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Attributes of Diffusion of Innovation's Influence on Smallholder Farmers' Social Media Adoption in Mpumalanga Province, South Africa

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Abstract: The adoption and utilization of social media as an advisory tool among smallholder farmers is relatively unexplored. Social media has the potential to enhance communication, making agricultural information easily available in the sector. This study investigated the relationship between the attributes of the diffusion of innovation theory and the socio-economic characteristics that influence social media adoption. An independent samples t-test and a one-way ANOVA were used for data analysis. The sample size was 217 smallholder farmers in the Nkomazi local municipality. The results revealed that the difference in the diffusion of innovation attributes based on gender, age, co-operative membership, and level of education had a statistically significant difference ($p < 0.05$). The findings suggest that extension services and other stakeholders including those in the private sector and policymakers should encourage wider adoption of social media by smallholder farmers. Governments need to invest in infrastructure such as community computer labs for training and access to social media. Open-access social media platforms that allow free internet access should also be considered for development. Additionally, policymakers should consider developing guidelines that encourage online advisory services, learning and information dissemination.

Keywords: social media; adoption; diffusion of innovation; advisory tool; socio-economic; smallholder farmers

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1. Introduction

The adoption and utilization of social media as an advisory tool among smallholder farmers is relatively unknown, as opposed to other mediums of communication. Varying mediums of communication and information dissemination relay information that assists people in their problem solving and decision-making. Social media as an advisory tool has the potential to allow smallholder farmers to not only be passive receivers of information, but also co-creators and interactors with information [1]. Most smallholder farmers make use and obtain information on agriculture from public libraries, websites, and direct contact with agricultural extension officials [2]. Agricultural extension officials are not many compared to the number of smallholder farmers, which calls for innovative ways of providing agricultural support and advisory services [3]. Other studies similarly found that even with governmental efforts for agricultural improvement, smallholder farmers have challenges with receiving adequate advisory services. On the other hand, agricultural extension officials have limitations of inadequate resources to provide advisory services appropriately [4–6].

Social media provides its users with many options as a medium for advisory services. There are thousands of social media platforms, sites and applications for varying target groups. For instance, applications such as WhatsApp and Telegram focus on direct communication between close associates or friends and constitute innovative tools such as direct messaging and media sharing such as videos, pictures, and audio content. Sites such as Facebook, Instagram, and Twitter emphasis innovative tools such as media sharing

and blogging and have elements of instant messaging. Though the utilization of social media platforms has increased, other sites have acquired less traffic and even terminated due to assertive competition [7]. The Myspace social media platform was unsuccessful in providing navigation, which led users to cyber-migrate to new sites and platforms [8–10]. The cyber-migration of mostly the young to platforms that better satisfy their usage needs, results in users reaching a certain level of indulgence that is gained through utilizing social media [11]. The predisposition of social media adoption is dependent on psychological motives, which encompass social, biological, and personal motives [12,13].

Using psychological motives to observe the adoption of new technologies in agriculture can play a vital part in improving social media as an innovation that is useful in agricultural practices. However, smallholder farmers do not adopt new technologies for their mere existence and availability [14]. According to Kumar et al. [14], the decision to adopt innovations is highly complex, as smallholder farmers must consider a range of factors to determine whether the technology is in their best farming practices. The adoption of agricultural technologies and innovations is influenced by several factors, such as institutional and infrastructural resources, perception of smallholder farmers, resource utilization efficiency, and economic and social policies [15]. According to Rogers's [16] diffusion of innovation theory, there are five characteristics of innovation that assist in the degree to which innovations are adopted. The five characteristics of innovation are compatibility, relative advantage, observability, trial-ability, and complexity [16,17]. The diffusion of innovation theory strives to clarify why, to what degree, and how new technologies and other advancements make their way through cultures and socialites [16].

Employing the diffusion of innovation theory can assist in understanding the potential of social media in agriculture. Especially given the diminutive utilization alongside the lack of awareness of social media in rural areas [18]. Social media has the potential to provide inducements, which will make agricultural information easily available in the agricultural sector [19]. It is necessary to be cognizant of which psychological motives influencing smallholder farmers' adoption and utilization of social media within the agricultural sector. The availability and affordability of ICT projects such as social media in agriculture can intensify communication and information dissemination about agricultural practices. Social media may limit constraints among smallholder farmers and extension personnel concerning sharing and disseminating information about agricultural practices [20]. Moreover, it can provide smallholder farmers with essential information on increasing productivity and thus ensuring food security. Especially, given the fact that about 30.8% of households in the Mpumalanga province are food insecure, with 22% being moderate and 8.8% being severe [21]. Smallholder agriculture plays an essential role in the improvement of food security through its access, contribution to food availability, dietary diversity and stability [22–24]. In turn, smallholder food production is one of the sustainable strategies in combating food insecurity, given that smallholder farmers are under-resourced [25–27]. Additionally, agriculture plays a pivotal role in employment and income generation [28]. Therefore, in practice, agricultural advisory tools are used to take necessary measures in implementing steps or approaches in advisory services [29]. According to Kuria [2], users of social media platforms, applications, and sites generate the content and shape it to their desires or needs. This makes social media an ideal advisory tool. The platforms, applications and sites of social media can strengthen and complement traditional methods of advisory services in sharing information by facilitating and shaping content using mediums such as personal computers and smartphones. Therefore, this study aimed to determine the influence of the technical attributes of the diffusion of innovation theory on the adoption of social media. The main objective was to investigate the difference in technical attributes of the diffusion of innovation theory based on the socio-economic characteristics of smallholder farmers in the Nkomazi local municipality.

2. Literature Review

2.1. Theoretical Framework: Rogers' Diffusion of Innovation Theory

The diffusion of innovation theory is one of the most popular concepts in exploring the dynamics that influence an individual's adoption of new technologies and innovations [30]. According to Kumar et al. [14], most literature about agricultural technology adoption highlight factors that are not discrete and that have inadequate restrictions, which tend to overlay effective adoption decisions because of co-dependency. These factors include institutional and infrastructural resources, perception of smallholder farmers, resource utilization efficiency, and economic and social policies [14]. The complexity of separating these factors is often challenging due to their influence on innovation adoption. The diffusion of innovation theory is a far-reaching psychological and social theory that is aimed at assisting in predicting how individuals make decisions for adopting new technologies or innovations by identifying their patterns of adoption and understanding its structure [31]. Min et al. [31] further state that the diffusion of innovation theory models human decisions towards adopting new technologies as a multi-stage process encompassing persuasion, knowledge, decision-making, implantation, and confirmation, also known as the innovation-decision process concept.

The multi-stage processes of the diffusion of innovation theory result in it becoming a metatheory. This implies that the theory is not all-inclusive or singular, yet it constitutes several frameworks or theories that serve to include and exclude certain concepts from one's perspective [32]. The foremost theories that have to do with the diffusion of innovation encompass the innovation-decision concept which involves the multi-stage processes, the adoption rate concept, perceived attributes concept, and individual innovativeness [17]. The individual innovativeness concept characterizes persons into five categories of adopters: innovators, early adopters, the early majority, the late majority, and the laggards [17,33].

Innovation perceived attributes concept has been suggested as an intermediary for people's adoption of social media and has features that ought to intensify the adoption rate concerning new technologies [16,34]. The characteristics of innovation are an essential concept that determines the adoption of technology and whether the prognostic capacity of the variable is strong [7,35]. The characteristics of innovation are operationalized as the structures of innovation that individual people observe as convenient in explaining adoption rates. Rogers's [16] diffusion of innovation theory identifies five characteristics of innovations such as social media that influence adoption: compatibility, relative advantage, observability, complexity, and the trial-ability of social media. The characteristics of innovation are the features offered by new technology such as social media that can provide smallholder farmers with an inordinate level of experience along with a high level of gratification, and through which adoption can be encouraged [7]. It is imperative to understand the perceived attributes concept and the individual innovativeness concept to recognize the linkage among the categories of innovation adopters and the characteristics of innovation concerning social media adoption. Figure 1 below represents the perceived characteristics of the diffusion of innovation theory.

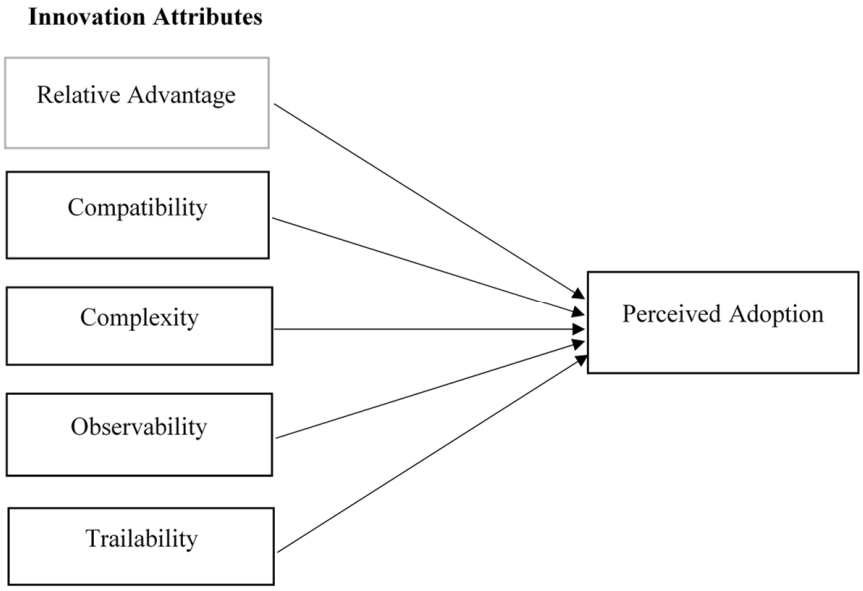

Figure 1. Perceived characteristics of the Diffusion of Innovation Theory (Adapted with permission from Mannan & Nordin [36]).

Technical Attributes of the Diffusion of Innovation Theory

Relative advantage: the relative advantage can be viewed as the extent to which new technology is apparent as providing enhanced benefits or working practice than its antecedent [30,37]. According to Rogers [16], factors such as enhanced status, increase efficiency, and economic growth can result from a relative advantage. The improvement in productivity and cost-effectiveness are key drivers in the adoption of innovations [14]. Relative advantage may be a strong predictor of the adoption of new technology by smallholder farmers, as the nature of new technologies define the type of relative advantage that an adopter finds important [7,38]. Other studies have investigated extensively on the relative advantage of mobile banking [30,39,40], and social media adoption and its impact as well as the resulting tactics [41,42], along with the adoption of M-payment services [43,44]. The forms of social media are different and how individual smallholder farmers perceive it may be different. Even though relative advantage may be broad, it is a good function as a perceptual concept. It is generalizable across varying disciplines for determining a perceived accomplishment of an innovation's intended purpose compared to an earlier innovation [44]. Social media sites, as well as platforms, provide benefits such as affordability, convenience, and immediacy. These benefits allow for a higher likelihood of adoption and most likely positively affect it and are linked with the perceived current and previous experience of smallholder farmers, which links them to compatibility [30].

Compatibility: the compatibility of innovation can be referred to as how well a new technology, such as social media, plays a part in the processes, consumption, and supply and demand of the users in terms of their needs [38]. It is the extent to which new technology is observed as being constant with the adopter's present and previous experiences, values, habits, beliefs, and potential needs of the adopter [16,37]. Compatibility plays a vital part in examining how a potential adopter's previous experience with similar innovations can affect their attitude towards adoption and the intention to use social media [31]. An innovation that is highly compatible with smallholder farmers has less uncertainty, more consistency and fits well with the smallholder farmers' situation. According to Zolkepi and Kamarulzaman [7], an innovation that is not compatible with the values of smallholder farmers can inhibit the adoption of innovations. Therefore, the innovation should be compatible mostly with previously adopted innovations and cultural values. A positive relationship was found from previous literature [14,31,37] between people's adoption of new technology and compatibility. The more compatible a particular social media platform

aligns closely with smallholder farmers' innovation needs, previous and current experiences, and values the higher its potential to be adopted. Poor innovation compatibility makes it difficult for innovations to be introduced and utilized by potential adopters [45]. Zhu and Kraemer [45] further state that if a different information innovation such as social media is perceived to be challenging to use or necessitates substantial training and learning, it lowers the rate of the innovation to be adopted by smallholder farmers.

Trial-ability: trial-ability speaks of the degree to which new technology may be tested with some degree of restriction [37]. Innovations that can be tested are generally more easily adopted. The individual testing of innovations in a manner in which smallholder farmers can have an understanding of the new technology, allowing for the examination of how the technology functions under the smallholder farmer's conditions, plays a role in whether they adopt it or not [7]. Trial-ability allows the users of innovations to experiment with the new technology, permitting smallholder farmers to clarify doubts and know how the innovation may assist them [14]. According to Rogers [16], innovations that can be tried based on an instalment in a limited space and time will be adopted more rapidly than less trial-able innovations. Social media platforms comparatively are very easy to utilize, and the technology can be tried and tested on a foundation that is limited before adoption across different smallholder farmers [38]. The characteristics and attributes of social media mostly relating to the platforms allow for individuals to try the innovation before their full adoption, enabling the technology to be amended during the trial period [7,16].

Observability: this characteristic of innovation is defined as the degree to which the outcomes of new technology are apparent to the external environment [37]. Rogers [16] states that the observability of innovation is the level at which the technology is visible to people in a particular social system and the ease at which the benefits can be observed and communicated. The more easily smallholder farmers can observe the results of the new technology such as social media, the more likely they are to adopt it [16]. Furthermore, such reflectivity encourages peer discussions concerning new technologies, as neighboring smallholder farmers and friends of adopters most commonly require appraisal information concerning the innovation. According to Park and Chen [46], the observability of new technologies has a positive consequence on the adopters' attitude, as the new technology such as social media, provides different benefits to users before they select any communication application.

Complexity: complexity can be referred to as the extent to which new technology is seen as challenging to use, understand, and implement [37]. The complexity of innovation can cause users to not understand the functionality of the introduced technology. Complexity is included to examine the functional aspects of social media as an independent technical variable. Certain innovations are much easier and clearer in meaning to adopters and users, whereas others are not and result in a lack of adoption [16]. Complexity arises depending on the level of change required from traditional methods for communication [47]. The changes may include incremental changes to already existing technology; radical innovation in which management and technology are greatly different; changes in design that require amendments in management; and linked changes to the process of management without technological changes to design [48]. Social media may be viewed as a difficult internet tool with complex procedures. This would make smallholder farmers feel that social media applications are not useful to them and are difficult to use compared to contacting an agricultural extension official through a phone call [31].

3. Materials and Methods

3.1. Study Area

The study area was in the Nkomazi local municipality. It in the eastern part of the Ehlanzeni district municipality in the province of Mpumalanga, South Africa. Mpumalanga province has approximately 263,391 agricultural households involved in livestock and crop production, and 28,004 of the agricultural households are in the Nkomazi municipality [49]. Crops mostly cultivated in the province include leguminous crops, maize, barley, sugar

cane, and wheat [50]. Other crops cultivated within the region include nuts, deciduous and subtropical fruits, tobacco, citrus, cotton, coffee, and tea [51]. The Nkomazi local municipality forms a strategic borderline in the middle of the east of Mozambique and the north of Swaziland. The linkage between the middle of Mozambique and the municipality is through the N4 main national road along with a railway line that generates the Maputo Corridor and the linkage between Swaziland and the municipality through the two provincial roads [40]. Umjindi local municipality borders Nkomazi local municipality in the west direction, the Kruger National Park in the north, and Mbombela local municipality northwest to the west direction [52]. The municipality encompasses 23 per cent of the Ehlanzeni district municipality and 4.07 per cent of the entire province of Mpumalanga [40]. According to the Nkomazi municipality IDP [53] and Municipalities South Africa [52], the largest employing industries in the study area are community services with an employment rate of 19.2%, trade has an employment rate of 19.7%, and agriculture has the highest at 22.8%. Other industries include transport with 4.3%, finance with 7.9%, construction has an employment rate of 7.9%, utilities have a rate of 1.2%, mining having only 1%, and manufacturing with 6.4%. The characteristics and the selection of the study area were reliant on literature as well as the contextual information, the objectives of the study, and practices, these characteristics included socio-economic, and constraints or barriers of smallholder farmers in adopting new technologies. Figure 2 below represents the locality of the Nkomazi local municipality.

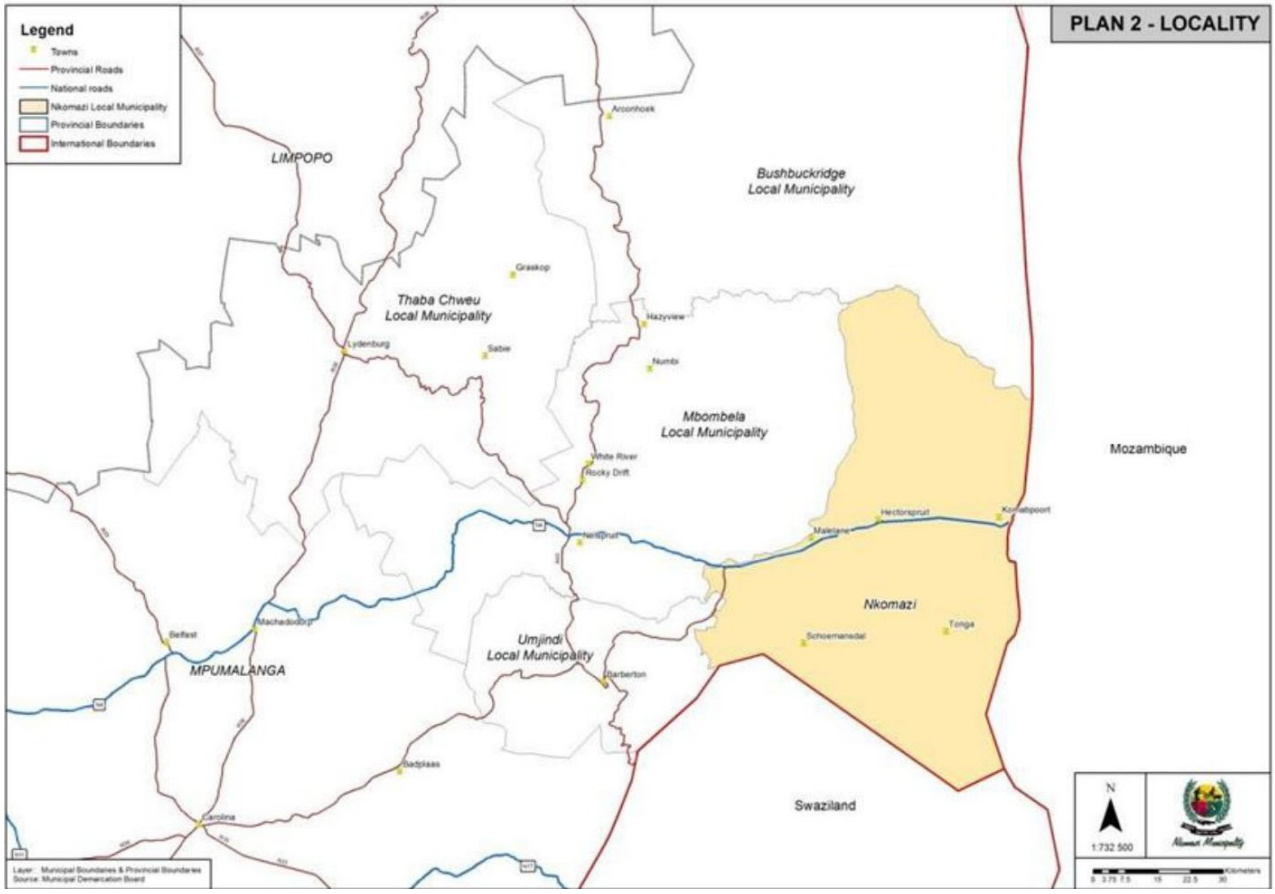

Figure 2. Nkomazi local municipality, Ehlanzeni district municipality, Mpumalanga, South Africa [53].

Research Design

Quantitative research strategies were utilized. A cross-sectional survey employing a structured questionnaire was used to allow for the fundamental scheme to be suitable for

all the principles of a research study allowing the outcomes to be relevant, though with limited generalizability, free from prejudice, and dependable [54,55]. The study utilized non-probability sampling techniques. Non-probability sampling entails not forcefully imposing an opinion of probability that the features within the study area might have a chance of being encompassed in the study sample [8]. The participants were selected using convenience sampling. The sampling technique is one where the participants of the target population meet a criterion such as their geographical location, ease of access, willingness to take part in the study, and general availability of the participants [56]. Both livestock and crop smallholder farmers were sampled to mitigate sample biases. The participants were selected as they occur spatially and administratively to where the research was conducted [56].

The convenience sampling technique was used to achieve a precise sample size for this research study concerning the unabridged farming population in the municipality. In applying this type of sampling technique, a house-to-house approach was used to interview smallholder farmers in communities with obvious smallholder farms out in the open. Colleagues and known individuals within the area assisted with referrals that provided some of the most convenient areas to conduct the study as well as the relevant community leaders to contact for assistance. The intended sample size utilized Yamen's [57] simplified formula for proportions was 378 calculated using the total of 28,004 smallholder farmers in the municipality. The actual sample size for the study was 217. The intended sample size was not reached due to COVID-19 restrictions, time constraints faced by smallholder farmers, geographical location of smallholder farmers, reluctance of extension officials to provide farmer information, and the type of sampling method used.

3.2. Data Collection and Analysis

A structured questionnaire can be referred to as a document, which constitutes a set of closed-ended questions that have a fixed pattern, in which the precise order and wording of questions or statements are specified, allowing for information to be gathered from participants [58,59]. A Likert scale model was utilized in the survey, which measures attitudes using five points; agree, strongly agree, neutral to disagree and strongly disagree [60]. The Likert scale is a set of viewpoint statements, wherein the statements stand regarded as constituting a significance that is fundamentally equivalent in assertiveness [60,61]. The data was analyzed using descriptive and inferential statistics. An independent-samples *T*-test and one-way ANOVA were employed to analyze data. Descriptive statistics were used to analyze the demographics in the study, such as the mean, percentages, and standard deviation [62]. Inferential statistics use probabilistic methods in analyzing sample data from a particular population [63]. The Statistical Package for Social Sciences (SPSS) 27 was utilized to analyze all the data.

4. Results

4.1. Demographic Characteristics of Smallholder Farmers

The results represented in Table 1 were obtained from the study concerning smallholder farmers' demographic characteristics.

The data obtained from the survey concerning demographic characteristics is presented in Table 1. The majority (52.6%) of smallholder farmers were in the age bracket <20–39. Smallholder farmers in the age group 40–49 were 17.5%. Smallholder farmers in the age group 50–59 made up 16.1%. The second least number of smallholder farmers was made up of the age group of 60 years and above with 13.9%, and the least number of smallholder farmers was found in the age group of those under 20 years of age with 3.5% of smallholder farmers. These findings do not concur with other studies that found the majority of smallholder farmers are of an older age group and that there is a lack of youth involvement in agriculture [64–66]. These findings are positively related to social media adoption as an advisory tool as other studies have found that digital natives being the younger generation are more likely to adopt innovations rather than

digital immigrants [67–70]. A link can be drawn concerning the fact that agriculture is the highest employing industry within the area with 22.8% [53]. Another link can be drawn concerning the unemployment levels present in the Mpumalanga province, pushing younger people to other sources of employment and entrepreneurship such as agriculture. According to the Mpumalanga Provincial Government [65], 63.3% of digital natives aged 15–24 are unemployed and 41.3% of digital natives within the age bracket of 25–34 are unemployed.

Table 1. Demographics Characteristics Summary (n = 217).

Variable	Description	Frequency	Percent
Age	<20	8	3.5
	20–29	63	27.4
	30–39	50	21.7
	40–49	40	17.4
	50–59	37	16.1
	60+	32	13.9
Gender	Female	105	48.4
	Male	112	51.6
Farm size (ha)	<5	99	45.6
	6–10	82	37.8
	11–20	21	9.7
	21–30	2	0.9
	31–40	7	3.2
	40<	6	2.8
Co-operative membership	No	180	82.9
	Yes	37	17.1
Social Media Use	No	117	53.9
	Yes	100	46.1
Electronic device owned	None	13	6.0
	Basic cell phone	89	41.0
	Smartphone	103	47.5
	Smartphone/laptop	12	5.5
Level of education	No school	39	18
	Primary	54	24.9
	Secondary	67	30.9
	Matriculated	33	15.2
	Agricultural certificate	7	3.2
	Diploma	12	5.5
	Degree	5	2.3

In terms of gender, men were majority (51.6%) of the smallholder farmers. These findings concur with Janavi et al. [19], who found that there are more male smallholder farmers than females. Myeni et al. [66] also found that males make up most smallholder farmers in South Africa. Contrary to these findings', other studies [71–73] found that there are more females heading farming households as opposed to males. Gender plays an important role in adopting innovations as an advisory tool, as it reveals the variations of users and their general preferences in terms of social media sites, platforms, and applications [74]. The findings agree with results from other studies, that males more than females adopt social media and that females tend to be less involved in technology adoption [19,75]. However, these findings did not concur with other studies that found that females more than males find social media to be useful and compatible with their needs [76–79]. This being that females tend to more involved in digital platforms. Furthermore, the male demographic in this study was larger than that of females.

The study also revealed that there were a high number of smallholder farmers (45.6%) with a land size of 5 hectares or less. According to Lehohla [50], about 68% of the land in the Mpumalanga province is used for agricultural purposes. Although this is the case there is not much information about the locations of small farms, which makes it difficult to estimate their numbers [80]. In concurrence with the findings of this study, Samberg et al. [80] found that there are very few smallholder farms with a land size of five or fewer hectares in sub-Saharan Africa making up 11% of smallholder farming communities. Furthermore, smallholder farmers often cultivate on very small plots of land and are the most prevalent form of agriculture globally, with family-scale production and labor [80,81].

The majority (82.9%) of smallholder farmers were not part of a co-operative. The findings are concurrent with those of Mojo, Fischer and Degefa [82], who found that most smallholder farmers were not part of a co-operative, with only 46% being members and 54% not being members. Similarly, Nwafor, Ogundeji and van der Westhuizen [83] found that only 13% of smallholder farmers were part of a co-operative, and most of them were not members of a co-operative.

The results also suggested that in terms of social media use, most smallholder farmers (53.9%) did not make use of social media even though there is a high number (47.5%) of them with smartphones. These findings agree with previous literature that suggests that most smallholder farmers do not use social media [29,84–87]. Furthermore, smallholder farmers are not aware of the benefits that social media can provide in terms of it being used as an advisory tool [85]. Smallholder farmers also lack the skills and knowledge of using social media and its platforms, resulting in lower usage [48]. Smallholder farmers' level of literacy also plays a crucial role in their adoption of social media. Most smallholder farmers have a minimum level of formal education more especially when it comes to the utilization of digital technologies, which negatively impacts their adoption of social media.

The findings from the study revealed that a high number (47.5%) of smallholder farmers own smartphones that can access social media, and those that own a basic cell phone cannot access social media (41%). These findings suggest that many smallholder farmers owned some type of electronic device. These findings are in agreement with other studies that suggest that many smallholder farmers may own mobile devices, but constraints such as perceptions of mobile phones being used only for voice communication, credit or data charges, and battery power limits stifle social media use [80,87–90]. Additionally, smallholder farmers do not necessarily have the awareness of using social media as an advisory tool. This limits them from investing in smart devices that have the necessary applications such as WhatsApp, Facebook, and other platforms in which agricultural information can be disseminated.

The study further found that 30.9% of smallholder farmers had a secondary level of education, followed by those with a primary level of education constituting 24.95%, and 18% had no schooling at all. It was also found by community survey [91] that most smallholder farmers have a limited level of education, with a majority having a secondary to no school level of education. This implies that most smallholder farmers had a limited to low level of education. These findings agree with other studies that found that smallholder farmers do not have very high levels of education, which influences their adoption rate [15,92–94]. These low levels of education result in a lack of literacy and awareness of the advantage of social media in disseminating agricultural information. Additionally, it makes it difficult for smallholder farmers with smart phones to understand information and navigate through social media platforms, especially given that a common medium of most social media platforms is the English language.

4.2. The Difference in the Technical Attributes of the Diffusion of Innovation Theory Based on Socio-Economic Factors

4.2.1. The Difference in Technical Attributes Based on Gender

An independent-samples *t*-test was conducted to test the relationship between gender against the technical attributes of the diffusion of innovation as presented in Table 2 below.

From Table 2 it can be deduced that for compatibility there was a significant difference in the scores between males (M = 2.15, SD = 0.88), and females [M = 2.39, SD = 0.89; t (215) = 1.96, p = 0.05]. The magnitude of the difference was large with an effect size of 0.27. In terms of trial-ability a significant difference was also found among males (M = 2.01, SD = 0.64) and females [M = 2.22, SD = 0.81; t (215) = 2.15, p = 0.03]. The magnitude of difference in mean scores was large with an effect size of 0.29. The results suggest that in terms of compatibility and trial-ability, there was a significant difference ($p < 0.05$) in mean scores among males and females. These findings agree with other studies that found that gender significantly influences the adoption of innovations [19,23,70,75,95]. Furthermore, other studies found that a significant difference exists between the mean scores of males and females [77,79,96]. Gender mostly reveals the variations in the users' themselves in terms of their preference concerning social media and the undertakings that are promotionally conducted during the utilization of social media sites [74]. Female social media users tend to be more stimulated in purchasing products, having a high fondness for maintaining their memberships together with associations with varying sites and pages they visit on social media [97]. Dzandu et al. [76] as well as Ilie et al. [78] also found that females value visibility along with the ease of use of social media. In comparison, males tend to value relative advantage, perceived critical mass, and the demonstrability of results.

4.2.2. The Difference in Technical Attributes Based on Co-Operative Membership

An independent-samples T-test was conducted to test the relationship between co-operative membership against the technical attributes of the diffusion of innovation as presented in Table 3 below.

Table 3 shows that for trial-ability a significant difference was found among co-operative membership (M = 2.35, SD = 0.84) and non-membership [M = 2.06, SD = 0.70; t (215) = −2.22, p = 0.027]. However, the difference in mean scores is very small, with an effect size of −0.40. The findings are consistent with those from other studies that suggest that social groups are important in adoption as they facilitate information flow, alert communities, extension officials, and other smallholder farmers about the availability or interest of a product or service that was not previously recognized by them [98–100]. Farmers groups and organizations are an important factor to consider in adopting social media as an advisory tool. The social groups that smallholder farmers are involved tend to have similar perceptions, values, and beliefs [100]. Social groups are a measure of involvement or association to a particular social organization, for instance, a co-operative, irrigation scheme, or union [67]. According to DFID [101], social capital is the social resources that persons use to create a living, involve interactions with other people and include categories referred to as connections. Therefore, social capital escalates the aptitude of a person to attain and have access to crucial knowledge and information about innovations and new technologies along with the benefits thereof.

4.2.3. The Difference in Technical Attributes of Diffusion of Innovation Based on Age

A one-way between-groups analysis of variance (ANOVA) was conducted to explore the difference in the technical attributes of the diffusion of innovation theory based on the age of smallholder farmers, as presented in Table 4 below.

Table 2. Independent-samples *T*-test—difference in the technical attributes of the diffusion of innovation based on gender.

Independent Samples Test										
		Levene's Test for Equality of Variances		*t*-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
RA	Equal variances assumed	0.317	0.574	1.133	215	0.259	0.13780	0.12163	−0.10195	0.37754
	Equal variances not assumed			1.131	212.377	0.259	0.13780	0.12182	−0.10233	0.37792
COM	Equal variances assumed	0.058	0.810	1.960	215	0.051	0.23571	0.12027	−0.00134	0.47277
	Equal variances not assumed			1.960	213.978	0.051	0.23571	0.12028	−0.00138	0.47281
TA	Equal variances assumed	1.809	0.180	2.148	215	0.033	0.21235	0.09887	0.01748	0.40723
	Equal variances not assumed			2.132	198.114	0.034	0.21235	0.09960	0.01593	0.40877
OB	Equal variances assumed	0.001	0.981	1.593	215	0.113	0.22812	0.14323	−0.05419	0.51044
	Equal variances not assumed			1.592	213.805	0.113	0.22812	0.14327	−0.05429	0.51054
CPX	Equal variances assumed	0.001	0.981	1.593	215	0.113	0.22812	0.14323	−0.05419	0.51044
	Equal variances not assumed			1.592	213.805	0.113	0.22812	0.14327	−0.05429	0.51054

Note: RA = Relative advantage, COM = Compatibility, TA = Trial-ability, OB = Observability, CPX = Complexity.

Table 3. Independent-samples *T*-test—influence of the technical attributes of the diffusion of innovation on social media adoption.

Independent Samples Test										
		Levene's Test for Equality of Variances		*t*-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
RA	Equal variances assumed	1.659	0.199	−1.200	215	0.232	−0.19381	0.16157	−0.51227	0.12466
	Equal variances not assumed			−1.113	48.494	0.271	−0.19381	0.17417	−0.54392	0.15630
COM	Equal variances assumed	0.049	0.825	−0.011	215	0.991	−0.00175	0.16123	−0.31955	0.31605
	Equal variances not assumed			−0.011	55.052	0.991	−0.00175	0.15235	−0.30706	0.30356
TA	Equal variances assumed	2.531	0.113	−2.221	215	0.027	−0.29163	0.13128	−0.55039	−0.03286
	Equal variances not assumed			−1.966	46.739	0.055	−0.29163	0.14837	−0.59016	0.00690
OB	Equal variances assumed	0.179	0.673	1.149	215	0.252	0.21926	0.19086	−0.15694	0.59545
	Equal variances not assumed			1.161	52.429	0.251	0.21926	0.18885	−0.15962	0.59813
CPX	Equal variances assumed	0.179	0.673	1.149	215	0.252	0.21926	0.19086	−0.15694	0.59545
	Equal variances not assumed			1.161	52.429	0.251	0.21926	0.18885	−0.15962	0.59813

Note: RA = Relative advantage, COM = Compatibility, TA = Trial-ability, OB = Observability, CPX = Complexity.

Table 4. Differences in technical attributes of diffusion of innovation based on age.

	Descriptive				Anova				
		N	**Mean**	**Std. Deviation**		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
RA	<20	8	1.7188	0.54178	Between Groups	24.873	5	4.975	7.066	<0.001
	20–29	59	1.7119	0.64962	Within Groups	148.538	211	0.704		
	30–39	46	1.9783	0.79377	Total	173.410	216			
	40–49	38	1.9671	0.89513						
	50–59	35	2.3857	0.88978						
	60+	31	2.6935	1.11189						
	Total	217	2.0622	0.89600						
COM	<20	8	1.7917	0.68863	Between Groups	18.618	5	3.724	5.138	<0.001
	20–29	59	1.9379	0.67374	Within Groups	152.923	211	0.725		
	30–39	46	2.1884	0.84810	Total	171.541	216			
	40–49	38	2.3070	0.92474						
	50–59	35	2.6286	0.87362						
	60+	31	2.6882	1.05387						
	Total	217	2.2688	0.89116						
TA	<20	8	1.7188	0.58915	Between Groups	17.394	5	3.479	7.418	<0.001
	20–29	59	1.8305	0.51995	Within Groups	98.945	211	0.469		
	30–39	46	1.9620	0.71680	Total	116.338	216			
	40–49	38	2.1316	0.72068						
	50–59	35	2.4000	0.58221						
	60+	31	2.6048	0.94819						
	Total	217	2.1094	0.73390						
OB	<20	8	1.6250	0.75593	Between Groups	39.714	5	7.943	8.291	<0.001
	20–29	59	1.9746	0.78055	Within Groups	202.132	211	0.958		
	30–39	46	2.2663	1.01023	Total	241.846	216			
	40–49	38	2.5724	1.16814						
	50–59	35	2.7714	0.92826						
	60+	31	3.1532	1.11183						
	Total	217	2.4251	1.05814						
CPX	<20	8	1.6250	0.75593	Between Groups	39.714	5	7.943	8.291	<0.001
	20–29	59	1.9746	0.78055	Within Groups	202.132	211	0.958		
	30–39	46	2.2663	1.01023	Total	241.846	216			
	40–49	38	2.5724	1.16814						
	50–59	35	2.7714	0.92826						
	60+	31	3.1532	1.11183						
	Total	217	2.4251	1.05814						

Note: RA = Relative advantage, COM = Compatibility, TA = Trial-ability, OB = Observability, CPX = Complexity.

A one-way between-groups analysis of variance was conducted to explore the influence of age on the technical attributes of the diffusion of innovation theory. The findings from the investigation showed that there was a significant difference ($p < 0.05$) among smallholder farmers' age groups in terms of relative advantage. The results concur with the findings of other studies that found that an increase in age reduces adoption [67,70,92,102]. A statistically significant difference ($p < 0.05$) was also found regarding the mean scores in age when it comes to compatibility. The findings agree with other studies that suggest that a difference in age influences adoption in terms of the needs and experiences of smallholder farmers [103–105]. A statistically significant difference ($p < 0.05$) in mean scores was furthermore found among smallholder farmers' age groups in terms of trial-ability. The findings are in agreement with results from other studies that suggest that smallholder farmers who are in younger age groups are more likely to try social media as an advisory tool, and are more likely to adopt innovations [67,68,70,102]. The influence of observability on the adoption of social media as an advisory tool among smallholder farmers' age groups had a significant difference ($p < 0.05$). These results are consistent with findings from other studies that suggest that millenarian age groups have a different attitude towards social

media and its adoption, due to cultural and economic factors [92,103,104]. A statistical significance was observed from complexity ($p < 0.05$) between smallholder farmers' age groups. Similarly, other studies found a significant difference between older smallholder farmers and those that are younger. Alalwan et al. [103], Correa et al. [104], and Reid [105], found that digital natives find it easier to make use of social media as they were born within the age of digital technology, whereas digital natives were born within an era where digital technology was either not invented or widely accessible and used. According to Zhang et al. [70], younger farmers tend to be more risk-averse and innovative, whereas older farmers have augmented conservativeness and therefore unfavorably impact the adoption of new technologies or innovations. This usually results in a negative relation to adoption by older farmers [67]. It can be argued that older smallholder farmers pose more experience and, through time, have accumulated more capital resulting in them becoming more likely to invest and adopt new technologies or innovations [102].

4.2.4. The Difference in the Technical Attributes of Diffusion of Innovation Based on the Level of Education

A one-way between-groups analysis of variance (ANOVA) was conducted to explore the difference in the technical attributes of the diffusion of innovation theory based on smallholder farmers' level of education, as presented in Table 5 below.

A significant difference ($p < 0.05$) was found among the levels of education of smallholder farmers concerning relative advantage. The results are in agreement with findings from other studies that suggest that the level of education of smallholder farmers has a direct relationship with social media adoption as it is easy to see the advantages it provides [106–108]. The study further showed that a significant difference at ($p < 0.05$) in compatibility was present among the levels of education of smallholder farmers. These findings concur with results from other studies that suggest that the more educated smallholder farmers are the more likely they are to adopt social media and other innovations [15,92,108]. The study also revealed a significant difference at ($p < 0.05$) in trial-ability among smallholder farmers' level of education. These findings concur with other studies that found that literacy has a direct influence on smallholder farmers' cognizance and adoption of social media as it plays a role in the utilization of many new technologies [56,93,105,108]. A significant difference was also found at $p < 0.05$ in observability among smallholder farmers' level of education. The results coincide with other findings that suggest that it is difficult for smallholder farmers who have low literacy and have never experienced and used technology to adopt social media as an advisory tool [92,93,105,108]. Smallholder farmers who can view social media within their particular social system and observe its benefits as an advisory tool are more likely to adopt it. There was also a statistically significant difference at $p < 0.05$ in complexity between smallholder farmers' level of education. The findings show that a primary level of education is essential in the measure of literacy and is essential in the understanding of innovations such as social media, as found by other studies [15,92,93,106]. In agreement with Rogers [16], complexity speaks to how adopters find a particular innovation easy to use and understand, whereas others do not, resulting in adoption or non-adoption. A direct relationship exists between the education level and the knowledge and the awareness of social media [108]. The suggestion is that the more smallholder farmers are educated, the more they are exposed and informed about social media and the greater the desire they gain to be willing to adopt and employ social media as an advisory tool for attaining agriculturally related information. Haruna and Baba [107] state that the educational background of smallholder farmers is positively essential and substantial concerning farmers' attitudes regarding usage of the internet for agricultural information dissemination. Higher levels of education are essential in adopting social media by smallholder farmers [106]. This provides them the aptitude to comprehend how the attributes of diffusion of innovation influences their decision-making.

Table 5. Differences in the technical attributes of diffusion of innovation based on level of education.

		Descriptive			Anova				
		N	**Mean**	**Std. Deviation**		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
RA	no school	39	2.6218	0.96973	Between Groups	42.938	6	7.156	11.519	<0.001
	primary	54	2.4352	0.95683	Within Groups	130.472	210	.621		
	secondary	67	1.9552	0.72552	Total	173.410	216			
	matriculated	33	1.3939	0.43764						
	agricultural certificate	7	1.7143	0.60257						
	diploma	12	1.3333	0.40358						
	degree	5	1.7500	0.58630						
	Total	217	2.0622	0.89600						
COM	no school	39	2.7778	0.89943	Between Groups	42.498	6	7.083	11.527	<0.001
	primary	54	2.6605	0.90536	Within Groups	129.043	210	0.614		
	secondary	67	2.1891	0.79184	Total	171.541	216			
	matriculated	33	1.5960	0.44688						
	agricultural certificate	7	2.0476	0.48795						
	diploma	12	1.5278	0.64288						
	degree	5	1.6667	0.52705						
	Total	217	2.2688	0.89116						
TA	no school	39	2.6154	0.64084	Between Groups	28.651	6	4.775	11.436	<0.001
	primary	54	2.4028	0.81034	Within Groups	87.687	210	0.418		
	secondary	67	1.9478	0.63146	Total	116.338	216			
	matriculated	33	1.6288	0.45122						
	agricultural certificate	7	2.0714	0.27817						
	diploma	12	1.5208	0.55859						
	degree	5	1.8000	0.37081						
	Total	217	2.1094	0.73390						
OB	no school	39	3.2308	0.87431	Between Groups	83.773	6	13.962	18.549	<0.001
	primary	54	2.9722	1.06915	Within Groups	158.072	210	0.753		
	secondary	67	2.2052	0.86813	Total	241.846	216			
	matriculated	33	1.6818	0.65929						
	agricultural certificate	7	1.4643	0.36596						
	diploma	12	1.3750	0.49429						
	degree	5	1.9500	0.57009						
	Total	217	2.4251	1.05814						
CPX	no school	39	3.2308	0.87431	Between Groups	83.773	6	13.962	18.549	<0.001
	primary	54	2.9722	1.06915	Within Groups	158.072	210	0.753		
	secondary	67	2.2052	0.86813	Total	241.846	216			
	matriculated	33	1.6818	0.65929						
	agricultural certificate	7	1.4643	0.36596						
	diploma	12	1.3750	0.49429						
	degree	5	1.9500	0.57009						
	Total	217	2.4251	1.05814						

Note: RA = Relative advantage, COM = Compatibility, TA = Trial-ability, OB = Observability, CPX = Complexity.

5. Conclusions

Social media can and has enriched how individuals interconnect and interact with each other and how they disseminate information and knowledge. This study was carried out to investigate smallholder farmers' adoption of social media as an advisory tool and investigate the difference in the technical attributes of the diffusion of innovation theory based on socio-economic factors of smallholder farmers in the Nkomazi local municipal-

ity. The results indicated that the diffusion of innovation theory attributes significantly influenced social media adoption by smallholder farmers based on gender, age, level of education, and co-operative membership. The smallholder farmers considered that receiving information through social media can positively enhance how they farm and easily attain agricultural information. The results further indicated that smallholder farmers considered that by trying social media platforms and shown how it works, they would be more likely to adopt it. Furthermore, they indicated that it would be easy to communicate with other smallholder farmers and agricultural extension officials through social media. It was also revealed that smallholder farmers considered that social media could assist them in learning more about agricultural practices. These results also indicated that smallholder farmers did not have the necessary skills to operate social media and did not understand the languages on social media platforms, sites, and applications. The findings revealed that smallholder farmers believe that advisory services from social media can improve their agricultural practices and see the benefits of using social media as an advisory tool instead of other traditional methods such as radio, television, and newspapers. It is, therefore, recommended that a top-down approach should not be used in the training programs, but one that is participatory allowing the smallholder farmers to assist in the program's development based on their needs and requirements. A co-operative social media platform that involves extension in the private and public sector, ICT technicians, parastatals, policymakers, tribal authorities and smallholder farmers themselves should be developed. This platform should encompass open-access internet that is free to use in both mobile devices and other electronic devices such as laptops and computers and considers the technical attributes of diffusion of innovation and socio-economic characteristics of smallholder farmers. Therefore, policy makers need to develop policies that allow for open access internet for educational purposes through electronic devices. Additionally, in implementing the developed policies, the aforementioned stakeholders need to be incorporated in the development, facilitation, monitoring and improvement of the suggested social media platform. Furthermore, the training of smallholder farmers in ICT and social media use, the creation of relevant information required, and the provision of the infrastructure and facilities that are required should be considered and implemented by extension services based on smallholder farmers needs and requirements. Policymakers should consider developing guidelines that encourage online advisory services, learning and information dissemination for smallholder farmers and the agricultural sector as a whole. These recommendations will allow for research to be undertaken to investigate the applications and measures taken by advisory service departments in implementing social media for advisory services, the effectiveness of applied social media advisory services in smallholder farming communities, and the improvements required in social media-based advisory services in smallholder farming communities.

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