate because it enables quick response to urgent problems. Farmers preferred traditional face-to-face interactions for controlling pest and diseases, advice from an extension officer, information on new agricultural equipment, and information on agricultural loans. This indicates farmers prefer talking to extension officers about more complex topics. It appears farmers were deliberate in their selection of medium

for receiving different types of information. This suggests they are knowledgeable on the suitability of ICTs for different types of agricultural information.

Farmers with smartphones exhibited different preferences for communication mediums. Overall, farmers preferred text messaging and the Internet over voice calls and face-to-face interactions for agricultural information. Most farmers with smartphones preferred the Internet for information on controlling pest and diseases and new agricultural equipment. It is likely that farmers with smartphones may first use the Internet to search for information and will consult with an extension officer only if unsuccessful in their own search; this should be explored in future research. According to the U&G, farmers will reevaluate their medium selection if their needs are not met (Blumler, 1979). Since farmers may search the Internet before contacting extension, it is critical Extension officers have the capacity to provide farmers with relevant information beyond what is available online.

This study bears important implications for extension service providers in developing countries. Consistent with Bell (2015), results showed farmers' preferred medium were appropriately matched to the information type. As such, there is potential for the Ministry Extension to diversify its approach to serving farmers through two-way ICTs. ICTs can complement farm visits to ensure farmers' needs are met in a timely manner. Extension officers can use voice calls and farm-visits to assist farmers with urgent and complex problems, while SMS can be used to disseminate information on market prices, prices of chemicals, weather updates, and dates of training courses. Therefore, extension providers should seek to take advantage of appropriate mediums such as text messaging, multimedia messaging, and

smartphone communication applications to meet farmers' needs.

Ministry Extension should reassess their methods of communicating with farmers. However, the traditional farm visit method is still an important approach to providing general advice to farmers. While farmers commonly used modern ICTs, it appears they appreciate the personalized face-to-face meetings with extension officers. Two-way ICTs are contextually appropriate for communicating with Trinidadian farmers on a regular basis between scheduled farm visits. It is recommended Extension adopts new communication channels to communicate with farmers as farmers appear competent, ready, and willing to receive extension services via modern ICT services and mediums.

Effective use of modern ICTs may require Extension officers engage in professional development to build their skills in using modern ICTs to communicate with farmers. In addition, Ramjattan (2016) indicated a lack of enabling policy and managerial support for using ICTs. As a result, it is critical an appropriate policy encourage extension officers' use of a combination of technologies to meet the diverse needs of farmers' (McNamara et al., 2017). ICTs can be effective in easing the burden of extension officers seeking to meet the demand of many farmers.

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