TANZANIA NATIONWIDE **MILLS CENSUS REPORT**

2022

WFP World Food Programme

OpenMap Development Tanzania

LIST OF ACRONYMS

DAICO	District Agriculture, Irrigation and Cooperative Officer
DED	District Executive Director
DMO	District Medical Officer
GAIN	Global Alliance for Improved Nutrition
GIS	Geographical Information System
GPS	Global Positioning System
GPX	GPS Exchange Format
HKI	Helen Keller International
JOSM	Java OpenStreetMap editor
NBS	National Bureau of Statistics
NFFA	National Food Fortification Alliance
mt	Metric Tons
ODK	OpenDataKit
OMDTZ	OpenMap Development Tanzania
OSM	OpenStreetMap
PMO	Prime Minister's Office
PO-RALG	President's Office Regional Administration and Local Government

QGIS	Quantum Geographic Information System
RAICO	Regional Agriculture, Irrigation and Cooperative Officer
RAS	Regional Administrative Secretary
RMO	Regional Medical Officer
SANKU	Sanku-Project Healthy Children
SDGs	Sustainable Development Goals
SMEs	Small and Medium Enterprises
TFNC	Tanzania Food and Nutrition Center
ToR	Terms of References
ToT	Training of Trainers
VEO	Village Executive Officer
WEO	Ward Executive Officer
WFP	World Food Programme
XLS	Excel Sheet Format

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ACKNOWLEDGEMENTS

The World Food Programme (WFP) would like to thank the Government of the United Republic of Tanzania for the support and collaboration provided through different ministries and departments, which have made the mapping exercise a success. In particular WFP thanks the Ministry of Industry, Trade, and Investment, the President's Office - Regional Administration and Local Government, Prime Minister's Office, Ministry of Health, National Bureau of Statistics (NBS), and Tanzania Food and Nutrition Centre (TFNC) for their involvement in data collection, data validation, report writing and eventual launch.

We also extend our gratitude to the technical committee of the National Food Fortification Alliance for their input and validation of the report, Sanku-Project Healthy Children, Global Alliance for Improved Nutrition, milling machine owners, community mappers, and our partner OpenMap Development Tanzania for designing, supervising, and undertaking the milling census and developing the interactive map.

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EXECUTIVE SUMMARY

The national milling census was conducted to establish a Geographical Information System dataset for micro, small, medium, and large mill enterprises in Tanzania. In addition the census was to provide information on each of the mills that included type of machinery used, production capacity use, food safety measures employed and fortification practice. Open-source tools and a community mapping approach were used for data collection where a total of 1,091 community mappers mapped 33,721 mills across 31 regions in Mainland Tanzania and Zanzibar over a over a of course of three months. The census focused on cereals and tuber mills maize, wheat, rice, and sorghum production for cereals and Cassava for tubers.

In addition to successfully mapping 33,721 food processing facilities the census also established the different food processing machines used in the mills with hammer mills (58%) being the major type of processing machine found followed by dehuller (28.7%), rice mills (9.3%) and others (3.7%) such as pin, roller, and disc mills. The results from the census further showed that only about 2% of maize flour millers surveyed fortified maize flour with vitamins and minerals. Packaging was practiced by only 36% of millers whereas 64% were not packaging their produce. The predominant staple food milled by majority of the millers was maize flour (50%) followed by tubers such as cassava (20%), sorghum (14%), rice (12%), and wheat (4%). Practice of safety measure such as wearing protective clothes was observed among 19% of millers while majority of millers (81%) did not wear any protective clothes. Following the mapping of mills, an online interactive web map was developed where stakeholders would be able to fetch, filter, analyse and make informed decisions based on available results for all 31 regions of Mainland Tanzania and Zanzibar. The census report and web map[1] were validated by a technical committee selected from the National Food Fortification Alliance.

The findings of this census will be instrumental to the Government and development partners in increasing access to fortified and nutritious foods in the country as well as supporting Government's efforts toward mandatory fortification.

1 https://www.millmaps.org/

INTRODUCTION

Picture 1: Deputy Minister of Industries, Trade and Investments, Honourable Exaud Kigahe and Sarah Gordon-Gibson, WFP Representative and Country Director launch the Milling Census Report in Dodoma

The cereal and tuber milling sector plays a crucial part in food and nutrition security in Tanzania, with over 85 percent of the population[2] relying on maize flour (ugali) to meet 40 percent of their average household calorie need. The sector is primarily divided into micro, small, medium, and large-scale enterprises. It is estimated that 95 percent[3] of all maize flour in the country comes directly from micro, small, and medium-scale mills while a large percentage of wheat flour, which is consumed in significant quantities in cities and towns, comes from large-scale mills.

In most industries, particularly food processing, up-to-date, available, and accessible data is crucial for a robust sector. However, the lack of information and unavailability of a milling database in Tanzania poses significant challenges for stakeholders, especially when navigating different regions, hence limiting their ability to make informed and relevant decisions.

To address these challenges, WFP in coordination with relevant stakeholders and in line with Sustainable Development Goal 2[4] launched a detailed mapping census of cereal and tuber mills across the country. The exercise was designed with the objective of providing a comprehensive analysis of the cereals and tuber milling sector in Tanzania. Data collected is expected to support relevant stakeholders in getting a better understanding of locations, commodities milled, capacities, distribution as well as food and nutrition security situation in terms of storage, and flour fortification status.

A digital web map that allows interactive visualisation and analysis of the data was created to simplify data access for all stakeholders. With the interactive map, the status of mills across regions can be analysed and various parameters like type of machine, energy source, ownership, etc can be useful for planning purposes.

2 50 million Tanzanians
3 Lessons learned from the Millers Pride – Lishe Bora project
4 End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

PROJECT OBJECTIVES

General Objective

To survey and provide Geographical Information Systems (GIS) data for micro, small, medium and large mill enterprises in mainland Tanzania and Zanzibar.

Specific Objectives

To **collect Global Positioning System (GPS) coordinates of each mill**, their production capacity, type of commodity they mill, kind of equipment used in the mills, energy used, fortification status and ownership

To **create an interactive map for national mills;** and

To **create a network of community mappers** in Tanzania

Picture 2: A mapper collecting mill machine information in Mpanda district

METHODOLOGY AND IMPLEMENTATION STRATEGY

OpenMap Development Tanzania (OMDTZ), was selected to undertake the census which applied a community mapping methodology for data collection. In this regard community mappers, mostly youth with access to smartphones and able to read and write were recruited and trained on use of open-source tools and knowledge for future use, i.e., to update the data when needed. This method proved to be efficient in terms of time management and cost, while at the same time presenting an opportunity for WFP to strengthen the capacity of local mappers. The mapping of existing milling machines was completed over a period of three months.

A phase-approach methodology and implementation strategy as shown below was used.

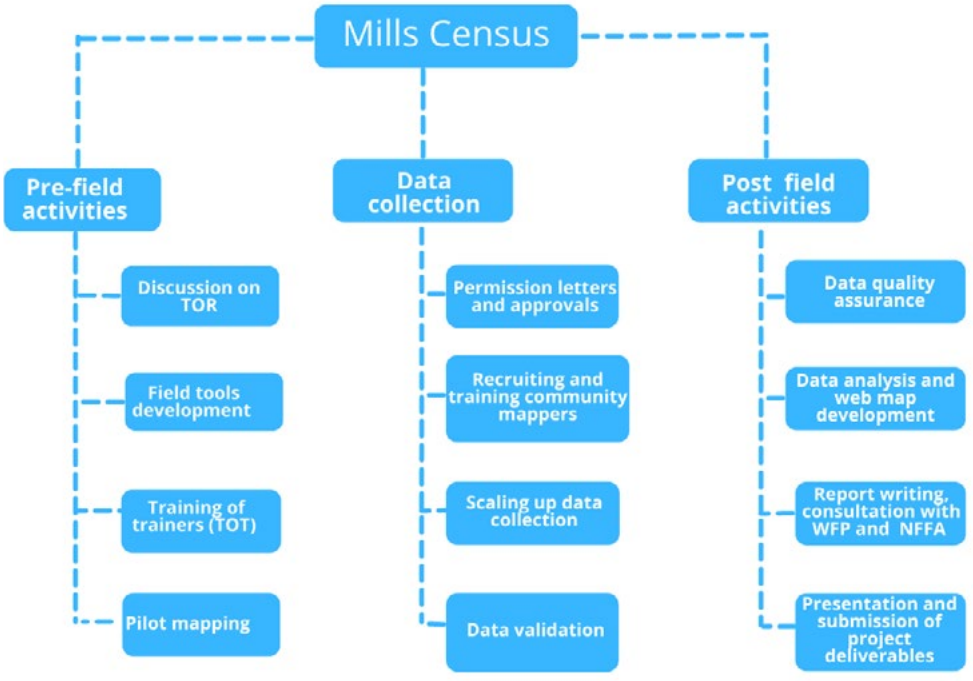


Figure 1: Methodology and implementation strategy

1. PRE-FIELD ACTIVITIES

Picture 3: An ODK Collect app loaded with the survey form

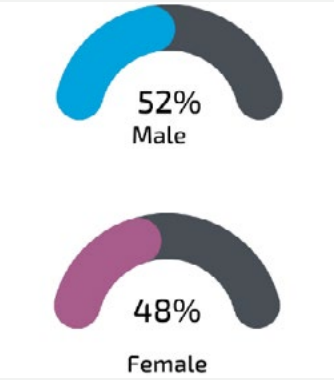


Figure 2: Team Composition

Pre-field activities were key in determining the best approach for the implementation of the project and the modality of the data to be collected. The activities required careful consideration of the terms of reference (ToR) of the assignment and seeking an understanding of the attributes to be collected. The activities included the below:

1.1 Data Collection

The data collection exercise involved the use of several tools such as Open Data Kit (ODK)[5] - a free android application for data collection, and OSMAnd[6] for navigation purposes. The tools were selected as they are open, user-friendly, and work offline, which is perfect for remote locations with limited internet access.

1.2 Survey Design

The questionnaires for data collection were provided by developed by WFP with minor inputs from key stakeholders. The questionnaires were converted into XLS form, which is an ODK form format compatible with the applications used.

Most of the survey questions were set as close-ended to ensure that the responses were structured and clear to improve the data cleaning process. A comment section was added allowing mappers to include additional information as needed. To ensure the accuracy of the GPS coordinates of the milling machines, GPS settings on data collection devices were set to a default limit of five meters accuracy.

1.3 Training of Trainers

Intensive one-week training was held for district and regional coordinators who were responsible to train and supervise field data collectors. During the training, data collectors were capacitated with skills required to use an Open Data Kit (ODK), conduct questionnaires, collect data as well as use the OSMAnd app to effectively coordinate the mapping process.

5 https://opendatakit.org/
6 https://osmand.net/

2. DATA COLLECTION

Picture 4: Training of community mappers.

This section includes activities performed during data collection such as obtaining approvals to conduct the survey, compiling existing data from authorities, pilot mapping, recruiting mappers, etc.

2.1 Permission for the Mills Census Survey

Approval for the activity was sought at different levels of government starting from national, regional, and district levels as well as ward/village level. The approval request provided the team an opportunity to also estimate the number of mills available it the proposed locations for assessment which was helpful in planning. National statistical data from the Ministry of Agriculture and Dodoma statistical data through the Departments of Manufacturing, Ministry of Trade, and Industries was also obtained in the process.

2.2 Pilot Mapping

Pilot mapping was conducted in the Morogoro region, which was selected due to its high number of mills expected compared to other regions allowing the team to map a diverse number of cereal and tuber mill machines ahead of scaling up.
The pilot aimed at:

- Testing the mapping methodology and questionnaire surveys to understand whether adjustments may be required to improve the survey;
- Assessing the time frame and number of mappers required for data collection at each region; and
- Understanding potential challenges and ways to address/ mitigate ahead and during the roll-out of the survey in other regions. Refer to Annexure for more details.

2.3 Recruitment of Community Mappers

Following the introduction of the project to the region and district offices and obtaining the required approvals for data collection, field mappers were identified and recruited in coordination with district trade officers, business officers, and other officials in the district.

2.4 Training Community Mappers

Training of community field mappers included - introducing the survey, training on basic data collection tools such as ODK Collect and OSMAnd, survey walk-through, familiarization with survey questions and answers, field practice, and engagement practices related to local leaders and millers.

ZONES FOR MILLS MAPPING IN TANZANIA

Picture 5: Zones for mills mapping in Tanzania

3. POST-FIELD ACTIVITIES

Picture 6: Monitoring data collection

This section includes activities performed after data collection such as data quality assurance, data analysis, development of web map, report writing, and consultation with National Food Fortification Alliance and WFP.

3.1 Data Quality Assurance

Throughout the mapping process, the team ensured the quality of the data by conducting daily data quality checks to observe data consistency, completeness, and accuracy. The team also performed data cleaning activities (e.g., removing outliers, and missing data interpolation) to get the desired quality.

To achieve the required accuracy, data spot checks were done throughout the different stages as follows:

a. Survey design

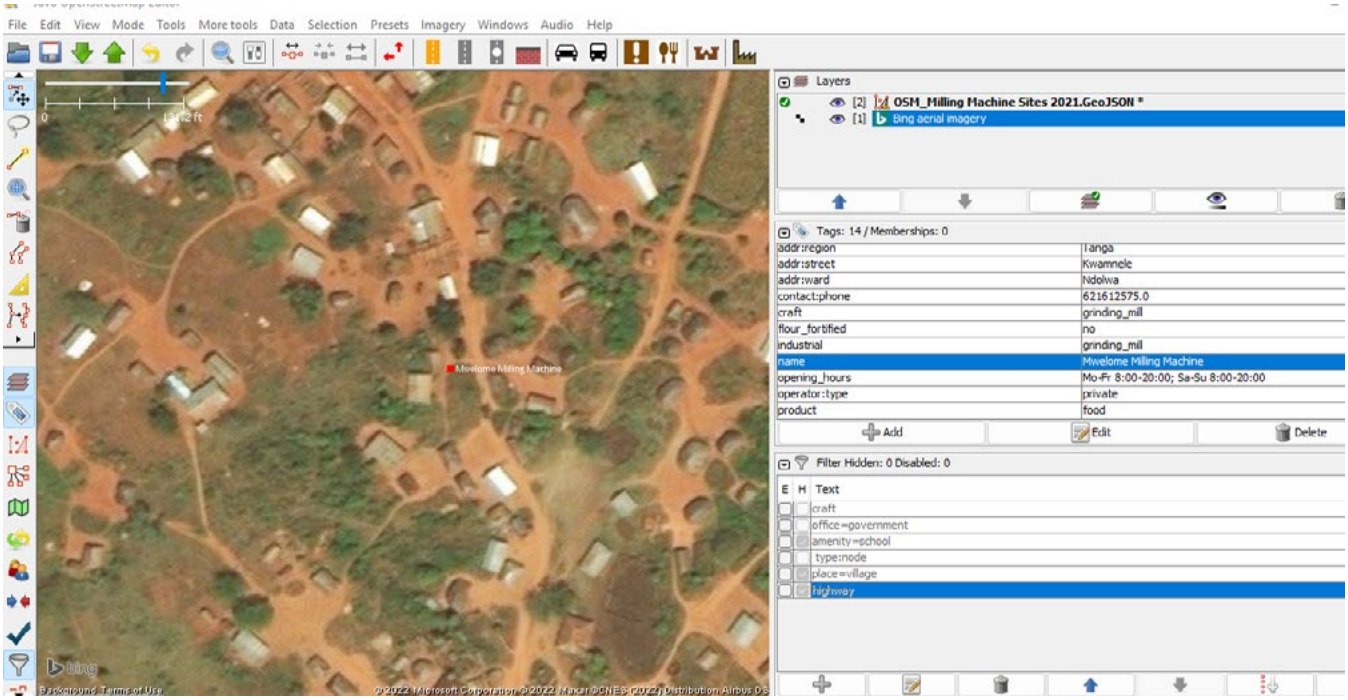
The questionnaire was developed with a variety of algorithms and data fields that helped reduce the occurrence of errors, improve data quality, and help in monitoring including:

- Survey metadata: the gathering of information in the background such as device identification, dates, and timestamp to estimate the duration required for data collection;
- GPS location accuracy: accuracy of GPS coordinates was ensured by setting up a default limit of five meters; and
- Relevance: skipping a question or making an additional question appear based on the previous response to ensure the surveyor will only fill in the relevant questions.

b. Monitoring data collection

The questionnaire was developed with a variety of algorithms and data fields that helped reduce the occurrence of errors, improve data quality, and help in monitoring including:

- Spot-check visits to sample villages to check if mappers have collected the information properly;
- Cross-check data collected from the field against preliminary data collected through authorities (number of mill machines available at each location/region);
- Random calls to local government officers to ensure that mappers have conducted the survey in their area; and
- Availability of stamped approval letters from local government officials of the village/ward



Picture 7: Data cleaning process by using JOSM

c. Data Cleaning

To ensure the data collected was aligned correctly ahead of the analysis and web-map development stage, an intensive data cleaning of the collected mills' machines was conducted across the different spreadsheets, Quantum GIS (QGIS) and Java OpenStreetMap Editor (JOSM).

KEY FINDINGS

This section provides a detailed analysis of the findings of the census including the number of mills surveyed, flour fortification status, and types of milling machines used, which are made available through an interactive map. The survey mapped all cereals and tuber mills facilities in Mainland and Zanzibar. Cereals mills included maize, wheat, rice, and sorghum, while tubers covered only cassava. The census mapped 33,721 millers surpassing the anticipated initial number of 13,000 mills.

A user-friendly web map incorporating mill data was developed, allowing enabling stakeholders to interactively visualize the dataset and gain a better grasp of mill features. Consultations with WFP and National Food Fortification Alliance technical teams were undertaken to ensure that the web map catered to the needs of stakeholders. Below are the detailed findings of each attribute collected during the census.

1. TYPES OF MILL PROCESSING MACHINES

Picture 8: Example of milling processing machines

Through this exercise, a total of 33,721 milling facilities and 55,801 unique milling processing machines - varying in capacity, functionality, and type of products milled – were assessed and mapped out. According to the census results, the Hammer machine accounted for 58 percent of all processing machines, followed by the Dehuller, which accounted for 29 percent. The census also recorded the use of other supporting tools including cassava milling and rice grinding machines.

The graph and pictures below elaborate on the types of processing machines mapped out through the census.

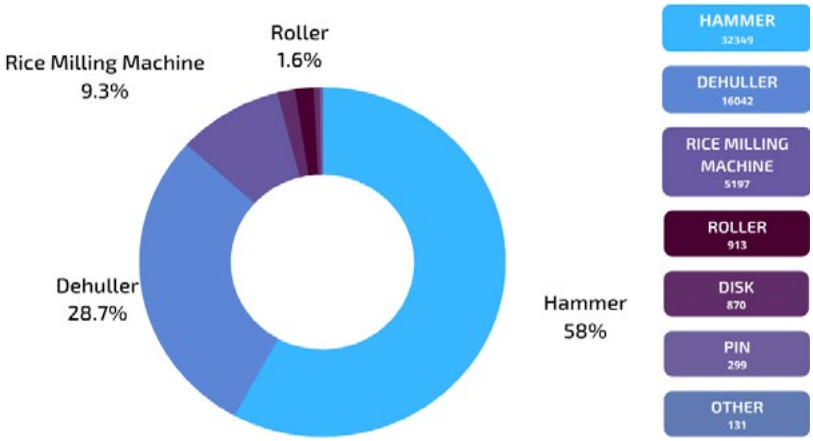


Figure 3: Types of mill processing machines

Picture 9: Diesel powered milling machine

1.1 Energy Sources

Findings from the census showed that most milling machines were powered by main grid electricity (66 percent), followed by diesel (33 percent). Other energy sources including solar energy account for only 1 percent. Power sources varied across regions, as well as urban and rural areas, depending on availability and accessibility, with most rural millers relying on diesel powered generators as their primary source of energy.

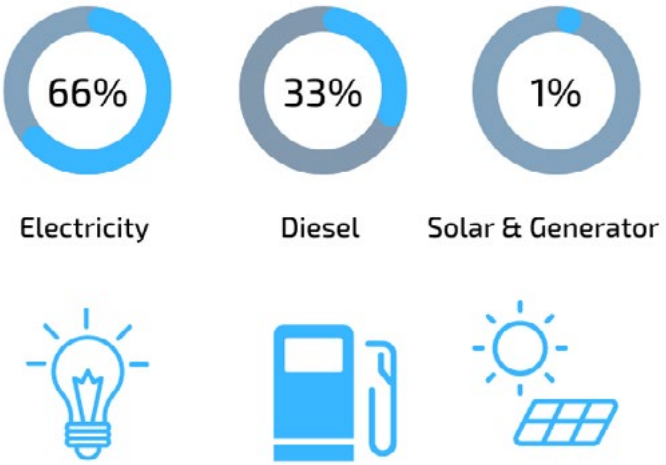


Figure 4: Milling processing machine energy sources used

1.2 Types of Cereal and Tuber Milled

The survey findings showed that, on average, 13,476 tons of cereals and tubers are milled every day by micro, small and medium-scale millers. Maize accounted for half of all grains milled (50 percent), followed by cassava (20 percent), sorghum (14 percent), rice (12 percent), and wheat (4 percent).

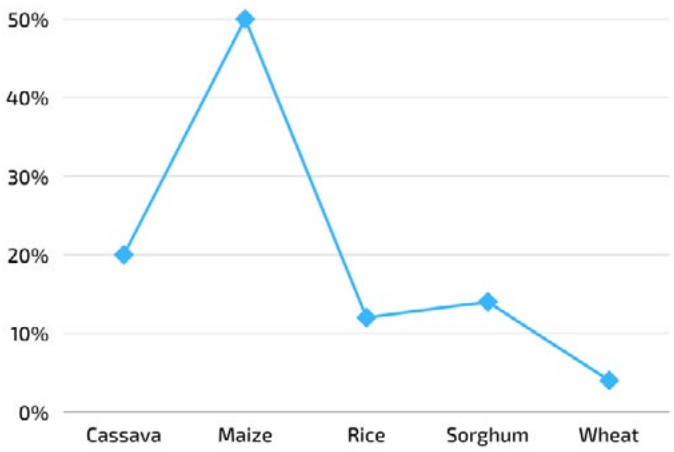


Figure 5: Types of cereals and tuber milled

Picture 10: Private individual owned mill

1.3 Safety Equipment

Findings from the census noted that only 19 percent of mill operators used protective equipment such as gloves, earbuds, safety coats, and masks while operating mills. Most mill operators (81 percent) did not use safety equipment, particularly in rural regions, owing to a lack of understanding of the risks associated.

Figure 6: Safety equipment status

2. MILLS OWNERSHIP

According to the census, 97 percent of mills are privately owned by individuals, 1.2 percent by community groups, 0.6 percent by private companies, 0.8 percent by religious organizations, and 0.3 percent by the Government.

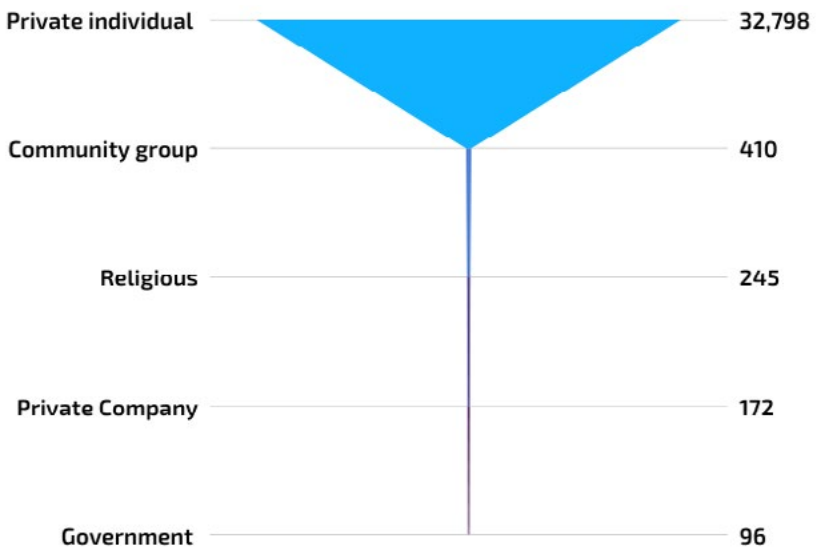


Figure 7: Ownership status of mills in Tanzania

Picture 11: Women owned milling machine

2.1 Gender Composition of Mills Owners

The census showed that only 6.7 percent of milling machines are owned by women, with the remaining 93.3 percent owned by men. This is despite the fact that women are heavily involved in the agriculture production.

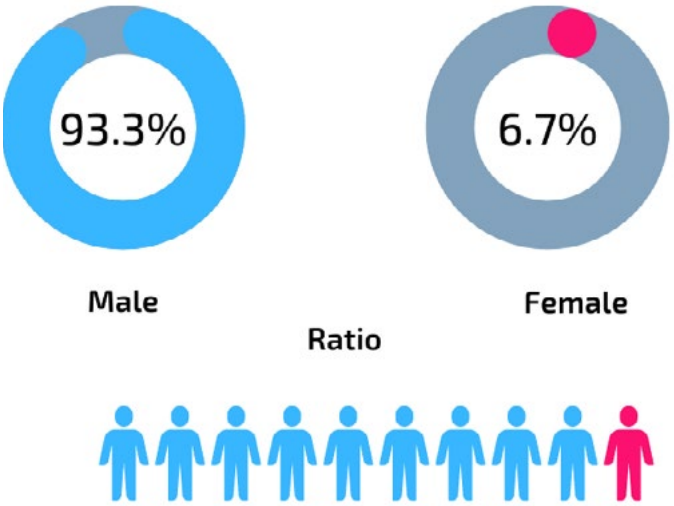


Figure 8: Gender composition of machine owners

According to the census results, 62 percent of machines are owned by people aged between 36 - 55 years, with no disparities between women and men owners.

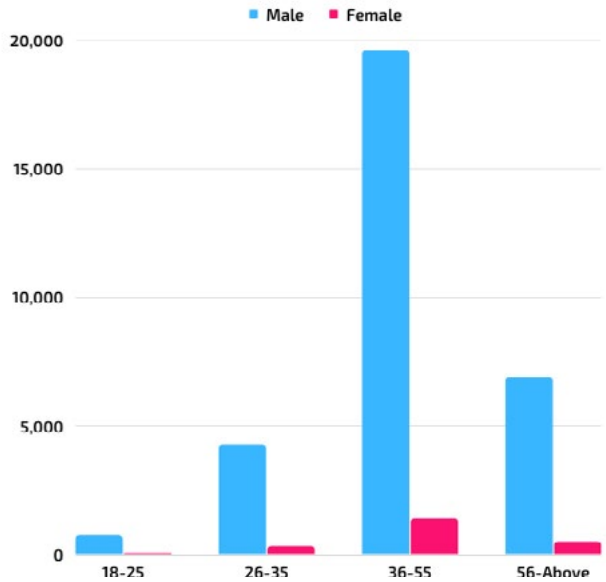


Figure 9: Age group of machine owners

Small	Medium	Large	Source
<10 MT/day	10-20 MT/day	>20 MT/day	*HKI. (2014).*
<20 MT/day Single hammer mill or single roller mill; Fortification using scoop and bucket method; Toll or service milling; No packaging or labelling	20-50MT/day; Roller mill and or hammer mill(s); Fortification with a conventional feeder/ conveyor system or Sanku dosing system; Packaging & labelling done	20-50MT/day; Roller milling; Fortification (conventional feeder conveyor system); Packaging & labelling done	*FFI. (2016).*
1.1 MT/day average; Capacity 2,871 kg per day (range: 230-8,600 kg/day) Mainly provide service milling and located in the villages	5-60 MT of flour per day. They have the potential to increase this production if the identified challenges are addressed	>100 MT/day	*Tom. C. (2013a).*

Table 1: Categories of mills

3. FORTIFICATION

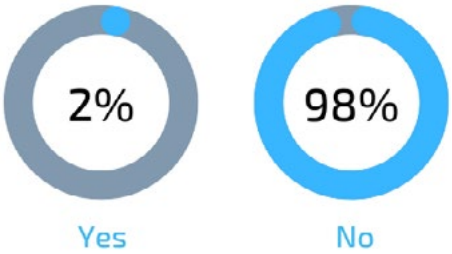


Figure 10: Micro, Small, and Medium-scale millers fortification status

Picture 12: Sanku dosifier

Fortification, the process of adding vitamins and minerals to staple foods, is an important and cost-effective nutrition strategy for preventing micronutrient malnutrition. Annually, around 210,400 mt of maize flour is produced and fortified by large producers, compared to 75,944 mt produced and fortified by micro, small and medium-scale mills. The categorization was based on the figure above.

Despite the production, the census results showed that only 2 percent of all micro, small and medium millers surveyed fortified maize flour. This means that around 95 percent of the population (over 50 million people) do not benefit from maize flour fortification programmes since they source their flour primarily from micro, small and medium-scale maize mills that lack fortification capacity. It is worth noting that those who fortified, had access to technologies, fortification tools, and training provided by actors on the ground such as Sanku, GAIN, WFP, Techno Serve, and Hellen Keller International.

Dosifiers, the primary fortification technique found in micro, small, and medium-sized flour mills, are supplied by Sanku, which offers fortification tools, training, and other assistance to small-scale flour mills, allowing them to fortify their flour with vitamins and minerals.

Picture 13: Dosifier for maize fortification

3.1 Fortification Standards/Requirements

Most millers - 69.2 percent - fortify flour using the East African Standards, The remaining 30.8 percent apply individual or unidentified specifications.

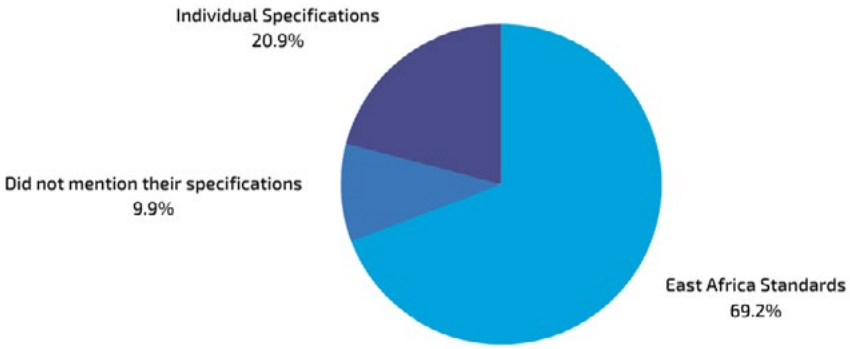


Figure 11: Fortification standards/specifications used by millers

According to findings, fortification continues to be limited and faces several challenges. Most micro, small, and medium scale owners/millers were either unaware of the fortification process and/or its benefits, particularly in villages, lacked the capacity to fortify, or had no access to fortification tools and technology.

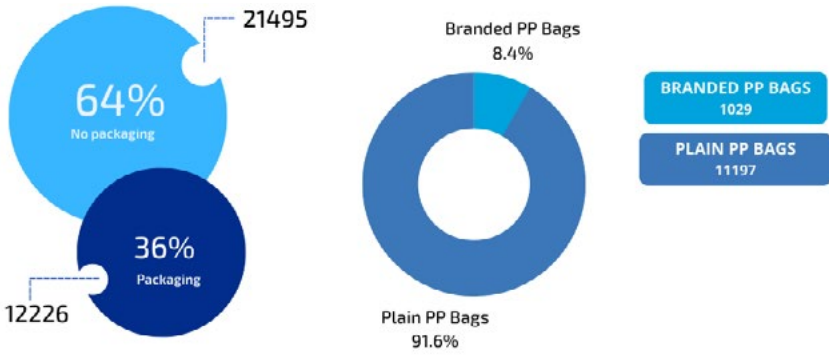
Limited financial resources play a major role in fortification as most small-scale millers rely on customers to bring their maize/grains, minimizing the odds of fortification. In addition, most millers operate based on supply and demand; a reliable approach for making a profit. According to millers, customers do not demand fortified products, hence why they do not fortify. Traditional views also contribute to the limited fortification including misconceptions related to impotence and infertility.

Picture 15: Large scale mill with packaging facility

4. PACKAGING

According to the census, 80 percent of small-scale millers did not provide packages. The majority of larger and medium-scale millers (commercial mills) provided packages, accounting for only 20 percent of all millers. Approximately, 81 percent of millers used polypropylene (PP) packaging, 9 percent stored in double-layered bags while the remaining used a combination of different packaging.

Micro and small-scale millers (toll mills) stated that they do not provide packages since their customers frequently bring their own, while others stated that they cannot afford to package. The figures below depict the packaging status.



Picture 14: Packaging status of cereals and tuber products

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Information is the key to the decision-making process, without information and the right kind of information decision-making is not possible. Information plays a crucial role in every stage of the decision-making process. The mill census was effective in gathering data of millers across the country and developed a GIS database that can be useful to stakeholders in the food sector as they make decision on the kind of programmes to engage in but also in identifying the existing gaps that need to be addressed. Census shows that use of safety equipment is very low, and this is a concern to food safety. Food safety is crucial to protect consumers from health risks related to common allergens and foodborne illnesses. The managements of food processing and packaging units need to understand the importance of having a quality and safety system which is in keeping with the Food safety standards, rules and regulations. Packaging should also be a concern in food safety. Product packaging not only ensures the safety of the consumer by decreasing the potential for moisture and cross-contamination, but also by clearly displaying crucial health and safety information on the package. Traceability is very important not only for food safety but also for the authenticity of the product.

The census results showed that only 2 percent of all micro, small and medium millers surveyed fortified maize flour. This means that around 95 percent of the population (over 50 million people) do not benefit from maize flour fortification programmes since they source their flour primarily from micro, small and medium-scale maize mills that lack fortification capacity. Most micro, small, and medium scale owners/millers were either unaware of the fortification process and/or its benefits, particularly in villages, lacked the capacity to fortify, or had no access to fortification tools and technology. This spotlights the need to ensure that there is adequate information sharing with all millers. There is also need to address the bottle necks that inhibit the uptake of fortification by the millers which is primarily as a result of lack of technology to facilitate the process.

This census highlights the need for strengthening fortification of flour by capacity building of millers. Food fortification requires ecosystem level efforts with relevant stakeholders to strengthen fortification agenda at country level. Innovation and new technologies can play a major role to strengthen ecosystem. Awareness and demand creation for fortified food is required to further drive the agenda. Need for assessment about food fortification in other priority foods and employment potential would generate more evidence to push this agenda and improve the scenario.

Picture 16: Safety and hygiene practice for milling

Recommendations

- This census highlighted the need to build the capacity of millers with the objective of promoting best practices within the broader food processing ecosystem and improving business and good manufacturing practices for food fortification. This will ensure fortified products are produced in the most cost-effective manner, hence improving profitability while ensuring food safety and hygiene practices are adhered to.
- According to the findings, there is a need to support the fortification enabling environment to create a system in which food fortification can sustainably improve access to nutrients and healthy diets. This would be achieved by engaging with ministries, industry associations, and non-profit organizations to deepen cooperation and forge new partnerships to strengthen the enabling environment that promotes all aspects of fortification.
- Demand creation is necessary to spur consumer demand for nutritious food through consumer education and communication. Social health marketing and awareness raising among the public on the importance of food fortification and its contribution to the prevention of micronutrient deficiencies will be critical in fighting micronutrient deficiencies among vulnerable populations in Tanzania.
- Access to micronutrient premix and fortification technologies were identified as key barriers to fortification. There is a need to explore innovative technologies to support fortification. The Government and stakeholders should explore additional opportunities to promote different models to address the constraints.
- Future assessments are needed to assess/examine the production of edible oils and salt to understand the fortification status of these priority food products.
- It is also recommended to undertake a secondary assessment of employment status in those industries, capital used for investments, and sources of that capital invested.
- Ensure that data is updated regularly.

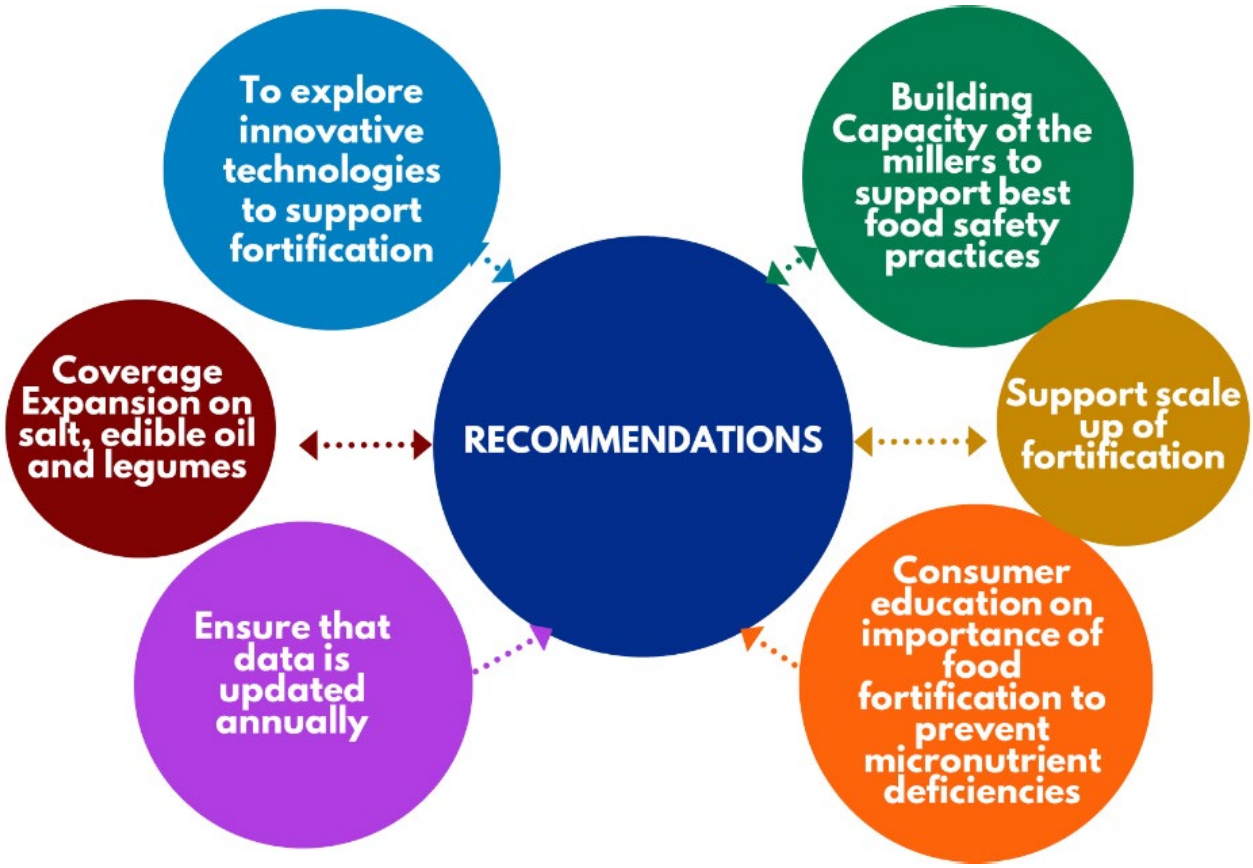


Figure 12: Recommendations

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1. Roger Bymolt r.bymolt@kit.nl and Jesse d'Anjou J.d.Anjou@kit.nl (2017) Lessons learned from the Millers Pride – Lishe Bora project.
2. Tanzania Food and Nutrition Centre (2019): Mapping of the salt sector for a comprehensive plan towards consolidation model for sustainable universal salt iodination
3. National Bureau of Statistics and Office of the Chief Government Statistician (2019): National Food Balance Sheet. Report 2014 – 2017. The United Republic of Tanzania.

ANNEXURE

1. Training of Trainers

Trainers were trained on all aspects of data collection including the following:

- Setting up an Open Data Kit (ODK) application for data collection. ODK is an open-source software used to collect and store different datasets according to one's use;
- Questionnaire walk-through for district and regional coordinators to familiarize them with the type of data expected to be collected and how to improve data accuracy; and
- OSMAnd training: OSMAnd is an app that carries highly detailed, fully offline maps of any region worldwide on one's device, displaying one's position and orientation on the map. The app helped mapping coordinators and mappers navigate while in the field.

2. Mapper Details

a. Details of community mappers: Gender Composition
While creating equal mapping opportunities was a priority, it was challenging to get a gender-balanced number of mappers. Out of 1,091 recruited mappers, only 25 percent were women.

The reasons for this imbalance include:

- Remote locations: The remoteness of some of the villages where mappers had to sometimes spend a night in a village to continue with the mapping the following day, which was a concern for female mappers due to some risks.
- Transportation: motorbikes were mostly used to access the machine locations. On some occasions, mappers would drive hours to reach remote villages, passing through forests. Female mappers considered this to be very risky.
- Cultural factors: some locations were hard for female mappers to collect information due to inhibiting cultural practices. The mills owners would not provide responses.
- Although most of the field mappers were male, the survey tried to engage as many female mappers as possible in places where there were no challenging factors.

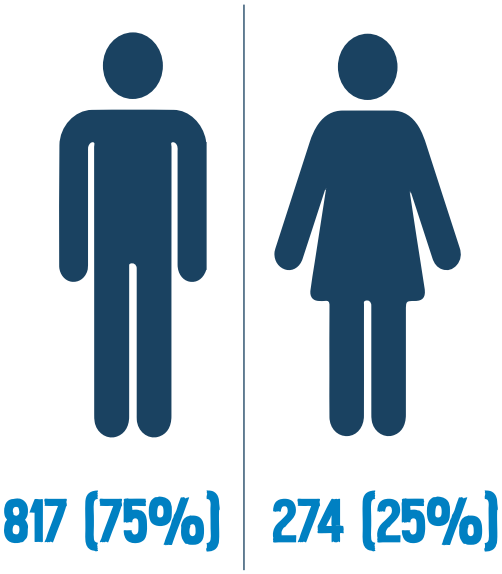

Figure 13: Gender composition of recruited mappers

Picture 17: Mappers preparing for data collection

b. Age Composition of Mappers

Most of the recruited mappers were young: 50 percent (18-25 years) and 46 percent (26-35 years) as shown in the figure below. However, in some areas like Ngorongoro, working with older people was crucial due to cultural issues i.e. communities mostly believe in their elders and leaders and are reluctant to provide information to other parties. Therefore, older mappers (40+ years) were recruited.

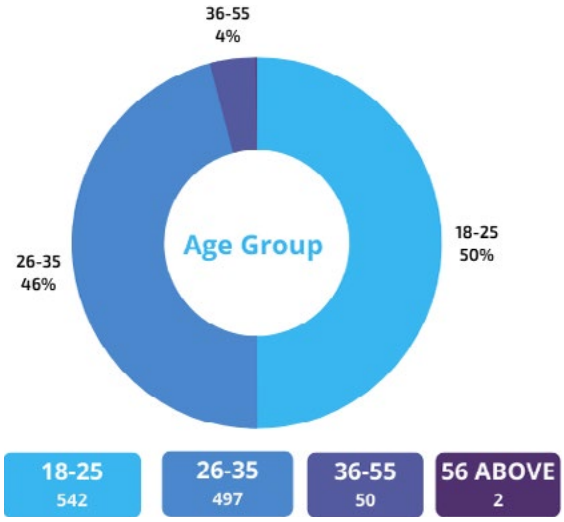

Figure 14: Age composition of community mapper

c. 4.2.5.3. Education Level of Mappers

Most of the recruited mappers were either at college or university level as the survey was implemented during the holidays. See the illustration below.

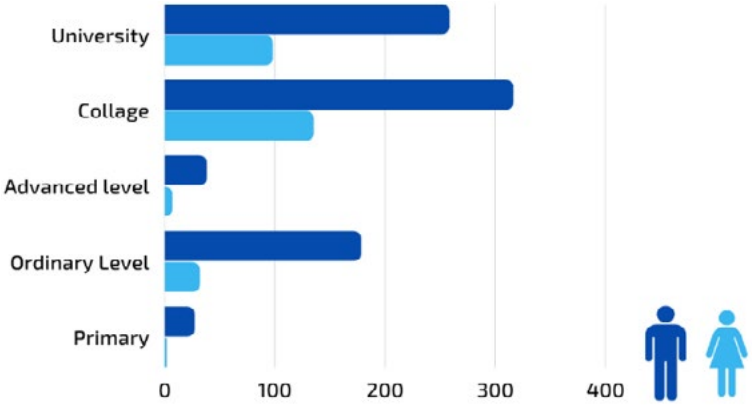

Figure 15: Education level of community mappers

Picture 18: Mappers briefing

Picture 19: Mappers testing data collection tools

3. Lessons learnt from pilot mapping

The pilot mapping was successful and provided inputs that helped in scaling up to other regions. Some of the lessons learnt from the pilot mapping included:

- Flexibility in communicating with respondents/mills owners to accommodate some adjustments in adding more machine types found in the field;
- Better understanding of hierarchical authorities' operational environment from central government to local authorities when seeking mapping permissions; and
- Identification of key persons/departments that could mostly be needed to be involved in the survey.

4. The criteria for mappers selection

Mappers were selected based on the following criteria:

- Possession of an Android smartphone (preferably with good GPS accuracy of less than five meters). Phones were provided to the mappers in case they had potential but had no phones with the needed requirements.
- Good communication skills and ability to read and write in Swahili and/or English.
- Enthusiasm and willingness to work with other team members.

5. Data collection Permission

- A nationwide approval letter was provided by the President's Office of Regional Administration and Local Government (PO-RALG). This was facilitated by WFP with support from OMDTZ;
- Regional and district/municipal permits and approval letters from PO-RALG were used to acquire letters to conduct mapping at lower levels within regions and districts/municipalities. This was primarily facilitated by the OMDTZ team; and
- Ward/village level approvals were provided by the local government authorities and were crucial in supporting the whole data collection process.

Picture 20: Mappers familiarizing with survey questions

6. Training Community Mappers

Mappers were trained on the following before the start of the survey and data collection

- Introduction of the survey i.e., the objectives of the survey, the value of the data to be collected, and the importance of mappers' participation in making the project successful;
- Training on basic data collection tools such as ODK Collect and OSMAnd. The training included: how to download and install the applications, set up phones to access online forms, download and edit the forms and upload them back to the server;
- Survey walk-through, familiarizing mappers with survey questions, reviewing possible answers, and identifying possible lines of meaning deviation in relation to the specific community. The trainers made sure questions were well understood by the mappers and that they were able to explain the questions well to the respondents;
- Field practice and familiarization with the questions to make sure they collect the required data; and
- How to engage with local leaders and mill owners by clearly explaining the purpose of data collection.

7. Data Cleaning

To ensure the quality of data collected, the following measures were taken:

- Spreadsheets: renaming of data fields, capitalization, translations, spelling check, and merging of different data collected.
- Quantum GIS (QGIS): the cleaned Comma Separated Value (CSV) and vector data of milling machines were loaded in QGIS, assessed, and edited using the attribute table and query functions within the QGIS to ensure every detail is well organized according to the data model.
- Java OpenStreetMap Editor (JOSM): an extensible editor for OSM that supports loading GPX tracks, background imagery, and data from local sources as well as from online sources allowing editing of OSM data (nodes, ways, and relations) and their metadata tags. This software was used to clean the collected data, aligning it with the correct OSM tagging format before the final data were uploaded.


Alvan Blanch
WFP
Alvan Blanch
TOOLQUIP INTERNATIONAL

World Food Programme

World Food Programme
Plot No. 113, Ada Estates, Burundi Street/Mwindu Lane, Kinondoni.
PO Box 77778, Dar es Salaam
wfp.org/countries/tanzania