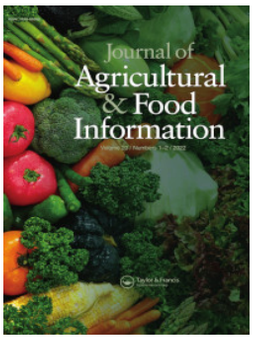

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A Study of Data Sources for Accessibility and Reuse Practices among Agricultural Researchers in Tanzania

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ABSTRACT

This paper reports a study that investigated how agricultural researchers use and reuse other researchers' data in Tanzania. This research used a survey method to investigate the factors influencing researchers in this use/reuse. Findings indicated that more than 80% of researchers use and reuse data accessed from different sources. Several factors influence the majority of researchers (more than 70%) to use and reuse data. The results of this study may attract the attention of agricultural researchers elsewhere to agricultural data use and reuse practices.

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Agricultural research; agricultural research data; data reuse; data sharing; data use

Introduction

Accessibility of data is a backbone of scientific research. A greater value is attained for research data when used and reused repeatedly (Shehzad, 2017). When using data acquired from secondary sources such as repositories, reports, and journal articles, researchers are reusing data once collected as primary data (Paff et al., 2019; Sielemann et al., 2020). Research data are used in various ways in scientific research. Researchers use secondary data to compare with new primary data collected, and to review literature for new research projects (Boté & Térmens, 2019; Zhao & Wang, 2015). In this sense, reusing other researchers' data benefits the sciences. Researchers' reuse of data created by others enhances scientific progress (Gregory et al., 2020). Thus, the reuse of scientific data has a potential benefit.

Data sharing is an important activity that enhances data reuse. Data sharing facilitates data accessibility for use and reuse (Late & Kekäläinen, 2020). If agricultural data cannot be located and accessed, these will be of no use even if well gathered (Ali & Dahlhaus, 2022). While scientific

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data sharing plays an important role to enhance data reuse, the practice has attracted more attention from researchers, governments, and international organizations and committees. For example, funding institutions, research institutes, the global health community, and international development agencies such as the World Health Organization (WHO), Research Data Alliance, FORCE 11, CODATA, the Welcome Trust, the Research Council of UK, and the Gates Foundation insist on open access for all funded research data (Adrian et al., 2018; Cooper & Springer, 2019; Khan et al., 2020; Kirub, 2016; Shen, 2015). The accessibility of data ensures data use and reuse by others. The Open Data Initiative is working jointly and struggling to build awareness, teach, and engage data users and publishers about the value of sharing and reusing data (Shehzad, 2017). According to Ali and Dahlhaus (2022), the FAIR principles (Findable, Accessible, Interoperable, and Reusable) emphasize that agricultural data need to be easily accessible for use by others.

The Government of Tanzania took several initiatives to ensure different types of data are accessible for use and reuse. The open data portal, focused on health, education, water, and social-economic data, was established in 2013 for preservation and dissemination of data (Agrawal, 2017). This initiative failed to achieve the targeted objectives; however, some remnants that were left behind gave the public the idea that data need to be open for use by others. In Tanzania, there are different types of statistical data, agricultural administrative data, and climatic and weather data that are shared and accessed via web-based platforms at the National Bureau of Statistics (NBS) and the Tanzania Meteorological Agency (TMA) (Bhatia et al., 2016; Kijazi, 2018; TMA, 2020; United Republic of Tanzania (URT), 2017). Despite the cost of their access, the availability and accessibility of agricultural, weather and climatic data from the NBS and TMA has continued to ensure that data will remain easily accessible for use by different stakeholders including researchers.

These initiatives in Tanzania, aimed at promoting data accessibility through data sharing and reuse, are focused on facilitating public access to governmental data from agencies such as NBS and TMA. Little effort has been made to make agricultural research data, in research institutions, accessible for use among researchers and other stakeholders. Furthermore, due to the absence in Tanzania of a research data sharing policy and a data repository, it is unclear where and how agricultural researchers access their data for reuse (Katabalwa et al., 2021; Mboera, 2015; Tanzania Agriculture Research Institute, 2019). This study seeks to answer the following questions: Where do agricultural researchers find reusable data? How do agricultural researchers reuse other researchers' data? What factors motivate researchers to reuse other researchers' data?

Literature review, theoretical framework, and research model

Agricultural research data

Research data are described as facts, numbers, letters, and symbols that describe an idea; data may be raw, analyzed, observational, experiential, or experimental, upon which an argument is constructed (Omo-Ojugo, 2018; Park, 2018). Agricultural research data can be generated through a range of activities such as animal feeding, husbandry, and crop practices (Wolfert et al., 2017). In the same line, agricultural research data can be generated through the use of agricultural science and technological equipment such as sensors, mobile phones, laboratory tools, satellites, drones, and radar (Wiseman et al., 2019). These scientific data are more valuable when shared and reused for further scientific research.

Data use and reuse

Data reuse is a concept that encompasses various activities, including using your own data for later comparison purposes, using other people's data to compare with newly collected data, and accessing one or more data sets for meta-analysis to address new research questions (Pasquetto et al., 2017). The data reuse process is not a single action that completes the process (Borgman & Pasquetto, 2017). The empirical research on scientific data reuse behaviors can be studied under two categories; the first is through data citation or bibliographic analysis (Park, 2018). In this approach, authors trace data reuse through data citations in literature; for example, searching databases to find journals or books containing the use of authors' data or secondary deployment of original or existing research data to study new questions (Curty, 2015). The second approach is to investigate scientific perceptions, experiences, and attitudes toward data use and reuse in the different research disciplines. This can allow the use of qualitative and quantitative approaches to gather data (Curty, 2015). Data reuse when studied through a qualitative method allows observing where researchers find reusable data, how they evaluate accessed data to fit the intended purpose, how researchers reuse data, what challenges researchers find in reusing data, and what motivates researchers to reuse other people's data (Tenopir et al., 2011). Data reuse also is studied through quantitative methods, such as survey and content analysis, that allow researchers to summarize data reuse experiences and problems and identify the intention to share or reuse data (Curty, 2015; Tenopir et al., 2011). This study applied both qualitative and quantitative approaches to establish agricultural researchers' experiences and attitudes toward data reuse.

Where do researchers find reusable data?

There is a rich literature on data sharing and reuse. Data sharing enables researchers to use other researchers' data. Tenopir et al. (2011) reported that 85% of researchers reused other researchers' data. Such data were accessed from primary sources such as surveys, experiments, and observations, as well as secondary sources, including data accessed from repositories, print publications, museums, CD-ROMS, data consortia, websites, and through personal requests. Wang et al. (2021) used meta-synthesis and inductive coding methods to analyze data reuse in different fields. They found that researchers accessed data beyond their laboratories and their collaborators, discovering data in the secondary sources noted above.

Moreover, a qualitative meta-analysis of two long-term distributed interdisciplinary consortia reveals that researchers accessed data from public collections and fellow researchers (Pasquetto et al., 2019). Researchers used/reused data accessed from local, national, and international networks such as Long-Term Ecological Research Network, Distributed Active-Archive Centers, Global Biodiversity Information Facility, National Biological Information Infrastructure, and National Ecological Observatory Network (Tenopir et al., 2011).

Other studies that focused more on data reuse practices by researchers in the agricultural sciences and related disciplines have shown that agricultural research data and other related information is shared and accessed through various data repositories and from other data infrastructure such as AGRIS, DOAJ (Directory of Open Access Journals), Global Online Research in Agriculture (AGORA), and Brage–UMB (Besemer et al., 2012; Gupta et al., 2016). A recent study conducted in the United States to examine attitudes and opinions of agricultural researchers on open access publishing and data sharing noted that agricultural researchers see the benefits of sharing data via repositories; they also admitted to having used data shared by others (Williams et al., 2019).

In line with this, Williams (2020) explored agricultural data reuse and data sharing based on a review of 102 recent publications by members of the Department of Crop Sciences at the University of Illinois at Urbana-Champaign. Agricultural researchers reused data from a variety of scientific sources including research literature, published articles, and disciplinary repositories (e.g., International Maize and Wheat Improvement Center (CIMMYT), Research Data & Software Repository Network, DDBJ (DNA Data Bank of Japan)).

Most of these previous studies explored data reuse practices by conducting an online survey to review literature or meta-analysis found in online databases to discover data sharing and reuse among researchers; the studies were not specific to agricultural research institutions. The

studies of agricultural research data reuse focused on researchers from one agricultural field, for example, crop sciences (Williams, 2022). Some previous studies used a small sample from which no generalization could be made. The current study employed mixed methods, including a larger sample size to investigate data use and reuse among agricultural researchers from different agricultural fields.

How do agricultural researchers use and reuse other people's data?

Through perusing various literature reviews, it was possible to understand the current data use and reuse practices among researchers. In Wang et al. (2021), the three stages of data reuse are (1) initiation, (2) exploration and collection, and (3) repurposing. Data can be used and reused in different ways. To reuse data effectively data users are required to be expert. Pasquetto et al. (2019) proposed a typology of data reuse ranging from comparative to integrative. Under the comparative purpose data reuse requires expertise in knowing about the quality of data and the ability to assess their value. Data are used for comparative purposes such as ground and calibration, while integrative reuse requires contributory expertise that involves the ability to reuse data in a new experiment. Data integration requires more specialization in scientific knowledge.

Furthermore, researchers use and reuse original or existing data to conduct new analyses, check the quality of newly collected data, study a new research problem, replicate research, validate research, and integrate with other data (Borgman & Pasquetto, 2017; Curty, 2015; Organization for Economic Co-operation and Development (OECD), 2007; Pasquetto et al., 2019; Tenopir et al., 2020). When data are reused for reproducibility purposes, these go through the following process: reanalyzing published data, repeating the study, replicating the findings under different conditions, and reprocessing new data (Pronk, 2019; Wang et al., 2021). A study that examined research data sharing and reuse practices of academic faculty researchers at the Virginia Tech University found that 44% of respondents reported that data can be repurposed and reused by researchers in the same discipline to support new investigations or integrated using new analytical techniques (Shen, 2015). A cross-sectional study to determine the utilization of Health Management Information System (HMIS) data and factors influencing the Tanzanian health system's performance revealed that HMIS data were used to compare performance of health care facilities in terms of service coverage, monitoring of disease trends over time, and providing evidence for community health education and promotion programs (Mboera et al., 2021). Data usage is very important in different research disciplines.

Other studies from agricultural sciences and technology involved examination of attitudes and opinions of agricultural researchers toward open access publishing and data sharing. Williams et al. (2019) indicate that sharing agricultural research data with the public will increase reproducibility and transparency of the research. The adoption of the FAIR data principles in agriculture can improve accessibility of agricultural research data that may lead to improved food security (Ali & Dahlhaus, 2022). Furthermore, agricultural data have been useful in agronomic studies and model inter-comparison, and crop modeling data have been used to accelerate innovation and improve agricultural production (Delserone & Dinkelman, 2016; Paff et al., 2019). However, it remains unclear how agricultural researchers in different fields use and reuse other researchers' data in Tanzania.

What factors influence researchers to reuse other researchers' data?

Joo and Kim (2017) used a survey method to investigate factors that motivated engineering researchers' data reuse behaviors. Findings pointed out that perceived usefulness, perceived concerns, and norms of data reuse motivated researchers to reuse other researchers' data. In addition, Curty (2016) employed a panel discussion to give a clear understanding of factors that facilitate or hinder data reuse in the social sciences. Data reuse behavior was connected to perceived benefits, perceived risks, perceived effort, social influence, facilitating conditions, and intentions to reuse data positively. Through a survey method, Tenopir et al. (2018) investigated motives, attitudes, and data practices of earth and planetary geophysicists; the attitudes of researchers toward data sharing and reuse were the motivators. Using a mixed-methods approach that combined coding with semi-automatic text-searching techniques to assess the impact of data sharing and reuse on data citation in STEM fields, Park (2018) discovered that data sharing and reuse practices were diverse across STEM disciplines.

Other authors have enumerated factors that motivate data sharing and reuse by researchers, including a mandate from funders (Kim & Stanton, 2016; Zenk-Möltgen et al., 2018) and the availability of research funds, which allow such data to be reused (Bezuidenhout & Chakauya, 2018). Data reliability also motivated researchers to reuse other researchers' data (Duan, 2016).

Despite the continuing efforts to promote data reuse, some challenges hinder data reuse practices among researchers. Williams et al. (2019) reveal that participants in an Ithaka S + R study gave the following reasons for not sharing their agricultural research data: the data would not be meaningful to others, lack of money, lack of time, lack of standards for data

sharing in many areas of agricultural research, the data would be difficult to prepare for sharing, and agricultural researchers typically do not receive any reward or recognition in terms of promotion and tenure for sharing their data. In addition to that, lack of data documentation, of accessibility, of specialized knowledge, technical issues, and failure of human scaffolds were identified as challenges to data reuse (Wang et al., 2021).

The literature review found that data reuse practices among researchers in agricultural research institutions in Tanzania are given little attention, as shown by limited documentation of research data from these research institutions. There is a lack of data sharing policy and data repositories in Tanzania (Katabalwa et al., 2021), thus the sources of data used and reused by agricultural researchers from different agriculture fields is unknown. Furthermore, it is not known what drives Tanzanian agricultural researchers to use or reuse other researchers' data.

Theoretical framework and the research model

This study adopted the Theory of Reasoned Action (TRA), which stipulates that a person's intention to perform a given behavior directly determines the performance of actual behavior (Ajzen & Fishbein, 1980). The TRA is a suitable theoretical framework to conceptualize the outcome of attitudes of respondents toward data reuse. The intention is influenced by two factors: the first is an individual's attitude toward behavior (cost and benefits), and the second is the subjective norms referring to the individual's pressure to engage or not to engage in a particular behavior (Ajzen & Fishbein, 1980; Curty et al., 2017; Yzer, 2013).

Subjective norms are important theoretical aspects that shape behavioral intention. This means that the pressure from society may influence a person to engage or not to engage in a particular behavior (Curty et al., 2017). Behavioral intention is a result of both individual influence (attitude toward performing the behavior) and subjective norms. This study adopted facilitating conditions as among the factors that influence a person to perform their actual behavior. Facilitating conditions or availability of infrastructure that preserved data can directly influence researchers to perform the actual behavior of accessing data from a repository and reusing it. Therefore, the presence of accessible data infrastructure may guarantee that a person has direct access to data and the reuse of such data.

The theory helped to measure the key concepts of this study: the dependent variable of the respondent's actual behavior of reusing data or not, and the independent variables, including individuals' perceptions that permit or forbid performing particular behavior (perceived benefits of

data reuse) (Hale et al., 2003), the social perception toward the appropriateness of data reuse (subjective norms) (Nguyen et al., 2018), and the availability of data infrastructure or facilitating conditions that guarantee the availability of data for use/reuse (perform actual behavior). According to Ambarwati et al. (2020), Venkatesh states that facilitating conditions do not affect behavioral intention, but affect actual use behavior. The availability of facilitating conditions such as resources, skills, and technical infrastructure (e.g., data repositories) can play a significant role in the use of the systems (Hamzat & Mabawonku, 2018). In this case, the presence of data platforms may drive an individual's actual data reuse. Almarri et al. (2019) reports that facilitating conditions greatly enhance user satisfaction. Figure 1 shows the conceptual model of factors that influence data use/reuse behavior.

Methods

The current study employed a descriptive and cross-sectional research design to investigate data sharing and reuse among agricultural researchers in Tanzania. The descriptive research survey was performed from February 2020 to March 2022, and enabled the collection and analysis of both qualitative and quantitative data. The qualitative approach was used to observe the circumstances in which researchers find themselves in need of other researchers' data. The quantitative approach was used to identify factors that drive researchers in the intention to reuse other researchers' data. Through the use of the TRA, the factors influencing intention and the actual behavior of data use and reuse were tested to verify the existing theory.

The study was conducted in Tanzania Agricultural Research Institute (TARI) centers and Sokoine University of Agriculture (SUA), as described in Mwinami et al. (2022). From a total population of 527 agricultural

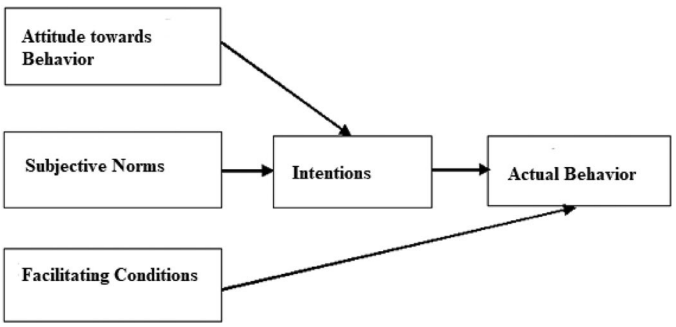

Figure 1. Conceptual model showing factors that influence data use/reuse behavior.
Source: Adopted and modified from Ajzen & Fishbein, 1980.

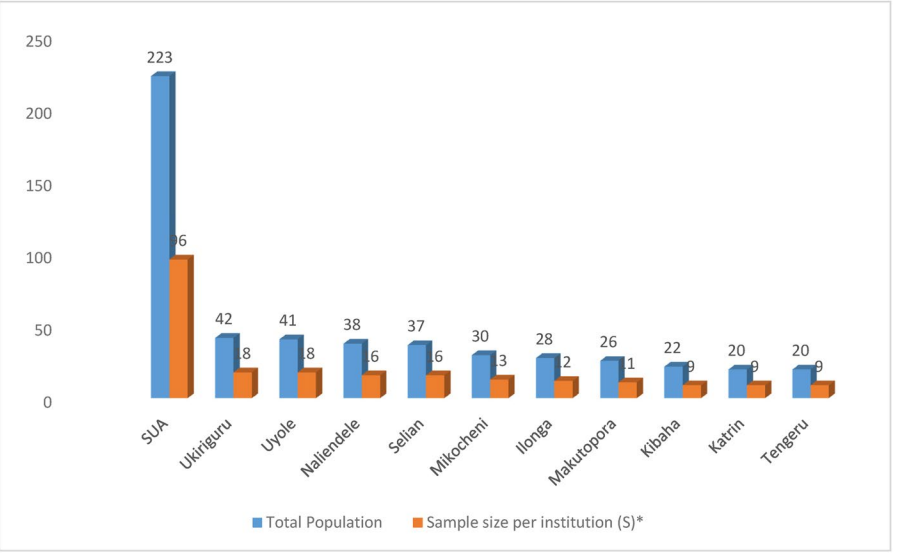

Figure 2. Sampling distribution.
Sample size per institution* = study sample size (227) times population per institution divided by total population.

researchers, Yamane's (1967) formula for calculating sample size was used to obtain the study sample size of 227 (Mwinami et al., 2022). After obtaining the sample size of 227, a representative sample size of respondents per research institution was calculated as shown in Figure 2 (Mwinami et al., 2022).

The survey instrument was tested and found reliable as described in Mwinami et al. (2022). Data collection and analysis were performed as found in Mwinami et al. (2022).

Quantitative data from 204 completed survey questionnaires were analyzed using descriptive statistical techniques that allowed us to obtain frequencies and percentages using Statistical Product and Service and Solution (SPSS) software. On the other hand, qualitative data collected through the focus group discussions and interviews were analyzed using content analysis and arranged in groups with similar subthemes. Qualitative results were used to elaborate on and validate the quantitative findings. Inferential statistics were obtained by running a Binary Logistic Regression technique. This technique was chosen because the dependent variable was a dummy variable (coded 0 = Yes, 1 = No) while the independent variable had several constructs. This technique was used to test the factors that drive actual behavior to use or reuse data. In this model, independent variables, i.e., perceived benefits of data use (attitudes) and subjective norms (society perceptions), and facilitating conditions (availability of data storage infrastructure) were identified to find out how they influence data reuse.

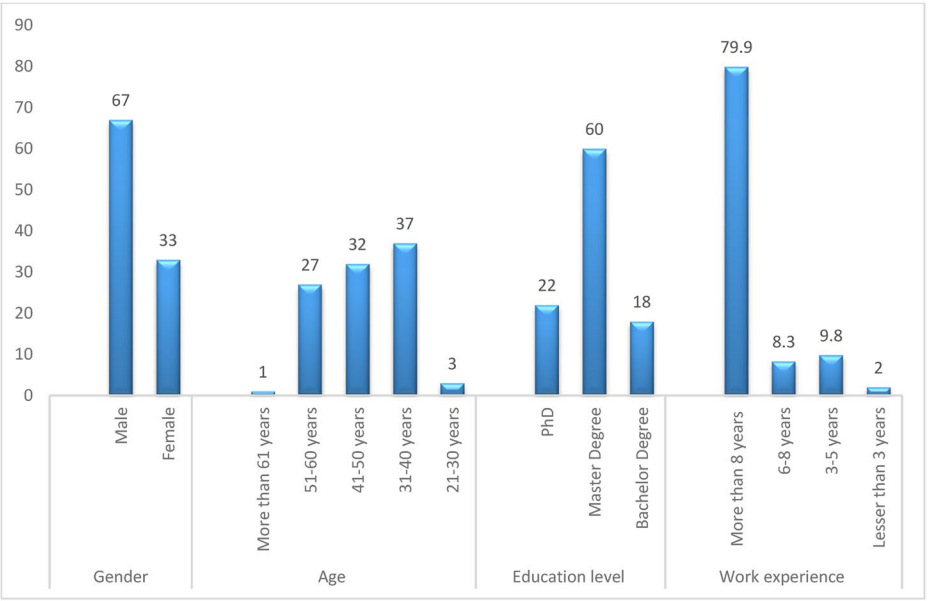

Figure 3. Demographic information of respondents.

Results

Demographic information of respondents

The demographic characteristics of respondents for this survey are presented in Figure 3. The results indicate that a significant percentage (67%) of the researchers who participated in this study were male, implying that the majority of researchers in the surveyed research institutions were male. A significant proportion of researchers (64%) were at an active age (31–60) and engaged in agricultural research. The results indicated that the largest percentage of the respondents (60%) had received a Master's degree while a few (18%) had completed a Bachelor's degree. This implies that most of the researchers in the surveyed area had a higher level of education that enabled them to conduct research. A large percentage of the researchers (79.9%) had work experience of more than 8 years. This implies that the majority of the researchers had established research experience and that the junior researchers would be learning and gaining experience from their senior colleagues (Mwinami et al., 2022). Through an interview, one respondent from a TARI center reported:

> …some well-experienced researchers have already retired and therefore, it takes time to make those younger researchers well-experienced. It was reported that there is a plan for the Government to bring back retired researchers to work under contracts but I am not sure if it will be implemented. This situation signifies the need to have well-experienced agricultural researchers to achieve the intended research objectives.

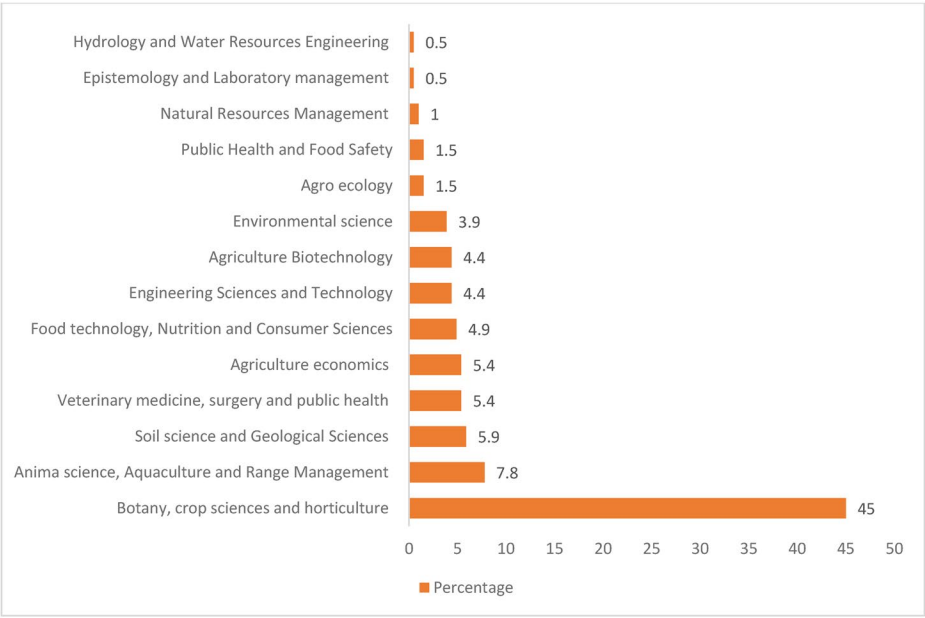

Figure 4. Academic field of specialization of researchers.

Table 1. Sources of agriculture research data used by researchers (N = 204).

Data sources	Frequency (n)	Percentage (%)
Data obtained from field surveys	198	97.6
Data obtained from field trials	195	95.6
Requesting data from fellow researchers	193	94.6
Data accessed from other research institutions and universities	189	92.6
Data obtained from research institution library	172	84.3
Data obtained from experiments	165	80.9
Local database (individual, institutional or departmental database)	46	22.5

Researchers' academic field of specialization

The findings in Figure 4 indicate the researchers' academic field of specialization for this survey, with the majority of researchers in botany, crop sciences, and horticulture. The next largest specializations of respondents were in animal science, aquaculture and range management, and agricultural extension and community development.

Where do agricultural researchers access data?

The findings from multiple responses are summarized in Table 1, and indicate that more than 80% of the respondents accessed data from field surveys, field trials, from fellow researchers, from other research centers and universities, from the institutional libraries, or through experimentation. At the focus group discussion at the Ilonga TARI center, researchers reported reusing data from national and international organizations:

> It was reported that researchers obtain agricultural research data based on soil, crop improvement, and crop protection through an observation process. Also, other different types of agricultural research data based on the climate and weather are accessed from the Tanzania Meteorological Agency (TMA) and the National Bureau of Statistics (NBS) website and database. We obtain different types of data from other research collaborators and funders, including the International Institute of Tropical Agriculture (IITA), International Research Institute for Climate and Society (IRI), International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), Centro Internationale de Agricultural Tropical (CIAT), Technical Centre for Agriculture and Rural Cooperation (CTA), the Food and Agriculture Organization (FAO), Access to Global Online Research (AGORA) and the International Maize and Wheat Improvement Centre (CIMMYT).

An interview with one of the key informants revealed the following:

> …research data are generated through laboratory experiments, observation, and field trials. I access data from secondary sources such as local and international online data sets (NBS, FAOSTAT) and other databases or platforms owned by project collaborators/partners. Also, I reuse secondary data by accessing them from the institution library when reviewing the literature. I get data through requesting from my fellow researchers, and communicating with other research institutions that are found within and outside our country.

Inferential statistics for sources of data for reuse across research institutions

Results from cross-tabulations of data sources and reuse (Table 2) show that there are variations in the researchers' sources of agricultural data across the institutions, with field surveys, trials, experiments, fellow researchers, and other research institutions being used predominantly over local or individual databases. The Ilonga, Naliendele, and Selian institutions did not report using local databases as a source of agricultural research data. Moreover, the use of the library, local databases, and experiments as a source of agricultural research data were significant ($p \leq 0.005$).

Type of research data accessed and reused

As shown in Table 3, findings indicate that 97.1% of respondents accessed and used both primary and secondary data, while 2.5% said that they accessed and used secondary data. Only 0.5% of respondents said they only accessed and used primary data.

Rate of researchers' use/reuse of other researchers' data

Results found in Table 4 indicate that about 51% always reused research data when writing research project proposals, papers, and technical reports,

Table 2. Inferential statistics for sources of data for reuse across research institutions (N = 204).

	SUA		Ilonga		Naliendele		Selian		Uyole		Tengeru		Katrin		Ukiriguru		Makutopora		Mikocheni		Kibaha		*p*-value
Source of data	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	
Institutional library	76	42.2	11	6.4	15	8.7	5	2.9	16	9.3	8	4.7	8	4.7	9	5.2	8	4.7	7	4.1	9	5.2	0.001
Fellow researchers	74	39.2	9	4.8	16	8.5	14	7.4	16	8.5	8	4.2	8	4.2	14	7.2	10	5.3	11	5.8	9	4.8	0.162
Field survey	80	40.6	11	5.6	16	8.1	15	7.6	16	8.1	8	4.1	6	3	15	7.6	10	5.1	11	5.6	9	4.9	0.097
Local databases	38	82.6	0	0	0	0	0	0	2	4.3	2	4.3	3	6.5	0	0	0	0	0	0	1	2.1	0.001
Experiments	70	42.9	8	4.9	13	8	7	4.3	14	8.6	7	4.3	8	4.9	15	9.2	9	5.5	6	3.7	6	3.7	0.005
Field trials	81	41.5	10	5.1	16	8.2	12	6.2	12	6.2	8	4.1	8	4.1	15	7.7	10	5.1	11	5.6	8	4.1	0.057
Other Tanzania Agricultural Research Institutions	71	38.1	12	6.4	16	8.6	14	7.5	8	4.3	7	3.7	7	3.7	15	8	10	5.3	10	5.3	8	4.3	0.227

F = Frequency (n)

Table 3. Type of research data reused by researchers (N = 204).

Type of research data accessed	Frequency	Percentage (%)
Both primary and secondary agricultural research data	198	97.1
Secondary agricultural research data	5	2.5
Primary agricultural research data	1	0.5
Total	**204**	**100**

Table 4. Rate of researchers reuse of others researchers' data (N = 204).

Rate of usage	Frequency (n)	Percentage (%)
Always	104	51.0
Occasionally	61	29.9
Very rarely	38	18.6
Never	1	0.5
Total	**204**	**100**

Table 5. How data are used/reused by researchers (N = 204).

Reuse of agriculture research data	Frequency (n)	Percentage (%)
Used in writing scientific paper	194	95.1
Answer scientific question	177	86.8
Aid interpretation of results	175	85.8
Used in reproducing new study	173	84.8
Used in comparing results	169	82.8
Used in shaping research question	165	80.9
Used as reference in training and teaching	163	79.9
Used in testing theories	157	77.0
Used in paper review (meta-analysis)	152	74.5

while about 30% occasionally did so. However, about 18.6% of respondents said that they reused research data very rarely.

How do researchers reuse other researchers' data?

More than 80% of the respondents indicated that they use/reuse agricultural research data in writing scientific papers, answering scientific questions, to aid interpretation of results, reproducing new studies, comparing results, and using data in shaping research questions (Table 5). A key informant stated:

> Researchers from research and academic institutions at SUA use and reuse data as reference materials during teaching and training students in various agriculture fields. Also, research data are used when writing research proposals for requesting project funds. Also, I use research data when writing review papers or conducting meta-analyses.

Another interviewee reported:

> I use data while preparing research technical reports (annual reports) to be submitted to funders/collaborators, and TARI Headquarters. Research data are facts, or any innovation is used when providing technical advice and training rural communities about new technologies generated through research.

Table 6. Factors influencing researchers to use/reuse other researchers' data (N = 204).

Factors influence	Frequency (n)	Percentage (%)
Attitude		
Data reuse improves my results due to similarity in study purposes	164	80.4
Data reuse helps me answer my study questions	154	75.5
Data reuse saves time for researcher	152	74.5
Data reuse is efficient due the use of similar tools in new study	135	66.2
Data reuse saves money/finance	133	65.2
Subjective Norms		
Institutional research arrangement	114	56.4
Funders' or project collaborators' policies	108	53.4
Facilitating conditions		
Quality data from trusted data storage infrastructure	154	74.5
Reliable data from trusted data storage infrastructure	163	79.9
Accessible data from trusted data storage infrastructure	129	63.2

Factors influencing researchers to reuse other researchers' data

The results presented in Table 6 indicate that more than 70% of the respondents were influenced by several factors to reuse other researchers' data. Based on the TRA, the factors included attitudes, subjective norms, and facilitating conditions. These factors are: data reuse improves results due to similarity in study purpose (attitude), data reused were those from trusted storage infrastructure (facilitating conditions), data were reused because they help answer research questions (attitude), data reuse saves time (attitude), and data were reused because they had good quality (attitude).

Modeling factors inducing researchers to reuse other researchers' data

The Binary Logistic Regression Model was used in testing the relationship between dependent and independent variables. The results found in Table 7 indicate that there is a relationship between the dependent variable (data use/reuse) and independent variables (attitude, subjective norms, and facilitating conditions). However, none of the independent variables had a statistically significant difference, inferring that all of them had an equal influence on data use and reuse (actual behavior).

Discussion

Demographic information of respondents

Results imply that male agricultural researchers superseded female researchers within the institutions under study. This situation has been a tradition in many agricultural research institutes and in universities that have specialization in agriculture. It is not surprising to find more male employees than female employees in this field. It is also worth noting that all of these institutions are dealing with scientific inventions

Table 7. Modeling factors influencing researchers to reuse other researchers' data.

							95.0% C.I. for EXP(B)	
Factors	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Facilitating conditions								
Reliable data from trusted storage	−910	.888	1.050	1	.305	.403	.071	2.293
Accessible data from trusted storage	-.342	.618	.305	1	.581	.711	.211	2.387
Quality data from trusted storage	.283	.635	.198	1	.656	1.327	.382	4.608
Attitude								
Data reuse saves money	-.111	.658	.029	1	.866	.895	.246	3.250
Data reuse improved my results	-.042	.825	.003	1	.959	.958	.190	4.827
Data reuse is efficient	-.320	.735	.189	1	.663	.726	.172	3.068
Data reuse helps to answer study question	.203	.757	.072	1	.788	1.225	.278	5.401
Data reuse saves time	.568	.729	.607	1	.436	1.765	.423	7.369
Subjective Norms								
Institutional research arrangement	-.148	.603	.060	1	.807	.863	.265	2.813
Funders' policies	-.080	.619	.017	1	.897	.923	.274	3.102
Constant	3.082	.968	10.133	1	.001	21.806		

and discoveries whose implementations require a background in science subjects. Traditionally in Tanzania and neighboring countries, physical science subjects have been learnt by more males than females. The findings of the current study are related to those of the study by Funk et al. (2018), which reveals that fewer women were working in jobs related to the physical sciences, technology, engineering and mathematics (STEM).

In terms of age group distribution, this study found that the majority of the researchers in agricultural research institutions were aged between 31 and 50 years and few were between the age groups of 21–30 years. Only two respondents who participated in this study were more than 61 years old. From this we can assume that researchers who were aged 31 years and above are experienced agricultural researchers participating in different research projects at SUA and the TARI centers. These results imply that researchers aged 31 years or above have been working with research projects for many years and therefore have generated agricultural research data that may be used by other researchers. Furthermore, researchers at the mentioned age have been using and reusing research data they accessed from other researchers or other sources.

Regarding the respondents' educational levels, the findings indicate that agricultural researchers are adequately qualified for their work as 82% had a Master's degree and above in the agricultural sciences. The respondents with this academic qualification have enough knowledge and skills to conduct research activities in the different agricultural fields as per their institutions' mandate and research priorities. In terms of experience, the results signify that agricultural research activities require researchers who are adequately well-experienced to achieve the intended goal of ensuring food security is achieved through improving seeds and farming methods.

Where do agricultural researchers find data to use and reuse?

Our findings indicate that agricultural researchers access and reuse both primary and secondary agricultural research data. They use their own primary agricultural research data or raw data obtained through research activities such as field surveys, field trials, observations, and laboratory experiments. The secondary data are from secondary sources such as repositories, literature reviews, and reading previous research reports. These results are in line with the study by Curty (2015), in which primary research data are used when a researcher collects data for a specific project and then uses the same data later on for the same or a later project. When datasets are contributed to a repository and retrieved by someone else and reused for a new project, it would be considered secondary data analysis.

Furthermore, a study conducted by Park (2018) details several types of data that were reused by STEM researchers in astronomy/physics and chemistry (crystal structure, crystallographic data, and molecular data); in computing (software, code, and models); in the earth sciences (datasets); in engineering (test data, datasets, and GIS vector data); in mathematical sciences (software, Matrix); and in technology (datasets, file sets, and TIFF images). Furthermore, data that are reused are those obtained from sources such as remote sensing, weather forecast services, and genome portals that provide resources for biotechnologists (Alliance for Internet of Things and Edge Computing Innovation (AIOTI),), 2020; Boté & Térmens, 2019; Seol et al., 2016). According to key informant interviews, researchers use/reuse other researchers' data via local and international data sources such as FAOSTAT and ICRISAT. Researchers also reuse data that are accessed from other institutions, collaborators, partners, and funder's datasets.

The inferential statistical results indicate that the use of the library, local databases, and experiments had statistical significance, implying that these institutions vary in the way they obtain data from these sources. The institutions differ in the extent to which they conduct experimental research, other than SUA, a research institution. The latter, on the other hand, has a library with an institutional repository and subscribes to many e-databases that offer researchers access to agricultural research data with opportunities to conduct secondary data analysis or meta-analysis.

How researchers use/reuse agricultural research data

Researchers use and reuse data in writing scientific papers; for example, researchers use their original research data or raw data to answer intended research questions. Researchers reuse other researchers' data by reviewing different literature or doing meta-analysis to compare results or make critical analyses. Furthermore, researchers reuse scientific data in writing

scientific papers, technical reports, and in project proposal preparation. These findings are related to those that reveal that research data were reused in writing research papers and dissertations (Curty, 2015; Kadir & Yunus, 2017). Our findings show that researchers reuse available data to compare results with what has been obtained in their current study. These findings are related to those that examine data reuse as an act of returning to one's data for later comparison purposes (Pasquetto et al., 2019), and to another in which agricultural researchers in research institutes generate, collect, store and use data for research and decision-making in agriculture (Ng'eno & Mutula, 2018).

Agricultural researchers use data as a reference in teaching and learning, especially in research institutions where there are some academic activities. These findings are related to an earlier study, which revealed data accessed from the UKDA data bank facilitated secondary analysis and teaching and learning (Kadir & Yunus, 2017). It has been shown that data are used in shaping and answering intended research problems and facilitating the interpretation of results, aligning with previous studies which reveal that research data are collected for different reasons, including pursuing new research projects and answering a variety of research questions within the study and generating new study hypotheses (Linek et al., 2017; Pouchard, 2015; Zuiderwijk et al., 2020).

Factors influencing researchers to reuse other researchers' data

In terms of factors causing researchers to reuse others' data, respondents reported several factors that motivate them. Such factors include the quality of data available from different sources, perceived benefits, and availability of data storage infrastructure. Findings obtained from Binary Logic Regression Model (Table 7) indicate no independent variables had a statistical significance, meaning that all the factors contributed equally to the actual behavior of data use and reuse. The reuse of existing data that are similar to a study's purpose were observed to drive researchers' intention to use that particular data. These findings are in line with the study by Joo and Kim (2017), in which researchers reused existing data that were seen to merit a new study.

Good quality data were observed to influence researchers in data reuse, as was the case with social scientists who reused data of good quality in terms of completeness and clarity (Curty et al., 2017; Zuiderwijk et al., 2020). The data accessible from trusted reliable sources or infrastructure was observed to induce researchers to reuse such data, as found in earlier studies (Caracciolo & Keizer, 2011; Koopman & De Jager, 2016). Saving time and minimizing cost were among the factors that drive researchers to reuse other researchers' data, matching previous reports that researchers

prefer to use data that are obtained or accessed by fellow researchers to save time and minimize the cost and duplication of efforts (Pronk, 2019; Sielemann et al., 2020).

Our findings also reveal that agricultural researchers reuse data that are openly published. Funding agencies insist that all data resulting from publicly funded research projects should be made open for reuse by others. This policy is beneficial to researchers because they can reuse other researchers' resources when writing a proposal, report or conducting meta-analysis. These findings align with studies that reveal that researchers were required to share their data so that they may be reused by others (Bezuidenhout & Chakauya, 2018; Delserone & Dinkelman, 2016; Zenk-Möltgen et al., 2018). During the interviews, researchers report that they access data from fellow researchers. Internal arrangements in research institutions also motivate researchers to reuse colleagues' data. Researchers working in teams with other project collaborators and funders allow them to exchange resources, which enables data sharing and reuse.

Conclusion

It can be concluded that agricultural researchers reuse data that are accessed from primary and secondary sources. There are factors that influence agricultural researchers to use and reuse other researchers' data. The use and reuse of existing accessible agricultural research data has a positive impact on the improvement of agricultural research that may facilitate the attainment of development goals by ensuring food security in the country.

Recommendations

1. Agricultural researchers should put more effort into exploiting their existing data and using original data during their research activities so that they achieve the best in all aspects of research in different agricultural fields.
2. In order to facilitate future use/reuse of data generated by researchers from different research projects, it is recommended that research institutions should establish their own local databases for hosting all agricultural research data.
3. Agricultural research institutions should formulate and implement a data sharing policy and establish standards or tools that may facilitate data reuse.
4. Researchers should be willing to allow their data to be reused by others simply because they too admit using or reusing the data that are accessed from other sources.

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