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Evaluation of web-based online agricultural information relevant to Tanzanian maize producers

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Abstract
This study examined the quality of web-based online agricultural information relevant to the maize industry in Tanzania. Selected online sources were evaluated to assess the agricultural information available in terms of four dimensions of quality, namely: *authority*, *completeness*, *timeliness*, and *understandability*. The study identified a wide variety of web-based online information on maize production, including information on seeds, fertilisers, pesticides, and grain-handling. It was found that the information was of variable quality. Among the 39 online sites studied, several lacked contact information, had outdated content, and contained information that was missing some important details, and none provided weather information. This study contributes to the body of knowledge on online agricultural information in an African context where the agricultural sector is central to national economic development. The online agriculture information evaluation tool used in the study can potentially be of use, in its current form or adapted, to researchers beyond Tanzania.

Keywords
agricultural information, online resources, maize production, authority, completeness, timeliness, understandability, Tanzania

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1. Introduction

Advances in information and communication technology (ICT) have created an environment that facilitates the production, exchange, and sharing of information via online platforms (Janc et al., 2019), including extensive information related to agricultural production (Food and Agriculture Organisation of the United Nations (FAO) & International Telecommunication Union (ITU), 2022). Numerous types of agricultural information are available, including information related to pest control, markets, prices, credit, loans, crop storage, inputs, agronomic practices, and agricultural innovations (Adio et al., 2016; Ogessa & Sife, 2017). Whilst much online agricultural information is useful, some is inaccurate and thus useless (Barau & Afrad, 2017; Muhammad et al., 2020), undermined by an absence of editorial review to validate content quality (Verkijika & De Wet, 2018). Variations in the quality of agricultural information are of great concern because information quality in this context affects livelihoods—by influencing individuals' ability to make decisions pertaining to their farming activities in relation to the seed variants to plant, weather patterns, maturity, fertiliser use, and the marketing of agricultural products (Kante et al., 2019).

Although the quality of agricultural information is known to impact agricultural productivity (Kante et al., 2019; Ndimbwa et al., 2020; Wilson & Lewis, 2015), little is known about the quality of different online agricultural information sources that are needed to support decision-making related to agricultural activities. Research has mostly focused on access and use, types of information sources, and the information-seeking behaviour of the farmers (Holt-Day et al., 2020; Magesa et al., 2020; Nkebukwa, 2018; Tumbo et al., 2018; Uwandu et al., 2018).

Despite the necessity of ensuring that reliable and recent online information for agriculture is accessed and shared, the information found on online sources related to agricultural topics is not validated to ensure that only accurate information is shared with stakeholders within the maize industry in Tanzania (Barau & Afrad, 2017). Research conducted by Ndimbwa et al. (2020) in Tanzania's Kyela District revealed that efforts by smallholder farmers to increase maize production were undermined by the inadequate quality of available online agricultural information. Given these weaknesses, this research examined the quality of online agricultural information intended to support Tanzanian maize producers in respect of seed selection, fertiliser application, pesticide use, and grain handling. We developed an online agricultural information evaluation tool, which was used to guide the evaluation of the selected online resources in terms of four information quality dimensions: *authority*, *completeness*, *timeliness*, and *understandability*.

2. Literature review and analytical framework

Information quality is a multidimensional concept that cannot be expressed through a single definition or even through the dimensions that measure it (Al-Hakim, 2007). This is because the term "quality" has no unified definition. Considering the

value of information in knowledge-intensive products and processes, Eppler (2006) cites two frequently used definitions of quality. The first explains quality as including all the features of a product or service that describe its ability to satisfy a given need, while the second describes quality as the extent to which the expectations of the user of a particular product or service are met or exceeded. These definitions set out by Eppler (2006) reveal two main components: a subjective component, as in meeting expectations; and an objective component, as in meeting requirements.

Abumandil and Hassan (2016), in a study in the banking sector, found that authority, completeness, timeliness, and interpretability are the core measures for assessing quality of information. Laumer et al. (2017), in studying enterprise content management systems, find that information quality should be contextualised through two measures: representation (characteristics of information conciseness, namely authority, understandability and presentation) and contextual application (degree of fitness for use in a task, namely timeliness and completeness). Within the context of health studies, Tao et al. (2017) consider accessibility, timeliness, understandability, and authority as the key dimensions to be examined to assess the quality of information available in online sources. Considering the dimensions of quality related to websites, Tate (2019) states that authority, accuracy, objectivity, timeliness, completeness, and the intended audience are the fundamental dimensions to be heeded when measuring the quality of information.

Table 1 summarises information quality dimensions found in some of the core literature, with an indication of which dimensions are foregrounded in which items of literature.

Table 1: Dimensions of information quality

Dimension	Abumandil & Hassan (2016)	Laumer et al. (2017)	Tao et al. (2017)	Tate (2019)
Authority	√	√	√	√
Completeness	√	√	√	√
Understandability		√	√	√
Timeliness		√	√	√
Accuracy	√			√
Interpretability	√			
Objectivity				√
Accessibility			√	
Presentation		√		

From the matrix in Table 1, the four dimensions that we decided to study were authority, completeness, timeliness, and understandability. A dimension cited in

all four pieces of literature featured in Table 1, namely, *authority* of information, is determined by the degree to which the reputation of a person or an organisation responsible for an online source is available to users (Tao et al., 2017). Tate (2019) warns that, on the web, anyone can state that they are providing authoritative information. Therefore, assessing the authority of the information on a website requires an extra eye to ensure the authenticity of the creator of the information. For instance, the use of contact information such as email addresses and phone numbers can be a useful indication of the authority of the individual or organisation that presents online information (Gaillard, 2018).

Completeness refers to whether the information contains all necessary details (Al-Hakim, 2007). It is the quality of being whole (Laumer et al., 2017; Tate, 2019). Information is considered complete if it provides factual information that is verifiable (Al-Hakim, 2007; Laumer et al., 2017). In the context of this research, agricultural information is considered relevant for farmers and other stakeholders of the maize industry in Tanzania if it addresses various activities in the maize production value chain. For example, the selection of maize seeds is determined by various factors, including weather, agroecological location, and maturity period (Dao et al., 2015; Temesgen & Kebena, 2019). This suggests that information made available via the web to support farming activities should provide expanded detail to ensure the application and usefulness of the information.

Timeliness is an important factor in agriculture development because every agricultural activity requires information that is current. Folnovic (2021) explains that because weather influences every activity during the growing season, information on the weather must be timely and provided in real time. Other agricultural information is considered timely when created/posted not more than two years before (Naruka et al., 2017). The timeliness of other agricultural information is influenced by the fact that maize is grown once or twice a year, depending on the agroecological zone. Therefore, information related to agricultural technology, practices, and innovations posted annually may be useful in relation to a second planting and harvest (Mbagwu et al., 2018).

Understandability is the degree to which information is easy to comprehend and apply (Al-Hakim, 2007). Readers should be able to understand certain information if they have some knowledge of the given topic. This suggests that understanding

information relates to the way in which it is presented. For instance, agricultural research reports carrying accurate information may not be easily understood by farmers because of the format used to express their content and because of the high level of language used (Lamptey et al., 2017).

Though the other dimensions were not considered for the purposes of this study, they do carry value as they were mentioned by key authors. Briefly, *interpretability* is the degree to which information is presented based on the ability of the consumer to understand it (Al-Hakim, 2007). *Accuracy* reflects the extent to which information is reliable and free from errors (Al-Hakim, 2007; Tate, 2019). It is determined by the professional experience and educational qualifications of the creator/author of the information (Brock University Library, 2023). *Presentation* refers to the way in which information is presented so that it is easily interpreted by a reader (Al-Hakim, 2007). *Accessibility* is the extent to which information is available without limitations related to time, special skills/abilities/technology, or accessibility (Eppler, 2006), so that it can be used by individuals to obtain access to information that will meet maize crop farming information needs.

3. Study design and methodology

A mixed-methods approach was used to determine the information quality of selected web-based online resources. Linked to the pragmatism paradigm, the exploratory sequential design was used to collect qualitative and quantitative data in two different phases. Qualitative data collection and analysis was used to verify the quality dimensions to be used for assessing agricultural information for maize production. Through systematic sampling of web-based online resources related to the Tanzanian agricultural sector and, in particular, the country's maize industry, we identified a sample of online resources. Online resources were identified via the use of keyword-searching. The keyword entries, in both Kiswahili and English, included "*mahindi*" (maize), "maize", "zea mays Tanzania" ("Zea mays" is the cientific name for maize), *"kilimo cha mahindi*" (maize cultivation), "*zao la mahindi*" (maize crop), "*mbegu za mahindi*" (maize seeds), and "fall armyworms maize" (fall armyworms is a maize pest that attacks cereal crops, including maize).

For each word search, 50 search results were included in the sample group, which yielded a total of 500 online resources. Spink et al. (2006) suggest that a 10% sample size should suffice in quantitative research to draw a reputable sample. Using simple

random sampling, every 10th online resource was identified to be part of the sample group. Thus, 50 sites were initially selected to be part of the sample size. These 50 sites were further analysed to ensure that they included information in either, or both, Swahili and English, as official languages of Tanzania, as well as information relevant to the maize value chain. Finally, 39 online resources were selected for inclusion in the study (see Appendix 2).

The information quality of the online resources was assessed, in December 2021, through application of a tool that we developed for this study: an online agricultural information evaluation tool (see Appendix 1). The tool was based on this study's four chosen dimensions of information quality: authority, completeness, timeliness, and understandability.

4. Findings and discussion

This section provides details on the findings that resulted from assessing the 39 selected web-based online resources in terms of the four identified quality dimensions: authority, completeness, timeliness, and understandability.

Quality dimension 1: Authority

Tate (2019) explains that assessing the authority of the information on a website requires that contact information such as email addresses and phone numbers can be checked for accuracy as an indication of the authority of the individual or organisation that presents information. As seen in Table 2, not all 39 online resources complied with the dimensions of authority in terms of (1) providing the names of authors, creators, or contributors; or (2) making contact information available. Table 2 shows that 31 of the 39 online resources included the names of the authors of, or contributors to, the contents. However, only 25 had contact information such as email addresses and phone numbers.

Table 2: Authority of information

Dimension	Attributes	Number of resources that complied (n=39)
Authority	Names of authors, creators, or contributors	31
	Authors', creators', or contributors' contact information (e.g., phone numbers, email addresses)	25

The lack of contact information for the creators of information provided on websites is perceived by authors such as Huff et al. (2015) as a serious limitation, because it suggests that the authors may not be willing to take responsibility for the validity and reliability of the contents shared on a website. Furthermore, the lack of contact details limits the ability of users to obtain access to more detailed content relating to the information posted on a website (Tate, 2019, p. 53). This suggests that contact information in online resources has implications for the users, information providers, and owners of a website. In instances where contact information is available, users are more inclined to trust the quality of information available on websites and to regard the information as authoritative. By allowing users to engage with creators/organisations through the provision of contact details, website owners can receive and benefit from feedback on their websites.

Quality dimension 2: Completeness

Maize production requires different types of information, including information about the weather, seeds, fertilisers, pesticides, and grain handling (Abass et al., 2014; Malozo, 2021; Mattah et al., 2015; Saïdou et al., 2018). The content of the 39 online resources was analysed to determine the completeness of the maize production information that was presented. Components of the maize value chain that were evaluated are presented in Figure 1.

Figure 1: Types of information evaluated

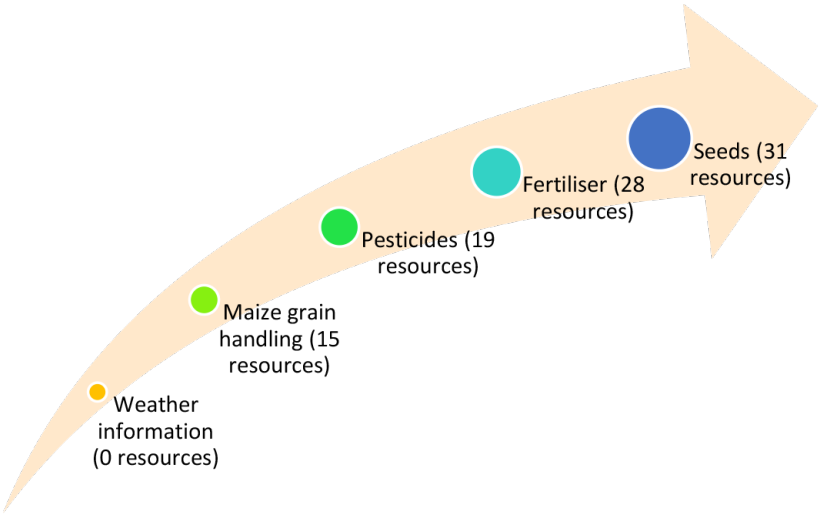


Table 3 sets out in more detail the findings regarding the completeness of the information provided in the 39 online resources.

Table 3: Completeness of information

Information on seeds (n=31)	
Topic	**Number of resources that complied**
1. Variety	29
2. Agroecological zone	12
3. Sowing time	15
4. Seeding rate (kg/ha)	20
5. Planting/sowing spacing	23
6. Maturity period (in days)	14
7. Yield/ha	16
Information on fertiliser (n=28)	
Topic	**Number of resources that complied**
1. Type	28
2. Time/stage of application	16
3. Soil information	4
4. Method of application	14
5. Application rate (kg/ha)	16
6. Interval/frequency of application	10
Information on pesticides (n=19)	
Topic	**Number of resources that complied**
1. Pest type	19
2. Pesticide type	17
3. Plant stage	6
4. Method of application	8
5. Application rate (litres/ha)	6
6. Frequency of application	1
Information on grain handling (n=15)	
Topic	**Number of resources that complied**
1. Cleaning	8
2. Drying	7
3. Storage conditions	6
4. Storage facilities	9

It was evident from the information provided about fertilisers via the online resources that none of the resources had complete information about the type of fertiliser given for maize farming. Most of the online resources lacked information on fertiliser application details (stage of fertiliser application, soil information, method of application, application rate, and frequency). This is undesirable, as inadequate information on fertilisers has negative implications for their use (Abebe & Feyisa, 2017). While authors such as Adiaha and Agba (2016) emphasise the importance of knowledge related to fertilisers and their use in enriching crops with nutrients during the growing period, authors such as Burke et al. (2019) lament the lack of comprehensive web information on the effective use of fertilisers throughout the maize production process in Zambia. The lack of information on fertilisers for maize farmers in Tanzania is of equal concern. A lack of knowledge on the use of fertilisers can negatively affect the environment and humans. Within Tanzania, the over-use of fertilisers can lead to toxins in the water and an imbalance in the crop food chain. Humans can be affected as chemicals presented in the fertilisers can cause cancer and other chronic diseases.

In terms of information on pesticides, information, such as that relating to the method of application and to application rate, was found to be under-represented. This is undesirable because it creates the strong possibility that pesticides will be used improperly. The effectiveness of a pesticide is affected by various factors including pest type, pesticide type, time of application, plant stage, method of application, application rate, and frequency (Damalas & Koutroubas, 2016; Mattah et al., 2015). According to Janc et al. (2019), an awareness of essential pesticide-related information (e.g., on application frequency, method of application, amount of fertiliser to be used, and pest threshold) contributes to the proper use of the pesticides. The lack of such information in online resources referring to pesticides implies that website information on this topic is insufficiently comprehensive. Incorrect pesticide use can affect the soil's physicochemical properties and thus the growth of maize plants. The faulty use of pesticides also negatively influences the calcium, magnesium, potassium, and manganese levels found in maize, leaving the end product without sufficient subsistence for consumption (Jallow et al., 2017; Mubushar et al., 2019). Another possible consequence is that such pesticides, when consumed by animals and humans, lead to imbalances in the animals' nervous systems, and illnesses linked to hormones or the endocrine system in humans.

With respect to the evaluation of the information on the correct handling of maize grains, it was found that the online resources did not provide sufficient detail on drying and cleaning maize grains or on storage conditions and facilities. In respect of the four main types of grain seeds that are used in Tanzania (SC Nduna, SC Shine, SC Sico, and SC Shungu), farmers need to be provided with sufficient detail on the management of these grains, so as to ensure an optimal harvest. On the specific topic of maize-cleaning, detail on the removal of foreign materials such as stones, dirt,

damaged grains, and other crops' grains is needed for use by agricultural extension officers and farmers (Akatuhurira et al., 2021). Also imperative is information on methods for removing moisture so as to avoid the deterioration of maize grains. Sai et al. (2019) explain that Tanzanian farmers can increase crop production by 13% if they know how to remove moisture. Details on how the moisture level in grains can be measured using grain moisture meters can make a valuable contribution in assisting agricultural extension officers to guide farmers on the measurement and control of moisture as a foreign material.

Finally, it was found that none of the reviewed online resources provided any weather information. Jack and Tobias (2017), Hilary et al. (2017) and Mugonya et al. (2021) point to negative impacts on maize farming caused by insufficient information on weather conditions. Information on possible rainfall, the influence of global warming, and temperature fluctuations has a direct and important influence on decisions pertaining to the best seed varieties to use, sowing time, pest control, and processes and procedures for maize grain handling. Msemo et al. (2021) propose that for weather information, specific and specialised online resources should be linked to official resources such as the Tanzania Meteorological Authority (TMA) website. Information provided by an organisation such as the TMA can serve as an authoritative, relevant, and reliable main source of weather information for various activities related to maize crop farming (TMA, n.d.).

Quality dimension 3: Timeliness

As indicated by Mubofu and Malekani (2020), timeliness is one of the essential criteria in determining the quality of an online information resource. In the agricultural sector, access to timely and reliable information contributes to agricultural production and to the adoption of agricultural inputs such as seeds, pesticides, and fertilisers. In evaluating the timeliness of the 39 selected online sources, we found, as seen in Table 4, that the majority—18(46.2%) of the resources—had content that was last created/updated in 2018-19, and that only 13 (33.3%) contained information that had been either created or updated in 2020 or 2021.

Table 4: Timeliness of information in the resources (n=39)

Year of most recent information addition	Number (percentage) of resources
2018-19	18 (46.2%)
2020-21	13 (33.3%)
No date	8 (20.5%)

Naruka et al. (2017) posit that agricultural information on topics such as seed information, pesticides, and fertilisers can be considered up-to-date if it has been created or posted within the previous two years. It was concerning that only one-third of the online resources had content created or updated during the two years leading up to the data collection in December 2021. Also of concern was the fact that eight of the resources did not provide any date of publication or date of information update. Up-to-date information is required by Tanzanian farmers, as farming practices are undergoing extensive transformation. As in many other African countries, Tanzanian farming communities are intensifying their efforts towards the use of modern inputs and improved seeds, in order to improve crop yields. Increased agricultural productivity is seen as a key catalyst for enhanced national employment and for more reliable food access in both rural and urban communities. As expressed by Wineman et al. (2020), agriculture in Tanzania is seen as the "engine" that generates income opportunities. Up-to-date online information aimed at fostering the expansion of agricultural opportunities is therefore imperative.

Quality dimension 4: Understandability

As per the evaluation instrument in Appendix 1, understandability relates to the languages and formats in which online information resources are provided. In terms of language, as shown in Table 5, it was found that 35 (90%) of the online resources used only Kiswahili, 3 (8%) employed both Kiswahili and English, and 1 (2%) used only English. Thus, most of the sites used only Kiswahili, so as to ensure direct access to information for maize industry stakeholders. This is advantageous to farmers in Tanzania, whose first language is Kiswahili (Isayam et al., 2018). Ndimbwa et al. (2020) assert that the language in which information is disseminated influences the extent to which information is usable.

Table 5: Language use in the resources (n=39)

Language(s) used	Number (percentage) of resources
Kiswahili	35 (90%)
Kiswahili and English	3 (8%)
English	1 (2%)

Regarding the information formats used (text, graphics, videos), the evaluation found, as shown in Table 6, that 22 (56.4%) of the resources were text-only, 13 (33.3%) carried a mixture of text and graphics, and 4 (10.3%) were video-only. Numerous scholars, including Flores and Sun (2018), have reported that the use of graphics, or a combination of text, graphics, and videos, is more effective than text alone in communicating meaning.

Table 6: Format use in the resources (n=39)

Format(s) used	Number (percentage) of resources
Text	56.4% (22)
Text and graphics	33.3% (13)
Video	10.3% (4)

What was not assessed, as it fell outside of the scope of the research, was the ability of farmers to access and read the content in the selected online information resources. This brings forth the possibility of further research to determine the internet usage levels and literacy levels of Tanzanian maize production stakeholders.

5. Conclusions

The findings from this study revealed that among the 39 web-based online resources studied, several of the resources lacked contact information, presented outdated content, and/or contained information that was missing some important details—and none provided weather information. These findings have implications for several maize production stakeholder groupings in Tanzania.

One such grouping is the information providers. Included in this stakeholder category are agricultural officers, who are important sources of agricultural information and advice for farmers in Tanzania. For these officers, web-based online resources are part of their communication infrastructure, and relevant and timely information is therefore imperative to ensure that they are able to advise farmers effectively. Also in this information provider category are the managers and content creators responsible for the online agricultural information resources—resources which, as this study has shown, are in many cases in need of substantial improvement. This study's findings are also significant for Tanzanian government departments and legislators, whose agricultural support policies and programmes are dependent on maize producers having access to high-quality information. Finally, and most importantly, there are the targets for the information: the farmers and other participants in the Tanzanian maize production value chain, who require online information resources that are authoritative, complete, timely, and understandable.

The online agricultural information evaluation tool that was developed and used in this study can be of value to all of the stakeholders just mentioned, because it draws attention to four important dimensions of information quality: authority, completeness, timeliness, and understandability. Since, as seen in this study, the quality of online information resources targeted at Tanzanian maize producers is questionable, all relevant stakeholders need to be empowered with information evaluation tools that enable them to identify useful and reliable online agricultural information.

The inadequate quality of web-based online agricultural information related to the Tanzanian maize industry revealed in this study requires further research to investigate how persons or organisations that are responsible for such information can be empowered to improve its quality. In addition, given the rapid advances in non-web-based digital resources accessible through non-web-based mobile apps and platforms providing interactive content to mobile devices, research is needed on the quality of the agricultural information being made available via these means to maize farmers in Tanzania and elsewhere on the continent. Given that mobile phones are the most-used digital tools for information access on the continent, mobile apps can be expected to play a central role in supporting the information needs of the continent's maize farmers. The information quality evaluation tool proposed by this study can be used, with adaptations to make it appropriate to the mobile context, to evaluate the quality of the agricultural information being made available to maize farmers who are reliant on non-web-based mobile platforms.

References

Abass, A. B., Ndunguru, G., Mamiro, P., Alenkhe, B., Mlingi, N., & Bekunda, M. (2014). Post-harvest food losses in a maize-based farming system of semi-arid savannah area of Tanzania. *Journal of Stored Products Research*, *57*, 49–57. https://doi.org/10.1016/j.jspr.2013.12.004.

Abebe, Z., & Feyisa, H. (2017). Effects of nitrogen rates and time of application on yield of maize: Rainfall variability influenced time of N application. *International Journal of Agronomy*, *2017*, 1–10. https://doi.org/10.1155/2017/1545280

Abumandil, M. S., & Hassan, S. (2016). Information quality and decision-making effectiveness: A study of banks in Palestine. *International Review of Management and Marketing*, *6*(7S), 127–132.

Adiaha, M. S., & Agba, O. A. (2016). Influence of different methods of fertiliser application on the growth of maize (*Zea mays* L.) for increase[d] production in south Nigeria. *World Scientific News*, *54*, 73–86.

Adio, E. O., Abu, Y., Yusuf, S. K., & Nansoh, S. (2016). Use of agricultural information sources and services by farmers for improve productivity in Kwara State. *Library Philosophy and Practice*, 1456, 1–16.

Al-Hakim, L. (2007). Information quality factors affecting innovation process. *International Journal of Information Quality*, *1*(2), 62–176. https://doi.org/10.1504/ijiq.2007.014607

Arbuckle Jr, J. G., Morton, L. W., & Hobbs, J. (2015). Understanding farmer perspectives on climate change adaptation and mitigation: The roles of trust in sources of climate information, climate change beliefs, and perceived risk. *Environment and Behavior*, *47*(2), 205–234. https://doi.org/10.1177/0013916513503832

Barau, A. A., & Afrad, M. S. I. (2017). An overview of social media use in agricultural extension service delivery. *Journal of Agricultural Informatics*, *8*(3), 50–61. https://doi.org/10.17700/jai.2017.8.3.395

Brock University Library. (2023). *Research support.* Research Support – Brock University Library.

Burke, W. J., Frossard, E., Kabwe, S., & Jayne, T. S. (2019). Understanding fertiliser adoption and effectiveness on maize in Zambia. *Food Policy*, *86*, 101721, 1–12. https://doi.org/10.1016/j.foodpol.2019.05.004

Damalas, C. A., & Koutroubas, S. D. (2016). Farmers' exposure to pesticides: Toxicity types and ways of prevention. *Toxics*, *4*(1), 1–10. https://doi.org/10.3390/toxics4010001

Dao, A., Sanou, J., Gracen, V., & Danquah, E. Y. (2015). Identifying farmers' preferences and constraints to maize production in two agroecological zones in Burkina Faso. *Agriculture & Food Security*, *4*(1), 1–7. https://doi.org/10.1186/s40066-015-0035-3

Eppler, M. J. (2006). *Managing information quality: Increasing the value of information in knowledge-intensive products and processes*. Springer Science & Business Media.

Flores, J., & Sun, J. (2018). Information quality awareness and information quality practice. *Journal of Data and Information Quality*, *10*(1), 1–18. https://doi.org/10.1145/3182182

Folnovic, T. (2021, June 12). *Importance of weather monitoring in farm production.* AGRIVI. https://blog.agrivi.com/post/importance-of-weather-monitoring-in-farm-production

Food and Agriculture Organisation of the United Nations (FAO), & International Telecommunication Union (ITU). (2022). *Status of digital agriculture in 47 Sub-Saharan African countries*. https://doi.org/10.4060/cb7943en

Gaillard, D. (2018, February, 8). Why you should display your contact details on a website? Samurai Web Experts. https://www.samurai-experts.com/spotlight/why-contact-details-are-important-on-a-website/

Hilary, R. S., Sseguya, H., & Kibwika, P. (2017). Information quality, sharing and usage in farmer organizations: The case of rice value chains in Bugiri and Luwero Districts, Uganda. *Cogent Food and Agriculture*, *3*(1), 1–16. https://doi.org/10.1080/23311932.2017.1350089

Holt-Day, J., Curren, L., & Irlbeck, E. (2020). USDA agricultural checkoff programs' YouTube presence and video quality. *Journal of Agricultural Education*, *61*(2), 190–202. https://doi.org/10.5032/jae.2020.01190

Huff, D., Edmond, D., & Gillette, C. (2015). *2015 B2B web usability report*. Huff Industrial Marketing and KoMarketing. https://komarketing.com/files/b2b-web-usability-report-2015.pdf

Isaya, E. L., Agunga, R., & Sanga, C. A. (2018). Sources of agricultural information for women farmers in Tanzania. *Information Development*, *34*(1), 77–89. https://doi.org/10.1177/0266666916675016

Jack, K., & Tobias, J. (2017). Seeding success: Increasing agricultural technology adoption through information. Growth Brief. International Growth Centre (IGC). https://www.theigc.org/sites/default/files/2017/12/IGCJ5833-Agriculture-growth-brief-171214-Web.pdf

Jallow, M. F., Awadh, D. G., Albaho, M. S., Devi, V. Y., & Thomas, B. M. (2017). Pesticide knowledge and safety practices among farm workers in Kuwait: Results of a survey. *International Journal of Environmental Research and Public Health*, *14*(4), 1–15. https://doi.org/10.3390/ijerph14040340

Janc, K., Czapiewski, K., & Wójcik, M. (2019). In the starting blocks for smart agriculture: The internet as a source of knowledge in transitional agriculture. *Journal of Life Sciences*, *90*, 1–12. https://doi.org/10.1016/j.njas.2019.100309

Kante, M., Oboko, R., & Chepken, C. (2019). An ICT model for increased adoption of farm input information in developing countries: A case in Sikasso, Mali. *Information Processing in Agriculture*, *6*(1), 26-46. https://doi.org/10.1016/j.inpa.2018.09.002

Lamptey, R. B., Sambo, I. A., & Hassan, A. A. (2017). Disseminating and promoting agriculture information through library and information services in Ghana. *Qualitative and Quantitative Methods in Libraries*, *5*(4), 901–907.

Laumer, S., Maier, C., & Weitzel, T. (2017). Information quality, user satisfaction, and the manifestation of workarounds: A qualitative and quantitative study of enterprise content management system users. *European Journal of Information Systems*, *26*(4), 333–360. https://doi.org/10.1057/s41303-016-0029-7

Magesa, M. M., Michael, K., & Ko, J. (2020). Access and use of agricultural market information by smallholder farmers: Measuring informational capabilities. *The Electronic Journal of Information Systems in Developing Countries*, *86*(6), 12134. https://doi.org/10.1002/isd2.12134

Malozo, M. (2021, February 21). Digital access to weather information helps young Tanzanian farmers build resilience. https://www.climatelinks.org/blog/digital-access-weather-information-helps-young-tanzanian-farmers-build-resilience

Maresma, A., Ballesta, A., Santiveri, F., & Lloveras, J. (2019). Sowing date affects maize development and yield in irrigated Mediterranean environments. *Agriculture*, *9*(3), 67–69. https://doi.org/10.3390/agriculture9030067

Martin, R., & Kahamba, J. S. (2017). Access and use of information communication technologies by agricultural extension agents in Tanzania. *Journal of the Open University of Tanzania*, *24*(2), 82–96.

Mattah, M. M., Mattah, P. A., & Futagbi, G. (2015). Pesticide application among farmers in the catchment of Ashaiman irrigation scheme of Ghana: Health implications. *Journal of Environmental and Public Health*, *2015*, 1–7. https://doi.org/10.1155/2015/547272

Maziku, P. (2019). Determinants for post-harvest losses in maize production for small holder farmers in Tanzania. *African Journal of Applied Research (AJAR)*, *5*(1), 1–11.

Mbagwu, F. C., Benson, O. V., & Onuoha, C. O. (2018). Challenges of meeting information needs of rural farmers through internet-based services: Experiences from developing countries in Africa. Paper presented to IFLA WLIC 2018 Kuala Lumpur. https://library.ifla.org/2195/1/166-mbagwu-en.pdf

Misaki, E., Apiola, M., & Gaiani, S. (2016). Technology for small scale farmers in Tanzania: A design science research approach. *The Electronic Journal of Information Systems in Developing Countries*, *74*(1), 1–15. https://doi.org/10.1002/j.1681-4835.2016.tb00538.x

Msemo, H. E., Taylor, A. L., Birch, C. E., Dougill, A. J., & Hartley, A. (2021). The value of weather and climate information to the Tanzanian disaster risk reduction sector using nonmonetary approaches. *Weather, Climate, and Society*, *13*(4), 1055–1068. https://doi.org/10.1175/wcas-d-21-0005.1

Mubofu, C., & Malekani, A. W. (2020). Agricultural information sources, channels and strategies for sharing agricultural research findings among farmers in Iringa district in Tanzania. *Library Philosophy and Practice*, 4041, 1–14.

Mubushar, M., Aldosari, F. O., Baig, M. B., Alotaibi, B. M., & Khan, A. Q. (2019). Assessment of farmers on their knowledge regarding pesticide usage and biosafety. *Saudi Journal of Biological Sciences*, *26*(7), 1903–1910. https://doi.org/10.1016/j.sjbs.2019.03.001

Mugonya, J., Kalule, S. W., & Ndyomugyenyi, E. K. (2021). Effect of market information quality, sharing and utilisation on the innovation behaviour of smallholder pig producers. *Cogent Food and Agriculture*, *7*(1), 1–17. https://doi.org/10.1080/23311932.2021.1948726

Muhammad, A. H., Siddique, A., Youssef, A. E., Saleem, K., Shahzad, B., Akram, A., & Al-Thnian, A. B. S. (2020). A hierarchical model to evaluate the quality of web-based e-learning systems. *Sustainability*, *12*(4071), 1–23. https://doi.org/10.3390/su12104071

Naruka, P. S., Verma, S., Sarangdevot, S. S., Pachauri, C. P., Kerketta, S., & Singh, J. P. (2017). A study on role of WhatsApp in agriculture value chains. *Asian Journal of Agricultural Extension, Economics & Sociology*, *20*(1), 1–11. https://doi.org/10.9734/ajaees/2017/36498

Ndimbwa, T., Mwantimwa, K., & Ndumbaro, F. (2020). Channels used to deliver agricultural information and knowledge to smallholder farmers. *IFLA Journal*, *47*(2), 153–167. https://doi.org/10.1177/0340035220951828

Nkebukwa, L. L. (2018). Access and use of agricultural information in Muleba and Misenyi districts, Tanzania. *Business Education Journal*, *2*(1), 1–11.

Ogessa, C. M., & Sife, A. S. (2017). Newspaper coverage of agricultural information in Tanzania. *University of Dar es Salaam Library Journal*, *12*(1), 12–26.

Sai, M. V. S., Revati, G. D., Ramya, R., Swaroop, A. M., Maheswari, E., & Kumar, M. M. (2019). Knowledge and perception of farmers regarding pesticide usage in a rural farming village, Southern India. *Indian Journal of Occupational and Environmental Medicine*, *23*(1), 32–36. https://doi.org/10.4103/ijoem.ijoem_121_18

Saïdou, A., Balogoun, I., Ahoton, E. L., Igué, A. M., Youl, S., Ezui, G., & Mando, A. (2018). Fertiliser recommendations for maize production in the South Sudan and Sudano-Guinean zones of Benin: Improving the profitability, sustainability and efficiency of nutrients through site specific fertiliser recommendations in West Africa Agro-Ecosystems. *Nutrient Cycling in Agroecosystems*, *1*(110), 361–373. https://doi.org/10.1007/978-3-319-58792-9_13

Spink, A., Jansen, B. J., Blakely, C., & Koshman, S. (2006). A study of results overlap and uniqueness among major web search engines. *Information Processing & Management*, *42*(5), 1379–1391. https://doi.org/10.1016/j.ipm.2005.11.001

Tanzania Meteorological Authority (TMA). (n.d.). https://www.meteo.go.tz/

Tao, D., LeRouge, C., Smith, K. J., & De Leo, G. (2017). Defining information quality into health websites: A conceptual framework of health website information quality for educated young adults. *JMIR Human Factors*, *4*(4), e25. https://doi.org/10.2196/humanfactors.6455

Tate, M. A. (2019). *Web wisdom: How to evaluate and create information quality on the Web*. CRC Press. https://doi.org/10.1201/b22397

Temesgen, T., & Kebena, T. (2019). Effects of varieties and intra row spacing on yield of maize (Zea mays L.) under supplementary irrigation at Guliso, Western Ethiopia. *International Journal of Environmental Sciences & Natural Resources*, *19*(5), 144–151. https://doi.org/10.19080/ijesnr.2019.19.556024

Tumbo, S. D., Mwalukasa, N., Fue, K. G., Mlozi, M. R., Haug, R., & Sanga, C. (2018). Exploring information seeking behavior of farmers in information related to climate change adaptation through ICT (CHAI). *International Review of Research in Open and Distributed Learning*, *19*(3), 300–319. https://doi.org/10.19173/irrodl.v19i3.3229

Uwandu, C. N., Thomas, K. A., & Okoro, C. M. (2018). Utilization of agricultural information sources and adoption of animal and crop technologies among farming households in Imo State, Nigeria. *Journal of Agricultural Extension*, *22*(1), 143–155. https://doi.org/10.4314/jae.v22i1.13

Verkijika, S. F., & De Wet, L. (2018). Quality assessment of e-government websites in Sub-Saharan Africa: A public values perspective. *The Electronic Journal of Information Systems in Developing Countries*, *84*(2), 1–17. https://doi.org/10.1002/isd2.12015

Wheeler, S. A., Zuo, A., Bjornlund, H., Mdemu, M. V., Van Rooyen, A., & Munguambe, P. (2017). An overview of extension use in irrigated agriculture and case studies in south-eastern Africa. *International Journal of Water Resources Development*, *33*(5), 755–769. https://doi.org/10.1080/07900627.2016.1225570

Wilson, R. T., & Lewis, J. (2015). *The maize value chain in Tanzania*. South African Institute of International Affairs. https://saiia.org.za/wp-content/uploads/2016/06/008-Tanzania_maize.pdf

Wineman, A., Jayne, T. S., Modamba, E. I., & Kray, H. (2020). The changing face of agriculture in Tanzania: Indicators and transformation. *Development Policy Review*, *38*(6), 685–709. https://doi.org/10.1111/dpr.12491

Appendix 1: Online agricultural information evaluation tool

Note: The decision as to whether a particular information resource is of sufficient quality or not remains in the hands of the information user. While this tool seeks to support the safe use of web-based online agricultural information, it does not replace the role of agricultural professionals in dispensing information or advice. Therefore, information users are encouraged to seek professional guidance when they feel that they will benefit from doing so.

Dimension	Attributes	Information available/not available
Authority	Are the names of authors, creators, or contributors available?	
	Does the online source present contact information such as phone numbers, email addresses of creators / authors / contributors?	
Completeness	To what extent does the information resources provide detailed information relevant to the maize value chain (in terms of the following)?	
a. Seeds	1. Variety	
	2. Agroecological zone	
	3. Sowing time	
	4. Seed rate (kg/ha)	
	5. Planting/sowing spacing	
	6. Maturity period (in days)	
	7. Yield/ha (depends on factors such as planting space)	
b. Fertiliser(s)	1. Type	
	2. Time/stage of the application	
	3. Soil information	
	4. Method of application	
	5. Application rate (kg/ha)	
	6. Interval/frequency of application	

Dimension	Attributes	Information available/not available
c. Pesticide(s)	1. Pest type	
	2. Pesticide type	
	3. Time/stage of the application	
	4. Plant stage	
	5. Method of application	
	6. Application rate (e.g. litres/ha)	
	7. Interval/frequency of application	
d. Grain handling	1. Cleaning	
	2. Drying	
	3. Storage conditions	
	4. Storage facilities	
e. Weather information	1. Location	
	2. Publication time (not older than a month)	
Timeliness	Does the online source provide a date of the last update of information on the site? Has the information available on the online source been updated recently (at least within the last two years for maize value chain information and in the last month for weather information)?	
Understandability	Is the information provided in the online information resource in a language that can be understood by the readers?	
	Is information presented in the online resource supported by graphical (photo / animation) or video information to enhance understanding?	

Appendix 2: The 39 web-based online resources studied

Name of online resource	Resource location (in December 2021)
Kilimo Solution Investments Tanzania (Agriculture Solution Investments Tanzania)	https://web.facebook.com/218482752173471/posts/utunzaji-na-uhifadhi-wa-nafaka-ya-mahindiutanguliziasilimia-80-ya-mahindi-yanayo/563297451025331/?_rdc=1&_rdr
Farmers Market	http://farmersmarket.co.tz/kanuni-5-muhimu-za-kufanya-kilimo-bora-cha-mahindi/
Mjasiriamali hodari (Strong Entrepreneur)	https://mjasiriamalihodari.blogspot.com/2017/10/kilimo-bora-cha-mahindi-growing-maize.html
Kilimo bora (Good Agriculture)	https://agricomlizy.blogspot.com/2019/09/kilimo-cha-mahindi.html
Farm Radio International Resource Pack 104	http://scripts.farmradio.fm/sw/radio-resource-packs/104-chickens-cowpea-sorghum/taarifa-za-kina-uzalishaji-wa-mahindi/
Farm Radio International Resource Pack 110	http://scripts.farmradio.fm/sw/radio-resource-packs/110-farm-radio-resource-pack/taarifa-za-kina-kupunguza-upotevu-wa-mahindi-baada-ya-mavuno/
Jifunze Kilimo (Learn Agriculture)	http://jifunzekilimotz.blogspot.com/20http://jifunzekilimotz.blogspot.com/2018/10/kilimo-bora-cha-mahindi.html8/10/kilimo-bora-cha-mahindi.html
Mitiki-Kilimo Kwanza (Teak-First Agriculture)	http://mitiki.blogspot.com/2010/08/kilimo-bora-cha-mahindi.html
Jukwaa la Kilimo (Agriculture Platform)	https://kilimoforum.wordpress.com/2016/08/17/kilimo-bora-cha-mahindi/
Kangetakilimo (Kangeta Agriculture)	https://kangetakilimo.co.tz/sw/makala-zote/113-kilimo-cha-mahindi.html
MSMEs Information Portal	https://m.facebook.com/msmeinfotz/posts/1841079969476210/
Shamba Darasa Mkusi (Field Class Mkusi)	https://www.youtube.com/@shambadarasaTV
E-Sokoni (In the Market)	https://vc4a.com/ventures/e-sokoni-2/
Halimashauri ya Wilaya ya Handeni (District Council of Handeni)	http://www.handenidc.go.tz/how-do-i-single/kulima-kilimo-bora-cha-zao-la-mahindi
Maisha Daily (Life Daily)	https://maishadaily.wordpress.com/2016/12/16/mahindi/
Frank Sungau	https://www.youtube.com/watch?v=jbs1TyS07uo
Morgiculture tz	https://www.mogriculture.com/2016/09/kilimo-cha-mahindi/
Mtandao wa Ushauri kwa Wakulima (Farmers' Advice Network)	https://www.youtube.com/watch?v=ty3kHrQU1lw
Kilimo Bora (Good Agriculture)	http://kilimoboratz2.blogspot.com/2018/01/zifahamu-mbegu-bora-mpya-za-mahindi.html

Name of online resource	Resource location (in December 2021)
Kangetakilimo (Kangeta Agriculture)	https://kangetakilimo.blogspot.com/2017/08/kilimo-bora-cha-mahindi-na-kangeta.html
Kilimo Online (Agriculture Online)	http://kilimoonline.blogspot.com/2018/01/kilimo-cha-kisasa-cha-mahindi.html
Kilimo For Life (Agriculture for Life)	https://kilimoforlifetz.blogspot.com/2018/10/kilimo-bora-na-cha-kitaalamu-cha.html
Maisha Daily (Life Daily)	http://maishadaily1.blogspot.com/2018/05/kilimo-bora-cha-mahindi.html
Modern Agriculture	http://brilliantus.blogspot.com/2016/09/kilimo-cha-kisasa-cha-mahindi.html
Muakilishi (Representative)	https://www.muakilishi.com/article/kilimo-kanuni-5-muhimu-za-kilimo-bora-cha-mahindi#
Mkulima Mdadisi (Inquisitive Farmer)	https://mkulimamdadisi.blogspot.com/2016/07/kilimo-cha-mahindi.html
Mkulima Tanashati (Smart Farmer)	http://mkulimatanashati.blogspot.com/2018/01/kilimo-cha-mahindi.html
Vincent Munde	https://www.youtube.com/channel/UCw8hCwmSy1gGyEYZ9BJavJw/playlists?view=1
Hodari Agricultural Consultants (Strong Agricultural Consultants)	https://www.facebook.com/hodarikilimo/posts/872403239770419
Farmers Market	http://farmersmarket.co.tz/hizi-ndizo-mbegu-za-mahindi/
Mkulima Mbunifu (Innovative Farmer)	https://mkulimambunifu.org/kilimo/namna-ya-kuhifadhi-mahindi-kulinda-ubora-na-kukidhi-mahitaji-ya-chakula/
Zao la Mahindi (Maize Crop)	http://africasoilhealth.cabi.org/wpcms/wp-content/uploads/2016/09/Maize_technology_brief1.pdf
Muviza	https://www.facebook.com/muviza.muviza/
Kilimo Hifadhi Shadidi Endelevu Katika Mseto wa Mazao ya Mahindi na Mikunde (Sustainable Agriculture for Mixed Farming in Maize and Legumes)	https://simlesa.cimmyt.org/wp-content/uploads/Final-CASI-booklet-revised-9-Feb-2019-1.pdf
Channel Ten	https://www.youtube.com/watch?v=cecIP1IS2MM
Kilimo Bora Tanzania (Good Agriculture in Tanzania)	http://kilimoboratanzania5.blogspot.com/2016/10/kilimo-cha-mahindi.html
Shambani Solutions (Farm Solutions)	http://shambanisolutions.blogspot.com/
Mkulima Mwenzako (Your Fellow Farmer)	https://mkulimamwenzako.wordpress.com/
Mkulima Mbunifu (Innovative Farmer)	https://mkulimambunifu.org/