Correlates of access to ICT and Food security of the Poor in South Africa's Soshanguve

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ABSTRACT

This study discusses access to information and communication technology in the context of food security in Soshanguve, a slum area of The City of Tshwane, the administrative Capital of South Africa. City dwellers access food from retail outlets in a country where dispatching food is a lucrative business. Hence, food price increases pose challenges to urban households. South African Broadcasting Corporation (SABC), other television stations and radio stations broadcast food marketing information through eleven official languages. Digital food marketing through cellular phone networks is on the rise.

ICT is hence a potential tool in the fight against food insecurity and hunger, since its use and range of application continue to grow at astonishing rates. ICT tools to enhance food security are highlighted in UNICEF's use of RapidSMS technology in Ethiopia and Malawi in their food distribution programmes supplying high-protein food to undernourished children ownership, among others.

Using questions contained in the USAID developed Household Food Insecurity Access Scale (HFIAS), questionnaires were administered to 300 randomly selected households in Soshanguve. Respondents were asked of their experiences of food insecurity (access) with a recall period of four weeks (30 days).

About half of households in Soshanguve are food secure, just over 12% are mildly food insecure, about the same proportion are moderately food insecure, while more than a quarter of surveyed households are severely food insecure. Most households in Soshanguve have access to the use of ICT devices, primarily in the form of cellular phone devices. Food secure households can utilise ICT tools in any manner to meet their food security needs. Our study shows that ICT access is positively associated with household food security. Transactional purchases of items on credit using cellular or landline telephony are, in particular, important in enhancing food security. Otherwise, households could beg for or borrow food from neighbours. Only the educated in Soshanguve purchase food items online by using computer access. Younger, single, educated, employed individuals mostly use ICT to advance the course of their food security. Food insecure households fall short only in ICT

transactions involving the use of landline telephony, and online food purchases using computers, of which demand is low in the slum areas.

Key words: Information and communication technology, food insecurity, correlation, poverty, urban and slum, South Africa

1. Introduction: ICT and food security

Recent technological developments have significantly altered the ways in which people communicate and society interacts. This continuum has modified lifestyle and dietary patterns. This has been described by experts as manifesting in the nutritional transition. McKinley and Wright (2014) observe that informative support in a virtual environment can encourage people to a search for a healthier lifestyle. Similarly, Alssafi and Coccia (2019) note the potential of social networks to improve food choices when it comes to fruit and vegetables. In South Africa, where mobile phones have become the most easily accessible and convenient way of offering services to customers (Han, 2012).

The South African Broadcasting Corporation (SABC) is by far the largest and most influential broadcaster in South Africa in terms of reach, size, overall audience figures, and share of the advertising market. Nearly 28 million radio listeners in South Africa tune into one of the SABC's 18 radio stations and its three free-to-air television channels attract over 21 million adult viewers daily. SABC stations cater for the country's 11 official languages, as well as the iXun and Khwe languages, and four TV channels, which include the 24-hour news channel (Doc, 2019). Other national digital networks transmit to about 84% of the population, with the remainder covered by satellite network.

UNSCN (2020)'s 2015 survey covering 118 countries finds that almost 75 percent of respondents increased their use of digital tools to cope with recent life changes such as food consumption. Respondents made more frequent use of grocery delivery apps and websites and food delivery through messaging apps and/or social-media sites. Restaurant or takeaway delivery apps did not feature heavily in people's responses.

Rather, recipe apps (15%) and recipe websites (36%) saw the biggest jumps in usage, confirming findings of a significant rise in home cooking (75%) – with a potentially sizeable, positive impact on nutrition.

This article examines the extent of food insecurity in the urban slum area of Soshanguve, an important township location in the City of Tshwane, the Administrative Capital of South Africa. Soshanguve's food insecurity vulnerabilities are compounded by the nature of urban condition of living, food prices and other environmental vulnerability factors which affect poor urban households' ability to grow food. Section one is introductory while section two links the theory and empirical literature of ICT access to households' food security. Data sources are discussed in section three while section four highlights the results of the study. The last section concludes the paper.

1.1 Problem Statement

About 13.5 million people experienced hunger in South Africa in 2002, dropping to 6,8 million in 2017 during which time, almost 20% of South African households had inadequate or severe inadequate access to food. Currently, it still affects 1,7 million households across the country (StatsSA, 2019).

Urbanisation of South Africa of 67.6% in 2020 is projected to rise to 71.3% in 2030 (Crush, and Frayne, 2016). Almost two-thirds of urban households are vulnerable to hunger (Statssa, 2019). Alemu (2015:16) estimates that 39% of households in Pretoria District Municipality are food insecure. The proportion of households using only cellular phones to communicate was 88.2% in 2017 (StatsSA, 2018). With the short message service (SMS), households can receive information directly on their phones, and in their local language about food retail sales.

1.2 Study motivation

In South Africa, many food processing and producing companies are using digital technologies to promote improved access to food. Researchers are hence trying to understand how digital technologies can be used to promote increased food security and to explore the impact of digital marketing on diet quality and health outcomes of children, adolescents and young adults (Boyland et al., 2020; White et al., 2019). This excites researchers theoretically and methodologically, because ICTs have the potential to provide search and marketing opportunities for information on household food security.

Food television advertising is widespread in South Africa to market and advertise products. As a result there is a significant interest in leveraging mobile phones to promote better access to food and nutritional behaviours and practices. A growing number of people are seeking tools to transform and facilitate their daily choices, including those associated with food. While social network sites have revolutionized the way in which people communicate and disseminating nutritional awareness information, robust evidence of their effectiveness in low-income countries is lacking (Barnett et al., 2017). Most studies to date are small, formative assessments of SMS-based interventions to change specific behaviours (such as breastfeeding practices) or observational studies of limited methodological quality (Lee et al., 2019; Muyaya and Manwana, 2017). This has motivated us to study what impacts ICT may have on food security in the urban slum area of Soshanguve, South Africa.

1.3 The study area

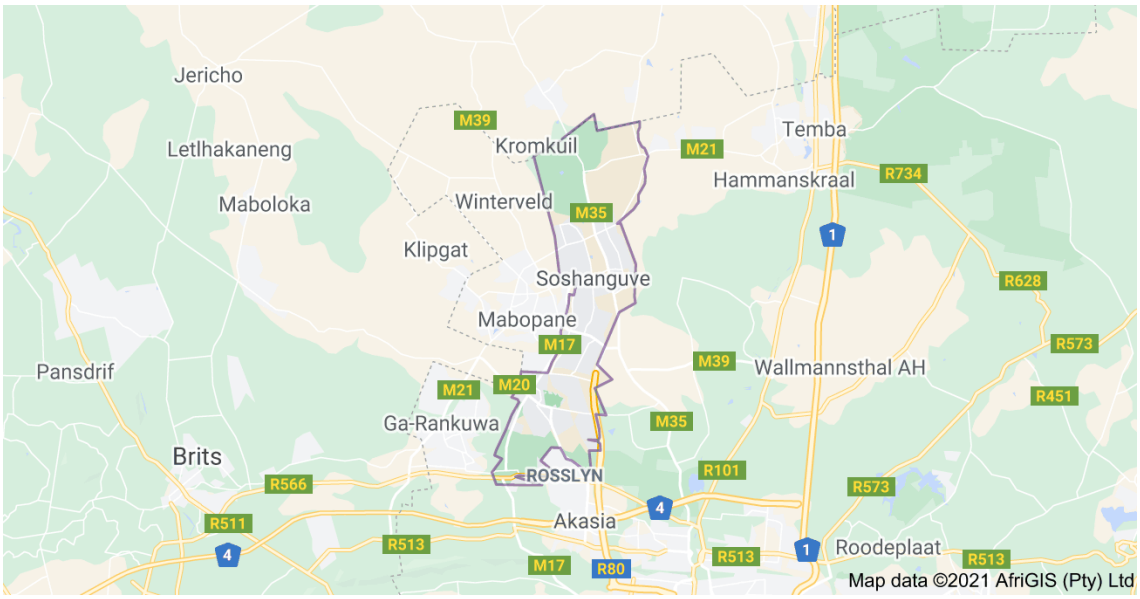
A slum dwelling township in the City of Tshwane (the administrative capital of South Africa), the population of Soshanguve, the study area, was 24,000 in 1950, rising to 866,000 in 2021 (UN, 2021; World Bank 2021). It is regarded as one of the urban core areas for Tshwane City development. It is a vast expanse of semi-developed territory with formal housing flanked by informal settlements, with vibrant spaza shops alongside of newly established malls. Black Africans dominate the population profile (92%). The gender composition of the population is 49,3% male and 50.7% female (StatsSA, 2019).

Soshanguve is located in Tshwane City's region 1, in the western part of the city of Tshwane that constitutes 27% of the City's population. It is actually a historically black residential area approximately 30 kilometres north of Pretoria. Prior to (the Bantustan) Bophuthatswana's declaration of independence in December 1977, Soshanguve was known as Mabopane East, forming part of the greater Mabopane- Boekenhout-Winterveld complex. These were designed as labour reserves for the manufacturing hub of Rosslyn and the city. Mabopane East was renamed 'Soshanguve' in 1977 when the area was incorporated into the Bophuthatswana Bantustan.

Since the late 1970s, the township has become a vast expanse of semi-developed territory with formal housing flanked by informal settlements, some well-established and some less so. It has a vibrant informal sector and spaza shops alongside of newly

established malls (Ligthelm, 2007). Figure 1 shows the map of the City of Tshwane and the specific location of Soshanguve.

Figure 1: The map of the City of Tshwane showing the location of Soshanguve



Authors identify economic drivers in the City of Tshwane as community services, finance, trade, manufacturing and transport. Also, the City's catalytic projects include; the Rosslyn Growth Node (Automotive Industry); Mabopane / Hammanskraal Rail Link Upgrade; Upgrade Tshwane Inner-rail loop; the Mamelodi Urban Integration of Peripheral Townships and Atteridgeville; Tshwane Inclusionary Housing and Urban Integration of Peripheral townships, Inner City (Capital Core); Rosslyn/Wonderboom quadrant; Waltloo/Silverton land development programmes; the Moloto Rail Corridor; and Garankuwa Smart City Development (CoT, 2017).

Most internal migrants in South Africa begin their urban experience by living in informal settlements such as those in Soshanguve, which also draw residents from black townships such as Mamelodi, Wallmannsthal, Mabopane, Winterveld and Atteridgeville (Gaither, 2000). The City of Tshwane's deprivation index shows underserved township areas including Atteridgeville, Temba, Mamelodi, Mabopane and Soshanguve as the most deprived areas which have the lowest levels of access to basic services (CoT, 2017). As employment opportunities in urban areas fail to keep pace with population growth, unemployment and poverty increase, reducing the urban

poor‘s quality of life. In 2017, only 84% of households resident in the Gauteng province had adequate food access (StatsSA, 2019).

1.4 Importance of information technology to urban slum dwellers.

In South Africa, government’s health and food security interventions include the use of mass media communication technologies to improve nutrition education and awareness, with a view of reaching large audiences. Information and communications technologies (ICTs) that include mobile phones, radio, TV, computers and satellite systems have been identified as a potential contributor to achieving global food security (Bowman, Mensah & Urama, 2014). UNSCN Nutrition 44, had put forward the idea of a digital food environment that “augments the complexity and intensity of the effects of food environments on the health and nutrition status of individuals and populations” (Granheim, 2019: 120). This is in line with United Nation’s recognition of information dissemination as part of the millennium development goals to be attained by 2015 for all its member states (United Nations, 2010).

Urban dwellers are highly dependent on markets for their food demands. In 2020, South Africa’s food dispatching market is estimated at $600 million (O’Grady, 2020). The urban transition is transforming developing countries’ food retail systems leading to an increase in the number of supermarket retail outlets (Traill, 2006). In this context, food security is significantly boosted through access to and use of cellular phone technology. The need to promote consumer food awareness has spurred the proliferation of food e-commerce platforms catering to various sources of demand, from fresh produce to ready-to-eat meals. Numerous e-commerce platforms have emerged to connect farmers, food retailers, processors with households or restaurants (Joiner and Okeleke, 2019). The two biggest food delivery platforms in South Africa are “Uber Eats” and “Mr D Food”, linking restaurants to households for a small delivery fee. Also, food retail outlets like Nandos make extensive use of video zooming technology to promote brand identity. Table 1 shows that about ninety-five percent of households in Soshanguve own cellular phones, while only 7.6% own a landline telephone. Even though Soshanguve is a very poor area, almost 30% of all households own Satellite television dishes (South African Market Insight, 2019). Access to information has been shown to reduce transaction costs, particularly search costs, improving market access, and household disposable income to purchase foods (Parlasca, et al, 2020).

Table 1: Ownership of ICT gadgets in Soshanguve, 2019.

ICT Asset	Percentage of population owning ICT Gadget
Cellular Phone	94.6
Television	86.5
Satellite Television	29.1
Radio	69.9
Computer	23.5
Telephone Landline	7.6

Source: South African Market Insight (2019).

2. Theoretical link of Information and Communication Technology with food security.

Experts consider nutrition problems as wicked problems. They include obesity, food insecurity, food marketing and sustainability (Haysom et al., 2019; Rush, 2019). Urban food insecurity is traditionally invisible, given that most of the earlier emphasis had been on rural food insecurity (Carter et al., 2010). However, authors such as Tibesigwa and Visser (2015) draw attention to the importance urban food insecurity as the problem and the resultant urban population burden as it stems from rural urban migration.

It is hence within the context of the desire to meet the Sustainable Development Goal 2 (SDG 2) and end hunger, achieve food security and improve nutrition by 2030 that experts recommend the urgent adoption of new, innovative approaches. According to Gareau (2004:73), ICT is a potential tool in the fight against food insecurity and hunger, since its use and range of application continue to grow at astonishing rates. The use of ICT, specifically GIS, has proven vital to improving food security by providing greater access to these types of data: (a) precision farming (Gebbers and Adamchuk, 2010), (b) food traceability (Golan et al., 2004), and (c) food desert mapping to inform hunger patterns and food access statistics (McEntee and Agyeman, 2010). ICT is likely to play a much greater role in food management and traceability (Zaks and Kucharik (2011).

Researchers associate greater television watching with increased consumption of food such as snacks, sweetened beverages and fast foods (Andreyeva et al, 2011). Halford et al (2004) further suggest that exposure to food advertisements promotes consumption.

Ingram (2011) opines that ICT can positively impact food security outcomes in several key areas: (a) food production (particularly via Internet access to aid communication between producers), (b) food distribution (by using ICT to enable Internet ordering and GIS for better forecasting), (c) food affordability (by using web connectivity to inform consumers and GIS to reduce production costs), (d) food exchange (via cell phone technology to aid producers in finding the best local markets and e-commerce to increase and encourage trade and data exchange), and (e) food safety (through smart packaging, food monitoring, and food tracking and traceability.

ICTs enhance household food security and poverty reduction by making information available on food security dimensions, marketing of produce and in overall helping households in making rational decisions (Chowdhury (2001).

In general, some experts identify that the capacities of ICTs on household food security are related to improving accessibility to information regarding food quality and quantity, introducing new recipes and technologies for food processing, providing more rapid accessibility to high quality information (Van Crowder and Fortier, 2000; Lashgarara et al (2010)), ensuring information about the appropriate times and places for optimized sales of food and agricultural products, increasing agricultural products and decreasing agricultural product losses (Temu and Msya, 2004).

ICTs could be used to meet the information needs of the local people by sharing the acquired knowledge and information. Mobile phones could also offer new, innovative channels to provide hard-to-reach populations with high-quality food, agriculture and nutrition advisory services and to promote improved behaviours and practices (Dia et al., 2017; Hall et al., 2015). Text (SMS) and voice-based messages may be particularly effective delivery channels for advisory services, as they only require simple mobile phones and basic (2G) connectivity, both of which are widely available in resource-poor settings. The importance of communication via radio, television and cellular telephony among rural and disadvantaged population is emphasised by Rimi and Chudi (2017:4-5). Del Prete et al. (2019) conclude that education and the use of

educational multimedia are important factors in Rwandan women's food security improvement.

ICT could also facilitate the adoption of mobile money type of financial transactions through affordable payment systems, which is of particular importance in developing countries where many households are unbanked and rely on remittances from family members (Donovan, 2012; Jack et al., 2013). Other benefits are associated with reduced security risk of moving around with cash and faster transfer of money into poorer crime-prone areas (Kikulwe et al., 2014).

Savari, Shiri and Asadi (2013) conclude that national and international telecommunication channels have a significant impact on household food security promotion in Iran; while Nagamani and Veni (2016) find that education and access to ICT are two of the significant factors influencing food security in female-headed households.

2.1 Empirical evidence of the impact of ICT on food security

The use of ICT tools to enhance food security are highlighted in UNICEF's use of RapidSMS technology in Ethiopia and Malawi in their food distribution programme supplying high-protein food to undernourished children ownership and SMS for collecting and exchange of local agricultural content in Uganda are discussed by Zambrano and Seward (2012: 27-29). Barnett et al (2020) discuss the same in the context of the mNutrition projects for treatment households in Tanzania. The use ICT tools in Brazil to access food recipes, health and nutrition information, the extent of food processing, gastrointestinal diseases and intuitive eating are discussed by Dos Santos and Pinto-E-Silva (2020).

Authors, such as Olaniyi and Ismaila (2016), suggest that the most available ICT tools for accessing information on food security dimensions are cell phone, radio, and television in that order. Sourcing information from the internet and receiving information by email ranked poorly. This might because their study was focused on a rural setting in Nigeria.

Owen (2008) reports that the most available ICT tools used by farmers are cell phone, radio and television. Lashgarara et al (2010); Lashgarara and Mohammadi (2011) report that old ICT tools (radio, television and cell phones) are the major ICT facilities

for acquiring information related to household food security dimensions among rural households in Iran. In the same vein, Arokoyo (2005) enumerated that these classes of ICT facilities (radio, television and mobile phones) remain the major ICTs used for extension delivery service especially in the rural areas. Preference for these ICT tools among the respondents could be related to many factors one of which is economic friendliness.

Adejo and Haruna (2009) also state that old ICT tools are ideal for rural areas, it is cheap to set up, easy to use and filling vital needs. Besides, the use of these technologies requires little or no literacy compared to new ICT tools such as internet, e-mail and printed materials.

Orji et al (202) find that living in households with access to electricity reduces the incidence of multi-dimensional poverty in Nigeria, Oluwatayo and Ojo (2019) report that overall, households that have access to ICT (Television, Mobile Phones, Personal Computers and Internet) have lower food insecurity incidence, depth and severity. They also find that households that lack access to radio have higher incidence of food insecurity, depth and severity relative to households that have access. Households that have access to television had lower incidence, depth and severity of food insecurity compared to their counterparts who do not have access.

They also find that households who lack access to personal computers have higher food insecurity incidence, depth and severity compared to those who have access to personal computers. This implies that households that lack access to ICT require higher amount of money to move out of food insecurity.

Results provided by Sinyolo et al (2020) show that the four variables capturing access to information were highly significant and positive across the models explaining increased consumption of fruits and vegetables in South Africa. Access to information is, in general, strongly associated with the increased frequency of fruit and vegetable consumption, and the probability of consuming the minimum World Health Organization recommended levels.

Empirical evidence is provided by researchers suggesting that ICT enabled use of mobile money significantly reduces household food insecurity. ICT enabled adoption of mobile money reduces the likelihood of being food insecure by ten percentage points, though the frequency of using mobile money does not have a significant effect

on food insecurity (Murendo and Willni, 2016:28). It is further suggested that a one-unit increase in the volume of money transferred via mobile phone reduces the probability of household food insecurity by 1.2 percentage points.

3 Data collection and sampling technique

Using questions contained in the USAID developed Household Food Insecurity Access Scale (HFIAS), we administered questionnaires to 300 randomly selected households in Soshanguve. Respondents were asked of their experiences of food insecurity (access) with a recall period of four weeks (30 days).[1] The administered household food security questionnaire consisted of twenty questions concerning the experiences of food insecurity of respondents. Each item was followed by a frequency of occurrence question, which assessed how often a given condition occurred. A negative response to the initial item was scored as ‘‘0’’, and the follow up questions were scored as follows: rarely = ‘‘1’’, sometimes = ‘‘2’’ and often (or always) = ‘‘3’’. The HFIAS scale gives a picture of households in different food security levels based on their position on the scale of 0–27. The portfolio collection method was used to determine the extent of household food insecurity.

We collected detailed information from the household head or a spouse on income and assets owned by each household and demographic characteristics of the household members including age, gender, level of education and employment status, access to food security, coping strategies, among others. Survey participants’ ICT asset endowments included the possession of information and communication technology assets such as television, radio, landline telephone, cellular phones, computer, satellite dish. All these variables were coded into dichotomous variables (owning the particular asset or not) and accorded a value of zero or one. After data collection, 285 questionnaires were deemed acceptable.

[1] Other authors have used short and medium term recall periods such as 24 h (Maxwell & Caldwell 2008) and seven days (Kennedy et al. 2011). In Australia, food insecurity has overwhelmingly been measured using a single item: ‘In the last 12 months was there any time you have run out of food and not been able to purchase more?’ (Seivwright, Callis and Flatau, 2020:2).

3.1 Household Food Security Estimation Method

Households differ in their degree of vulnerability to food insecurity and some households, for a number of reasons, are more vulnerable than others. Levels of food security in the location in and around the City of Tshwane are principally related to household income and the ability to access food through purchase. The reason why particular households may be classified as food insecure could be because they either had insufficient money to purchase food or the possibility that their food supply did not last. As such, in order to determine household food security status, this study administered a questionnaire that sought to probe individual respondents' behaviours and experiences associated with difficulty in meeting food needs.

In order to determine food insecurity, households that answer at least three or more conditions of food insecurity are classified as food insecure, meaning that, they are, at times unable to acquire adequate food for one or more household members. Food Secure households are those that do not worry about food access and rarely experience anxiety about not having enough food. They are able to have a full meal three times a day without food running out.

4. Data Analysis

All analyses were conducted in 2020 with SPSS Version 26. First, we describe the socio-demographic characteristics of the study sample overall and by food security status using cross tabulations and chi-squared tests of significant differences. Statistical significance for all analyses was set at $p < 0.05$ or higher.

4.1 Prevalence of food insecurity in Soshanguve and Access to ICT.

About half of households in Soshanguve (50.3%) are food secure, 12.3% are mildly food insecure, about the same proportion are moderately food insecure (12.3%), while 26.3% are severely food insecure. As shown in Table 2, most households in Soshanguve have access to the use of ICT devices primarily in the form of cellular phone devices. Slightly more male headed households (90.4%) have more access than female headed households (89.3%). The proportion off households using traditional landlines as a means of communication is low. More than one-fifth of

households make use of computers, and close to two-thirds of them have satellite dish installations at home. The older generation appear to be doing away with landline telephony. In larger households, the preference appears to be for possessing cellular telephony, reduced or no landlines but significant access to satellite dish as a means of communication. In households where the Head is employed, it is not unusual to have access to cellular telephony, access to computer devices and satellite dish installation. This is also in line with the educational status of the household head.

Table 2: Selected socio – economic characteristics of household head

			Ownership of Information and Communication Technology (%)			
Variable	Sample size	Average Food security score	Cellphone	Telephone (Landline)	Computers	Satellite Dish
Gender of household head						
Male	125	7.31	90.4	8.8	20.8	31.2
Female	159	7.47	89.3	5.0	22.6	32.3
Total	284	7.40	89.8	6.7	21.8	31.9
Age of household head						
<40 (23-40)	95	6.87	89.4	8.4	27.3	37.9
41-50	65	8.38	90.8	7.7	26.2	30.8
51-60	45	8.6	91.3	4.3	15.2	18.2
61-64	17	8.61	88.9	11.1	16.7	33.3
>65	62	5.9	88.3	3.3	15.0	33.3
Household size						
1	12	5.58	83.3	16.7	33.3	33.3
2-4	143	6.93	83.9	8.4	18.9	22.7
5-7	85	7.83	95.3	5.8	26.7	41.9
>8	44	8.63	100.0	0.0	18.6	41.9
Employment of household head						
Informal	56	8.82	87.5	3.6	10.7	16.1
Employed	98	4.32	100.0	12.1	40.4	55.6
Unemployed	127	9.14	82.9	3.9	12.4	20.5

Education of household head						
No Education	77	8.02	92.2	2.6	14.3	27.3
Primary (1-6 years)	93	7.12	86.9	7.6	14.1	24.4
High School	104	7.94	89.5	9.5	27.6	35.2
Degree/Diploma	10	0.3	100.0	0.0	90.0	100.0

Source: Survey data

4.2 Understanding the general theory of correlation.

The importance of understanding the possible correlations between variables is well covered in academic literature. Correlation measures the monotonic association between two variables such that, considering any chosen two variables, when the value of one variable increases, the value of the other simultaneously so does as well. It could also be in the reverse direction that when the value of one variable increases, that of the other decreases.

Most often, the term “correlation” refers to Pearson product-moment correlation and is used in the context of a linear relationship between two continuous, random variables. It is commonly abbreviated as “r.”

Pearson’s correlation measures the strength of the association between two variables (Pernet, et al., 2013, p.1). Gagne (2014), among others, have applied this method in the field of psychology, medical research, economic and management studies. In general, the term correlation denotes any of a broad class of statistical relationships involving dependence. By nature, correlation is symmetric, so that if inferences about the variables are made from a reverse direction (IO predicting stress rather than stress predicting IO), the same prediction holds true (Kraemer, 2006).

Experts suggest that the observed estimated coefficient of correlation be accompanied by a confidence interval. An appropriate hypothesis test assists the researcher to make useful inferences as to whether the value of the population correlation coefficient “ρ” is close to 0 or significantly different from 0.

4.3 Correlation between socio-economic characteristics, ICT usage and food security in Soshanguve.

We have examined the correlation between food insecurity and ICT use in Soshanguve. A strong correlation between the two measures indicates criterion validity (Hackett et al, 2007). Studies in Iran by Savaria, Sheykhib, and Amghanic (2020) report that the standardized path coefficient between local, national and international ICT channels and Iranian women's participation in improving food security is 0.65. They show that 49% of the variance in women's participation in food security improvement is accounted for by access to these ICT channels.

Table 3 shows that ICT access is correlated positively with household food security and negatively with food insecurity. Transactional purchases of items on credit using cellular or landline telephony are in particular important in enhancing food security. Otherwise households could beg for food from neighbours or borrow food. This is in line with the findings of a survey by Crush and Caeser (2016) which report that food transfers are particularly important for food-insecure urban households, including those in Cape Town and Johannesburg.

Larger households in Soshanguve tend to have a greater likelihood of food insecurity. They also have greater propensity to communicate with members and others using ICTs. They are hence able to purchase food on credit, borrow and beg for food. They also buy unwanted food for survival.

There is a positive relationship between household income, access to use of ICTs and food security. means that the higher the income, the higher the chance of household food security status. Only the educated in Soshanguve purchase food items online by using computer access. It is the younger, single, educated, employed individuals who mostly use ICT to advance the course of their food security.

Studies have shown that being able to obtain money or food from a neighbour or a friend is less risky than doing business with loan shacks. Many households however rely on micro-lenders as a means of coping with food insecurity while households that have established social ties with spaza shop owners buy food on credit. *Spaza* shops act as safety nets for low-income urban households in desperate times as they often allow their customers to take food on credit, affording them the chance to acquire food

when they lack the resources to do so (Battersby, 2015). They also provide foods at more affordable prices and quantities (Peyton *et al*., 2015).

Table 3: Correlation of socio-economic characteristics and ICT usage

Characteristics of Household	Use of Information Communication Technology				
	Purchase food on credit using cellphone	Purchase food on credit using computer (online)	Borrow food	Beg for food	Purchase miscellaneous food
Age of Head	-0.12**	-0.14**	-0.03	-0.05	-0.11
Gender of Head	-0.02	0.01	-0.06	-0.06	0.00
Marital status of Head	-0.02	-0.13**	-0.06	-0.01	0.03
Employment status of Head	-0.09	-0.06	-0.06	-0.08	-0.00
No of people employed	0.23***	0.42***	0.20***	0.25***	0.13**
Education of Head	0.10	0.28***	0.06	0.08	0.02
Household size	0.12**	0.05	0.14**	0.13**	0.16***
Household income	0.24***	0.45***	0.26***	0.25***	0.13**
Income sources					
Wages	0.23***	0.47***	0.25***	0.25***	0.09
Pension	-0.14**	-0.19***	-0.10	-0.13**	-0.27***
Child grant	0.13**	-0.06	0.13**	0.09	0.10
Other grants	0.47	-0.15**	-0.10	-0.10	0.06

Source: Survey data. **, *** denote significance at 5% and 1% levels

4.4 Correlation between ICT and food insecurity status in Soshanguve.

Table 4 shows that there is a positive relationship between household's food security status and the undertaking of ICT related transactions for food security purposes. Food secure households can utilise ICT tools in any manner to meet their food security needs. The corollary is also true, that food insecure households have negative association between their ICT transactions and food insecurity statuses. Food insecure households fall short only in ICT transactions involving the use of landline telephony, and online food purchases using computers, of which demand is low in the slum areas.

Table 4: Correlation of ICT and food insecurity in Soshanguve

Use of ICT in food security transactions	Food insecurity status of household			
	Food Secured	Mildly insecure	Moderately insecure	Severely insecure
Cellphone purchase of items on credit	0.19***	-0.05	-0.63	-0.24***
Telephone Landline purchase of food items on credit	0.20***	-0.18***	-0.05	-0.04
Computer aided purchase of items on credit	0.18***	-0.16***	-0.23***	-0.09
Cellphone to borrow food	0.18***	-0.13**	-0.05	-0.15**
Cellphone to beg for food	0.18***	-0.16***	-0.04	-0.13**
Cellphone to buy miscellaneous food items	-0.02	0.03	-.03	-0.04

Source: Survey data. **, *** denote significance at 5% and 1% levels

5 Conclusion

This study has looked at how access to information and communication technology impacts on food security in Soshanguve, a slum area of The City of Tshwane, the administrative Capital of South Africa. City dwellers access food from retail outlets in a country where dispatching food is a lucrative business. Food price increases have hence traditionally posed particular problems to urban households in South Africa. Through the medium of the South African Broadcasting Corporation (SABC), television stations and radio stations broadcast food marketing information to South Africans in the country's 11 official languages. Digital food marketing through cellular phone networks is on the rise.

Our study shows that ICT access is positively associated with household food security. Transactional purchases of items on credit using cellular or landline telephony are important in enhancing food security. Otherwise, households could beg for or borrow food from neighbours. Only the educated in Soshanguve purchase food items online by using computer access. It is the younger, single, educated, employed individuals who mostly use ICT to advance the course of their food security. Food insecure households fall short only in ICT transactions involving the use of landline telephony, and online food purchases using computers, of which demand is low in the slum areas.

CONFLICT OF INTEREST DECLARATION

The Authors declare that they have no conflict of interest

References

Adejo, P., Haruna, U. (2009). Access of farmers to ICTs for agricultural development in Bauchi local government area, Bauchi state, in *Proceedings of the 43rd Annual Conference of the Agricultural Society of Nigeria*, Abuja, October 20–23, 2009, pp. 704–707.

Alemu, Z.G. (2015). Developing a Food (in) Security Map for South Africa, Working Paper No. 220, African Development Bank, February.

Alssafi, A., Coccia, C. (2019). Feasibility and Acceptability of a Nutrition Intervention Delivered Through Instagram for Obesity Prevention among Saudi College Students. *Journal of the Academy of Nutrition and Dietetics*, 119(9): A43. Available at https://jandonline.org/article/S2212-2672(19)30703-8/fulltext (Accessed on 29 October 2020).

Andreyeva, T., Kelly, I,R., Harris, J.L. (2011) Exposure to food advertising on television: association with children's fast food and soft drink consumption and obesity. Economics of Human Biology 9(3): 221–233.

Arokoyo, T., (2005). ICTs Application in Agricultural Extension Services Delivery. In: Agricultural Extension in Nigeria, Adedoyin, S.F. (Ed.). Agricultural Extension Society of Nigeria, Ilorin, Nigeria, pp: 245-251

Barnett, I., Batchelor, S., Gilligan, D., Haddad, L., Hidrobo, M., Ledlie, N., Shyam, T. (2017). *External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia: Inception report for the impact evaluation*. Brighton, UK, Institute of Development Studies. Available at https://www.ids.ac.uk/publications/inception-report-externalevaluation-of-mobile-phone-technology-based-nutrition-and-agricultureadvisory-services-in-africa-and-south-asia/ (Accessed on 29 October 2020).

Barnett, I., Gordon, J., Faith, B., Gilligan, D.O., Hidrobo, M., Palloni, G., Batchelor, S., Scott, N. (2020). Using mobile-phone technology to change behaviour: Lessons from mNutrition. Available at: www.unscn.org/unscnnutrition45 (Accessed on 29 October 2020).

Battersby, J., Haysom, G., Marshak, M., Tawodzera, G. (2015). *A study on current and future realities for urban food security in South Africa, Sustainable Cities*. South African Cities Network.

Boyland, E., Thivel, D., Mazur, A., Ring-Dimitriou, S., Frelut, M.L., Weghuber, D. (2020). Digital food marketing to young people: a substantial public health challenge. *Annals of Nutrition and Metabolism,* 76(1): 6-9. doi:10.1159/000506413 DOI: 10.1159/000506413

Bowman, W., Mensah, M., Urama, K. (2014). Information and telecommunication technologies in Africa: a potential Revolution. Under the Radar 2: *Innovation for Sustainable Development*. Edited by Jean-Yves Grosclaude, Rajendra K. Pachauri, and Laurence Tubiana. New Delhi: TERI. Pp: 29-50. OCLC 883178928.

Carter, N. K., Lanumata, T., Kruse, K., Gorton, D. (2010). What are the Determinants of Food Insecurity in New Zealand and does it Differ for Males and Females. Wellington: Public Health Association of Australia.

Chowdhury, N. (2001). Information and Communications Technologies, Appropriate Technology for Sustainable Food Security. International Food Policy Research Institute, Washington DC, USA.

City of Tshwane (2017). Profile of the City of Tshwane Metropolitan GAU. Pretoria, South Africa.

Crush, J., Caesar, M. (2016). Food Remittances: Migration and Food Security in Africa (rep., pp. 1-51). Waterloo, ON: Southern African Migration Programme. SAMP Migration Policy Series No. 72.

Crush, J, Frayne, B (2014). *Feeding African Cities: The Growing Challenge of Urban Food Insecurity.* In S. Parnell and E. Pieterse, eds., Africa's Urban Revolution. Zed Books, London, 110-132.

Department of Communications of the Government of South Africa (DoC) (2019). Official guide to Government Communications 2017/18. Government Printers, Preoria

Del Prete, D., Ghins, L., Magrini, E., Pauw, K. (2019). Land consolidation, specialization and household diets: evidence from Rwanda, Food Policy 83(C): 139–149.

Department of Communication (DoC) (2019). Official Guide To South Africa 2017/18. Communication, Government Printers, Pretoria.

Dia, L., Sablah, M., Ag Bendech, M. (2017). *Integration of nutrition in agriculture extension services in Africa*. Accra, Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/3/a-i6891e.pdf (Accessed on 29 October 2020).

Donovan, K. (2012). Mobile Money for Financial Inclusion, in: Information and Communications for Development. The World Bank, pp. 61–73.

Dos Santos, F.F., Pinto-E-Silva, M.E.M. 2020). Social networking for nutrition: Educational intervention in the digital age, Available at: https://www.unscn.org/uploads/web/news/UNSCN-Nutrition44-WEB-21aug.pdf (Accessed on 29 October 2020).

Food and Agriculture Organization (FAO); International Fund for Agricultural Development (IFAD); World Food Programme (WFP). (2015). The state of food insecurity in the world: Meeting the 2015 international hunger targets: Taking stock of uneven progress. *FAO, IFAD and WFP: Roma, Italy, 2015*, 1–54. ISBN 978-92-5-108785-5, Available at: https://www.fao.org/3/i4646e/i4646e.pdf (Accessed on 29 November 2021).

Gagne, F. (2014). Descriptive statistics and analysis in biochemical ecotoxicology, *Biochemical Ecotoxicology*, Retrieved from https://www.sciencedirect.com/topics/medicine-and-dentistry/correlation-analysis (Accessed on 23 January 2020).

Gaither, C, (2000). After the miracle: Burdened by its past, free South Africa presses forward. Available at: http://journalism.berkeley.edu/projects/safrica/facing/taxi.html (Accessed on 26 November 2021)

Gareau, S. E. (2004). The development of guidelines for implementing information technology to promote food security. *Agriculture and Human Values*, *21*(4): 273-285.

Gebbers, R., Adamchuk, V. I. (2010). Precision agriculture and food security. *Science*, *327*(5967): 828-831.

Golan, E., Krissoff, B., Kuchler, F., Calvin, L., Nelson, K., Price, G. (2004). Traceability in the U.S. food supply: Economic theory and industry studies (Report No. 830). *Economic Research Service*, U.S. Department of Agriculture, Agricultural Economic Report No. 830. Available at: http://www.ers.usda.gov/publications/aer830/aer830.pdf (Accessed on 06 November 2020).

Hackett, M., Zubieta, A.C., Hernandez, K., Melgar-Quiñonez, H. (2007). Food insecurity and household food supplies in rural Ecuador. Archives of Latin American Nutrition. 57(1): 10-17. PMID: 17824194.

Hall, A.K., Cole-Lewis, H., Bernhardt, J.M. (2015). Mobile text messaging for health: a systematic review of reviews. *Annual review of public health.* 36(2): 393–415.

Halford, J.,C.,G., Gillespie, J., Brown, V., et al. (2004) Effect of television advertisements for foods on food consumption in children. *Appetite* 42: 221–225.

Han, C. (2012). South African Perspectives on Mobile Phones: Challenging the Optimistic Narrative of Mobiles for Development. *International Journal of Communication 6:* 2057–2081 Available at: https://ijoc.org/index.php/ijoc/article/view/1456/2568 (Accessed on 18 June 2021).

Haysom, G., Olsson, E., Dymitrow, M., Opiyo, P., Taylor, B.N., Oloko, M., Spring, C. et al. (2019) Food Systems Sustainability: An Examination of Different Viewpoints on Food System Change. *Sustainability*, 11(12): 3337. Available at https://www.mdpi.com/2071-1050/11/12/3337/htm (Accessed on 29 October 2020).

Granheim, S.I. (2019). The digital food environment. In *UNSCN Nutrition 44. Food environments: Where people meet the food system*: 115–121. Rome, United Nations System Standing Committee on Nutrition. Available at: https://www.unscn.org/uploads/web/news/UNSCN-Nutrition44-WEB-21aug.pdf (Accessed on 29 October 2020).

Ingram, J. (2011). A food systems approach to researching food security and its interactions with global environmental change. *Food Security,* 3(4): 417-431.

Jack, W., Ray, A., Suri, T. (2013). Transaction Networks: Evidence from Mobile Money in Kenya. *American Economic Review* 103 (3): 356–361.

Joiner, J., Okeleke, K. (2019). *E-commerce in agriculture: new business models for smallholders' inclusion into the formal economy.* London, GSMA.

Kennedy, G., Ballard, T., Dop, M. C., Union, E. (2011). Guidelines for measuring household and individual dietary diversity. Rome, Italy: Food and Agriculture Organization of the United Nations.

Kikulwe, E.M., Fischer, E., Qaim, M. (2014). Mobile money, smallholder farmers, and household welfare in Kenya. PLoS ONE 9 (10): e109804. 10.1371/journal.pone.0109804.

Kraemer, H., C. (2006). Correlation coefficients in medical research: from product moment correlation to the odds ratio, *Statistical Methods Medical Research*, 15(6),525–545.

Lashgarara, F; Mirdamadi, S.M., Hosseini, S. J. F. (2010). The causal model role of ICTs in food utilization of Iranian rural households. African Journal of Agricultural Research 5(20): 2747-2756.

Lashgarara, F., Mirdamadi, S. M., Hosseini, S. J. F. (2011). Identification of appropriate tools of information and communication technologies (ICT) in the improvement of food security of Iran's rural households. *African Journal of Biotechnology*, *10*(45): 9082-9088.

Lee, J., Pelto, G.H., Habicht, J.-P., Bhuiyan, M.M., Jalal, C. (2019). Identifying nutrition and health-relevant behaviors, beliefs and values of school-going adolescent girls in rural Bangladesh: Context for interventions. *Current Developments in Nutrition,* 2(5): 20–25.

Ligthelm, A.A. (2007). The impact of shopping mall development in township areas on small township retailers. Media Release. Bureau for Market Research, Unisa (University of South Africa), Pretoria

Maxwell, D., Caldwell, R. (2008). The Coping Strategies Index, 2nd edn., CARE USA. Available at: http://www.seachangecop.org/sites/default/files/documents/200801TANGO-CopingStrategiesIndex.pdf. (Accessed on 18 November 2020).

McKinley, C.J., Wright, P.J. (2014). Informational social support and online health information seeking: Examining the association between factors contributing to healthy eating behaviour. *Computers in Human Behaviour*. 37: 107–116.

McEntee, J., Agyeman, J. (2010). Towards the development of a GIS method for identifying rural food deserts: Geographic access in Vermont, USA. *Applied Geography, 30*(1): 165–176.

Murendo, C., Wollni, M. (2016) : Mobile money and household food security in Uganda, GlobalFood Discussion Papers, No. 76, Georg-August-Universität Göttingen, Research Training Group (RTG) 1666 - GlobalFood, Göttingen

Muyaya, L. M., Manwana, E. M. (2017). Effectiveness of Mobile Phone Interventions in Improving Breastfeeding: Systematic Review of Randomized Control Trials. *International Journal of Research,* 4(6): 796–848.

Nagamani, T., S., Veni, G., K. (2016). ICTs for the empowerment of rural women: a review, International Journal of Computer Science and Technology 7 (2): 166–170.

O'Grady, V. (2020). South Africa uses apps for rides and food – and now medicines. 15 October. Available at: https://www.developingtelecoms.com/telecom-technology/apps-content-ott/10137-south-africa-uses-apps-for-cars-and-food-and-now-medicines.html (Accessed on 08 November 2020).

Olaniyi, O.A.O.A., Ismaila, K.O. (2016) "Information And Communication Technologies (Icts) Usage And Household Food Security Status Of Maize Crop Farmers In Ondo State, Nigeria: Implication For Sustainable Development." (2016). *Library Philosophy and Practice (e-journal).* Paper 1446. Available at: http://digitalcommons.unl.edu/libphilprac/1446 (Accessed on 01 November 2020).

Oluwatayo, I. B., Ojo, A.O. (2019). Effect Of access to ICT on food insecurity among farming households In Nigeria. The Journal of Developing Areas 53(2): 155-168.

Orji, A., Ogbuabor, J.E., Nwosu, E., Anthony-Orji, O., Amoji, N. (2020). Analysis of Poverty Correlates and Multi-Dimensionality in South East Nigeria: New Empirical Evidence From Survey Data, Poverty and Public Policy, 12(3): 255-270

Owen, D. (2008). Training workshop on ICT for rural development: Access and application. USAID ICT4D program. Available at: http://go.Worldbank.org/XL89032600 (Accessed on 01 November 2020).

Parlasca, M.C., Mußho, O., Qaim, M. (2020). Can mobile phones improve nutrition among pastoral communities? Panel data evidence from Northern Kenya. Agricultural Economics.51: 475–488.

Pernet, C.,R., Wilcox, R., Rousselet, G. A. (2013). Robust correlation analyses: false positive and power validation using a new open source Matlab toolbox, *Frontiers in Psychology*, 3, 606. Published 2013 Jan 10. doi:10.3389/fpsyg.2012.00606 (Accessed on 23 January 2020).

Peyton, S., Moseley, W., Battersby, J. (2015) Implications of supermarket expansion on urban food security in Cape Town, South Africa, African Geographical Review, 34:1: 36-54,

Rimi, T.A., Chudi, A.F. (2017). Analysis of the Roles of Information and Communications Technologies in Rural Women Farmers' Empowerment in Rivers State, Nigeria. *Library Philosophy and Practice (e-journal)*. 1498. Available at: http://digitalcommons.unl.edu/libphilprac/1498 (Accessed on 05 November 2020).

Rush, E. (2019) Wicked problems: the challenge of food safety versus food security – working towards the SDG goals? *European Journal of Clinical Nutrition*, 73(8): 1091–1094.

Savari, M., Shiri, N., Asadi, A. (2013). The impact of resources, channels of information and communication on empowerment of rural women in Diwandareh county, Rural Research 4(5):1302–1308

Savaria, M., Sheykhib, H., Amghanic, M.S. (2020). The role of educational channels in the motivating of rural women to improve household food security, One Health, Available at: https://doi.org/10.1016/j.onehlt.2020.100150 (Accessed on 05 November 2020).

Seivwright, A. N., Callis, Z., Flatau, P. (2020). Food Insecurity and Socioeconomic Disadvantage in Australia, International Journal of Environmental Research and Public Health, 17(2): 559; **https://doi.org/10.3390/ijerph17020559**

Sinyolo, S., Ndinda, C., Murendo, C., Sinyolo, S.A., Neluheni, M. (2020). Access to Information Technologies and Consumption of Fruits and Vegetables in South Africa: Evidence from Nationally Representative Data, International Journal of Environmental Research and Public Health. Published online on 7 July 2020

South African Market Insight (2019). Soshanguve in numbers. Available at: https://www.southafricanmi.com/soshanguve-in-detail.html (Accessed on 30 October 2020).

Statistics South Africa (2019). The extent of food security in South Africa. Government Printers, Pretoria.

Statistics South Africa (2018). 2018 General Household Survey, Government Printers, Pretoria.

Tibesigwa, B., Visser, M. (2015). Small-Scale Subsistence Farming, Food Security, Climate Change and Adaptation in South Africa: Male-Female Headed Households and Urban-Rural Nexus Technical Report, Economic Research Southern Africa (ERSA), June.

Temu, A., Msuya, E. (2004). Capacity Human Building in Information and Communication Management Toward Food Security. 2004", CTA Seminar on the Role of Information Tools in Food and Nutrition Security, Maputo, Mozambique, 8-12 November.

Traill, W. B. (2006). The rapid rise of supermarkets? Development and Policy Review, 24(2): 163–174.

United Nations (2021). World Population Prospects, available at: http://www.macrotrends.net. (Accessed on 19 April, 2021).

United Nations (2010). *We can end poverty 2015. Millenium development goals. Available at:* http://www.un.org/millenniumgoals/ (Accessed on 02 November 2020).

Van Crowder L., Fortier, F. (2000). National agricultural , rural knowledge and information system (NARKIS): a proposed component of the Uganda National Agricultural Advisory Service (NAADS).

White, K., Habib, R., Hardisty, D.J. (2019). How to SHIFT consumer behaviours to be more sustainable: a literature review and guiding framework. *Journal of Marketing*, 83(3): 22–49.

World Bank (2021). Population living in slums (% of urban population) - South Africa, available at:

https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=ZA (accessed on 23 March 2021).

Zaks, D. P. M., Kucharik, C. J. (2011). Data and monitoring needs for a more ecological agriculture. *Environmental Research Letters*, *6*(1), 014017. doi:10.1088/1748-9326/6/1/014017

Zambrano, R., Seward, R. (2012). Mobile technologies and empowerment: Enhancing human development through participation and innovation. Available at: https://www.semanticscholar.org/paper/Mobile-technologies-and-empowerment%3A-Enhancing-and-Zambrano-Rk/5f3868d2866ed3c8b9f50a29ea54a3fe8d3a9d6c (Accessed on 29 October 2020).