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WAREHOUSE ASSESMENT REPORT

KILOMBERO-KITETO-KONGWA-MVOMERO DISTRICTS,

TANZANIA, 2012

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DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

CONTENTS

CONTENTS	1
INTRODUCTION AND BACKGROUND	2
OBJECTIVES	3
METHODOLOGY	4
CAVEATS AND LIMITATIONS	5
ASSESSMENT FINDINGS	6
ASSESSMENT RECOMMENDATIONS	14
CONCLUSIONS	21
APPENDIX A – PRE-ASSESSMENT INSPECTION TEMPLATE	22
APPENDIX B – WAREHOUSE ASSESSMENT CHECKLIST	25

INTRODUCTION AND BACKGROUND

The United States Agency for International Development in Tanzania (USAID/Tanzania) has issued a five-year Task Order to ACDI/VOCA entitled the Staples Value Chain - NAFAKA activity under the USAID's Feed and Future (FtF) Initiative. The goal of FtF is to "sustainably reduce global poverty and hunger." USAID/Tanzania's overall program under FtF will: (a) increase agriculture productivity; (b) maintain the natural resource base and promote adaptation to climate change; (c) stimulate the private sector; (d) increase trade; (e) support policy reforms and good governance; (f) ensure underserved groups benefit from growth; and (g) expand knowledge and training by supporting research and development.

Value Chains require that farmers and traders be aware of how their products are going to be stored at various points along transport routes. They must be aware of both the location and conditions of these stores. They are also required to know the capacity of the facilities, and the safety and security of the product in these facilities. Knowledge of these factors will help provide a basis for enhanced production, transportation, and marketing of the product. Additionally, assurance that good facilities exist to store products will provide incentives to increase production.

Storage facilities offer the opportunity to enhance food security and also enable farmers to improve their incomes by storing commodities and selling at premium prices later in the year. As quality is an important determination to crop pricing, effective storage is therefore crucial to improving agricultural incomes and food security.

NAFAKA is implemented in 4 Districts of Kilombero, Mvomero, Kongwa and Kiteto. One of the tasks to implement the project is to improve the market infrastructure within the areas in which NAFKA is working. In order to achieve this NAFKA required an assessment of grain storage facilities in the two rice-growing districts of Kilombero and Mvomero, and the two maize-growing districts of Kongwa and Kiteto. This is necessary in order to develop a roadmap for facilitation and upgrading of improved grain storage facilities and networks.

OBJECTIVES

The objective of this exercise is to identify and assess:

- village level stores and warehouses
- trading centers in rural areas near villages with stores and warehouses (these are often annexed to milling machines, and often keep substantial amounts of paddy and maize)

This assessment will determine availability, adequacy in terms of capacity, and location as well as their conditions for safety and security with a view to upgrade selected warehouses to be used by NAFKA supported associations. This study is intended to complement but not duplicate the study performed by the COMPETE project in which warehouses along the main trade routes were assessed.

Specifically the following will be examined:

Warehouse location and geography

- Warehouse/storage capacity, and differences among identified warehouses;
- Warehouse distribution along rural/district roads and basis for location;
- Produce origin for each warehouse;
- Produce destination of each warehouse; and
- Key stakeholder and producer perceptions of village warehouse locations.
-

Warehouse Management

- Adequacy of warehouse maintenance and cleanliness;
- Warehouse ventilation (or lack thereof);
- Stock control systems and procedures; and
- Key stakeholder and producer perceptions of warehouse management.
- Availability of mechanical handling equipment/retrieval systems

Warehouse Regulations, Ownership and Conditions

- Regulation of ownership and management of the warehouses;
- Analysis of conditions or specifications for rehabilitation, upgrading and management of warehouse facilities;
- Regulations and practical applications governing produce management and expiration;
- Regulatory determination of expiration dates; and
- Regulatory authority site and management visit procedures.

METHODOLOGY

This Warehouse Assessment utilizes both primary and secondary sources in compiling and analyzing available data and information, the result of which are summary recommendations for consideration.

Primary Research

A Pre-Assessment questionnaire (Appendix A) and warehouse inspection checklist (Appendix B) were developed to guide each warehouse inspection. A checklist was completed for each site inspected, and populated with key data pertaining to instances of required maintenance and key observations in relation to warehouse management and security. Photographs were taken at each site as a record of inspection findings. GPS coordinates of each warehouse identified were recorded.

Following inspection GPS coordinates were used to undertake a detailed mapping exercise of all warehouses inspected. The finalized electronic mapping is provided alongside this report for reference.

Collated data, pre inspection questionnaires, and completed assessment checklists were collated and tabulated. These findings are contained in separate annexes to this report.

In addition:

- CA-USA visited the local government authorities on arrival in each district and interviewed them regarding available warehousing. Each district Agriculture officer was able to provide limited data which varied in quality. None of the District data accounted for more than approximately 15% of the number of warehouses encountered during our assessment. It should be noted that although they did not have recorded information, the local officer in each district was very aware that their data was not up to date and identified areas where we were likely to encounter new warehousing.
- In each district CA-USA attempted to cover every road however, with a finite amount of time to cover each district it was not possible to cover the entire length of some feeder roads due to the quality of the roads. However, in these cases it became clear that the infrastructure was deteriorating beyond the point of possible use by road hauliers, or other means of small-scale transport.
- Without any maps identifying NAFKA villages, CA-USA was reliant on driver knowledge to identify NAFKA villages. To the best of our knowledge the assessment encompasses all NAFKA villages.
- It was clear after visits to some of the larger villages that many facilities exist in private walled locations that are very difficult to locate without unique local knowledge. For example, in one location in Kilombero, Mang'gula CA-USA used a local guide who located approximately 20 warehouses in one morning. CA-USA's information from the local NAFKA source identified only 10 in the area, and the information from the local Agriculture officer identified less. As a result, it would be logical to assume that other facilities may exist that were not identified in most of the larger villages during the survey. Most of the facilities encountered in this way generally ranged from 100-400Mt in size.

Disaggregated Warehouse Data

District	Number of Warehouses Assessed
Kilombero	173
Kiteto	40
Kongwa	80
Movomero	35
Total	328

CAVEATS AND LIMITATIONS

Inspectors conducting the assessment identified the following caveats and limitations:

- Inspectors were required to locate and identify warehousing and storage in each of the 4 districts. No opportunity existed for Pre-assessment questionnaires to be distributed prior to the study, and where owner or agent was present were completed on site at time of visit.
- Over Three hundred Grain (maize/rice) store/warehouses were located and assessed during the survey. Due to time constraints, or where the owner or his agent was not present at the time of visit, collation of full data may not have been possible on each and every occasion. Where this was the case trend data will be applied.
- Although there were exceptions in each area, most warehouses were either full or close to capacity in the case of the Rice areas of Kilombero and Mvomero. In the maize growing areas of Kiteto and Kongwa, most were empty in readiness for the new harvest.
- Lack of availability and reliability of geographical data pertaining to the location of stores / warehouses, District boundaries, Premises, and transportation networks.
- Assessors obtained photography at all sites where obtaining photography was permitted / possible. In some instances photography was not possible due to denied permission.

ASSESSMENT FINDINGS

GENERAL AND WAREHOUSE MANAGEMENT

The basic requirements of a warehouse are:

- Maintain the integrity of cargoes throughout the storage cycle
- Correctly sited
- Sound internal and external construction / weatherproof in relation to climatic fluctuations
- Capability to provide a healthy and safe operating environment for staff
- Appropriate access for goods in / goods out
- Allow for correct stacking / stowage of cargoes
- Capacity for lot separation where required
- Maintenance of correct ambient temperature
- Secure
- Free from pest
- Efficient access to and retrieval of cargoes
- Allows appropriate use of Mechanical Handling Equipment (MHE)
- Robust inventory control according to product / owner / grade

Cosmetic Maintenance:

Most of the warehouses assessed required an element of cosmetic maintenance. Although ‘cosmetic’ in nature, such works can be significant from an operational perspective. For example, it is standard practice to paint warehouse walls white to better detect ingress of insects / pests.

Warehouse Management:

Essentially, the precursor to any warehouse investment program should ideally be the establishment of a robust warehouse management environment at all levels to ensure that current facilities allow maximum utilization and that improvements resulting from construction of new warehouses and / or enhancement of existing warehouses can be sustained in the future. It was evident throughout the study that warehouse management techniques were lacking.

With regard to ownership and operations, most privately owned warehouses, including those with capacity leased to the public, are operated by identifiable owners or their representatives. On the other hand, those under the custody of the government/village authorities are usually leased to Farmers Cooperative Unions (FCUs), a third party operator or used for purposes other than grain storage (entertainment, a meeting hall, storage of scrap materials or just abandoned). In a few cases, such as Dosidosi in Kiteto, the FCUs directly own the warehouse facility and members are privileged with access to storage capacity against a fee.

Human Resources and Capacity:

Appropriate human resource and capacity is critical. Warehouse staff tend to be poorly paid, and consequently staff turnover can be high. Some, but not all, staff received initial basic training but no periodic capacity enhancement. All cargo handling witnessed utilized manual labor rather than mechanical aids. While this is understandable in relation to employment imperatives it does not allow for efficient cargo handling nor for safe operating procedures. Inadequate manual handling techniques can also lead to damage of the produce being handled in some cases and consequential wastage.

The commitment and enthusiasm of accompanying warehouse staff was generally evident but this was tempered by a lack of continuation of training, and resource constraints. Warehouse operations are a science and require vocational training in terms of best practice. Invariably, where training and resources are not provided, the warehouse will not operate to maximum capacity and effectiveness.

Maintain integrity of cargoes

The prime requirement of a warehouse / storage facility is to assure that the condition, integrity, and quantity of the cargo stored therein is maintained:

- Not all warehouses assessed were weatherproof, although some required only basic maintenance to make them weatherproof. Newer builds are generally of a superior design and construction quality to those built before 2000.
- It was commonly noted that deterioration of cargoes could result from inappropriate stacking techniques which do not allow sufficient ventilation or effective pest-control counter-measures.
- In some warehouses it was noted that input materials such as fertilizer were not adequately separated from produce, which could allow cross contamination.
- Manual handling and poor stacking techniques may also adversely affect stored material. Here, as in many developing countries, bags of produce are often stacked to make an improvised 'staircase' to facilitate 'high stacking' Construction has a part to play in this. For example, warehouses should be constructed on a 'raised platform', often facilitated by loading bays / ramps, to deter rodent ingress. Many of the warehouses assessed were flat to ground level. Also, some warehouses had ventilation openings at too low a level, again this can facilitate ingress.
- In some areas lack of a raised floor will result in water damage to stock where flooding occurs.

Warehouse Siting

Ideally, warehouses should be constructed as near as possible to feeder roads:

- Many of the warehouses assessed were located in 'farm yard' environments with unpaved / unmaintained access routes.
- Most of the facilities assessed were in an environment commensurate with current methods of manual handling. However, should mechanical handling be introduced consideration would have to be given to improved access and paving.
- Holding areas and adequate turning circles must also be considered.

- Warehouses are generally constructed where someone with the means to construct owns the land, and not because of any study into ideal locations. As such some are in very difficult to access by any transport larger than a small vehicle or donkey.
- Often Warehouses are located in the center of villages which is not ideal for heavy traffic. That said, it appears the drivers of the trucks, and sometimes traders themselves, prefer to access stores located in the towns and larger villages due to the fact that more facilities exist such as accommodation.

Warehouse Construction

As evidenced in the detailed assessments, there was significant variation in the construction of the warehouses:

- Structures varied by district, but generally fell into 1 of 3 types.
- Recent construction of either red brick or cement block, with iron sheet roof, typically in good condition and of good design.
- Older permanent structures, with most in need of some refurbishment
- Temporary structures of wood, metal sheet and tarpaulin (Kilombero - Mvomero), or mud walled buildings with iron sheet roof (Kiteto – Kongwa). Some of the mud walled structures in Kongwa were on excellent raised foundations, the walls being relatively temporary in construction but still possible to secure against pest/theft.
- Most structures older than 10 years were in need of routine maintenance to a larger or lesser extent. Traditional construction materials tend to be used.
- In many cases the concrete floors were not even, which can make cargo handling difficult and dangerous.
- Floor levels were not always raised above ground level which can cause problems with water entry and this was an issue with some of the facilities assessed.
- Walls tended to be sound in most cases of newer construction with reinforced columns being used in most, however some older buildings had walls visibly leaning at dangerous angles probably due to poor construction and/or where stock has been stacked against the walls exerting an amount of pressure on them. This is not good practice and would be dangerous if pre-engineered type structures were to be used in the future.
- In many cases walls required re-painting. Walls should be painted white so that any pest infestations will be easily apparent. Rendering walls with cement would also reduce maintenance and pest issues.
- Various roofing materials are in use, mainly galvanized steel or aluminum sheeting. Whatever the type there will always be a need for regular maintenance to ensure integrity and weather resistance. Some of the warehouses are in need of prompt roofing repairs. Roofing should overhang eaves and gables by about one meter although this was not always the case.

Warehouse Operation - Environment / Health & Safety

This is an area, which in virtually all cases, requires attention:

- Most of the operating environments observed were sub-standard.
- Stacking methods in general use were dangerous and cargo handling was conducted without standard safety precautions.
- Most of the conducting staff said they were unaware of any Health and Safety Standard Operating Procedures and such procedures probably do not exist on local or institutional level.
- At the mill level, virtually all mills did provide signs re guidelines for operating specific equipment installed safely. Invariably, facilities for stores staff were minimal.
- Adequate light in a warehouse is a health and safety imperative. Unless the warehouse is in operation during hours of darkness artificial light is un-necessary where openings, vents and open doorways are a feature of warehouse design. In many cases this was not the case and, even during the day, there were instances where warehouses were too dark for safe operation.
- Other hindrances to safe operation observed included dirty floor surfaces, trip hazards, and lack of fire extinguishing equipment.
- In the case of paddy rice storage, a large quantity of husk is kept on the floor in most warehouses , apparently to absorb any moisture.
- Warehouses/stores in Kilombero and Mvomero districts often house a rice mill within the same building where paddy is stored, with any resultant milling creating large amounts of airborne dust. With only a few facilities using de-dusting systems to reduce the amount of dust and stones entering the milling machine, this creates a serious health problem for all workers in the mill, and also for any clients waiting for the final product. Better ventilation and relocation of Milling machines to suitable areas is required to reduce the long term exposure of farmers, traders, and particularly mill operators to high levels of dust/particles from the husk.

Access for Goods In / Goods out

Most of the warehouses had adequate, albeit basic, access in relation to the manual operating techniques currently employed:

- Naturally, the number of access points varied in relation to the size of the warehouse. While small storerooms will only have one door, even the smallest of warehouses should have a minimum of two for goods in and goods out, this was not always the case. Two access points facilitates first-in / first-out rotation of cargoes held in storage.
- The preference for warehouse access is sliding doors. If these are not employed standard doors should open outwards, some assessed did not.
- Ledges at the bottom of door openings were also observed which provide a hindrance / hazard to staff during loading and unloading operations.
- Many of the access points observed would require modification if mechanical handling aids are employed in the future.

Stacking and Stowing of Cargoes

- Most Maize was bagged in 100 Kg sacks. Paddy rice sometimes exceeded 150kg sacks
- Sacks tend to be stowed directly onto the warehouse floor surface, in stacks of ten or more high.
- Evidence of a number of warehouses with walls leaning dangerously is probably due to poorly stacked stock leaning against the side wall of the warehouse.
- Polypropylenes sacks have a tendency to slide when over-stowed, this can be a serious hazard; jute sacks are less prone to slip.
- Most Warehouses stacked using an interleaved method which is more stable. However, some were stacked one on one, or haphazardly, and are not satisfactory from the perspectives of safe handling, maintenance of cargo integrity and ventilation.
- Manual handling techniques were used throughout the survey and the traditional ‘staircases out of sacks’ method, widely used in developing countries, was used to access the top of stacks.
- In virtually all cases there was insufficient airflow around the stacks, and with little use of pallets, there was generally no airflow underneath stacks.
- Intermediate stack separation was not utilized.
- Some produce is vulnerable to compacting if over-stowed. Simple countermeasures and awareness training could rectify the inadequate stacking and stowing systems currently used.

Lot Separation

- Most stock belonging to any particular owner was stored together, with each sack marked with the owners name, with stock belonging to others, stacked above and below partly due to lack of space in some of the facilities.
- No floor or wall markings dividing bays were evident. Aisles tended to be haphazard with no allocated access / movement lanes, and as indicated above, are dangerous for moving stock with unstable stock stacked high.
- On occasions, input materials / fertilizers and other commodities such as Diesel or Petrol or Tractors/vehicles etc were co-stored with produce. Lot separation is an important feature of inventory control and is also a precaution against natures of cross-contamination which may cause a problem. The importance of lot separation where more than one product is stored, where grading takes place, and / or as a precursor to a Warehouse Receipt system is paramount. Lot separation is also an essential practice for export cargoes where traceability to source is becoming increasingly important.

Warehouse Ventilation and maintenance of ambient temperature

- There was no temperature control / monitoring in any of the warehouses assessed. The fact that Tanzania suffers power outages in the rural areas, and some warehouse/stores are in areas that do not have mains electricity at the village level means this is unlikely to be installed in the near future.

- A wide variety of ventilation opening types were witnessed in the study, from good quality, efficient venting to non-existent. When openings were too low they can be ineffective in relation to ventilation and may not serve the dual purpose of a light source, and where mesh is damaged or not present can be a point of entry for pests.
- Incorrectly located vents may also allow ingress of water.
- Some vents were so large and low as to constitute a security risk for stock.
- In areas without power, efficient ventilation openings can also provide a light source if correctly located.
- A small percentage of warehouses and stores had no visible ventilation whatsoever.

Warehouse Security

- The level of security in most of the warehouses visited was well below acceptable by international standards, this is mitigated somewhat by the fact that the majority of warehouse/stores are either located close by the owners residence or, in the owners walled compound, or, centrally located in village areas where neighbors provide some security by their proximity and in smaller communities security is less of an issue.
- A number of warehouse locations were visited that were well away from any habitation without any staff or security present or visible during the survey.
- Very few warehouses appear to employ night security with only some mills in Kilombero with large stocks likely to have either staff or security present out of normal hours.
- Virtually all of the warehouses visited had doors secured by heavy duty padlocks, most with good strong iron doors, securely installed and with metal covers over the locking areas to prevent the use of bolt cutters on padlocks etc.
- A small percentage of locations had wooden doors that ideally would need replacing for obvious security reasons.
- Large scale theft of bagged produce is unlikely to be a serious issue due to the logistics involved in carrying this out and the need for large transport, however deterrents are still necessary, particularly as accurate inventory control methodologies are not in use.
- Adequate facilities security would normally be a criteria for any eventual warehouse licensing, this has to be verified.
- Temporary warehousing in Kilombero was generally very open access and requires a security presence to prevent any theft.
- Where possible the emphasis should be on robust compound security rather than individual building security, however, due to the location of some of the warehouses visited this was not always a possibility.

Pest

- Although in many cases warehouse design was not optimized for the prevention of pest; mainly due to open access, non-raised floor levels, dark walls, un-repaired holes in ventilation and light openings; few warehouses reported using poison. However a number of rodent carcasses found in close proximity to some Warehouses would suggest that poisons are in use, at least in some locations.
- Brick walls left un-rendered also play a part as relatively poor cement and pointing means pest can easily access by climbing.
- Poor stacking and storage techniques would suggest that any eventual spraying activities would not be entirely successful.
- Bird droppings were evident in virtually all open warehouses where no measures are in place to prevent access, and even in some newer brick warehouses, access to the latter is usually by poor vents or the fact mesh is not installed, or open space between walls and eaves/roof. There is a lot of scope for NAFKA to assist the warehouse operators in this area. It should be noted that, in produce destined for export, inherent pest is not generally considered an insurable risk.
- No records of fumigation activities were reported in any of the facilities visited. In the 2 largest locations KPL (KILOMBERO) and Tan Rice (MVOMERO), this would seem to be a likely requirement due to the size of the facilities, but neither offered any information on the subject when asked.

Efficient access and retrieval of cargoes

- No mechanical handling was seen at any location, with the exception of the Tan Rice Mills, KPL facilities and 1 other warehouse in Mvomero, where a forklift was present, but apparently not in working order.
- All movement of stock, into and out of warehouses together with all stacking is by manual labor.
- In only one location did the survey identify the use of a trolley for movement of sacks.
- In order for any equipment, whether mechanical or manual, to be used, most floor surfaces and access areas would need to be improved in order for this to be effective.
- Where warehouses were storing sacks for multiple small holder farmer's (SHF) most did keep aisles free for accessing stock, and each person storing grain is responsible for paying for any labor required to access their stock.
- Advance notices for deliveries from farmers are not common except when a farmer prefers a particular storage location within the warehouse.
- The warehouse owner/manager is responsible should any stock/sacks be damaged during movement of such to access another person's stock. Most stacking is very inefficient, there were a number of instances noted where stacks were leaning dangerously as a result.
- Haphazard storage makes retrieval of any outgoing stock disorganized costly and time consuming.

- Very few Warehouses had any form of ramp to allow easy access. Most warehouses were relatively level with the surrounding area, or, where raised, had a step to be negotiated when entering or leaving with stock.

Use of Mechanical Handling Equipment (MHE)

- As indicated only the largest 2 facilities were using any sort of mechanical equipment for the movement of stock, both Forklift trucks , a non-functioning unit was seen at a third location. In all other cases transport/movement of stock is manual.
- All loading, unloading and trimming operations were conducted manually. This is however probably cost effective at present, and also creates employment and is commensurate with the labor culture of the country.
- Some of the more recently constructed warehouses assessed could make use of some MHE such as fork lift trucks, conveyors or retrieval equipment; however, most would be unable to benefit from even the most basic MHE without some refurbishment and / or modification of access points, and the maintenance of this MHE would be an issue.
- The cost of purchasing MHE is probably not viable at this stage for a warehouse operator, as local manual labor costs are passed on to the owner of the stock.
- The size of the warehouses surveyed and the frequency or lack of, of incoming/outgoing stock would also not make the cost of mechanical measures viable in most cases.

Inventory Control

- Virtually all warehouses had a very rudimentary and informal method of recording incoming/outgoing stock
- Whatever methodology used, all were paper based manual systems and are operated by the manager from warehouse buildings. Systems, such as basic on-site, bin cards system did not appear to be in use.
- In most cases, stock was left with a mill/warehouse on a trust basis, with only the warehouse manager/owner recording in a ledger. In a few cases, the farmer received a paper copy.
- Some of visited facilities had experienced minor or major losses through spillage, spoilage or pilferage; however, none had tools, standards or clearly defined procedures for reporting inventory or commodity loss.

ASSESSMENT RECOMMENDATIONS

RECOMMENDATION CAVEATS

These recommendations are based on the results of physical warehouse assessments which, by their nature, give a limited view of the overall warehouse environment within the specified value chains. Traders, large and small, were also questioned together with transporters. It is believed that there was sufficient consistency in the findings of the assessments to make certain assumptions of the overall warehousing landscape which allows integrity in the recommendations below.

FINDINGS

General and Warehouse Management

In developing countries where food security is a concern and produce is a key export commodity, warehousing of produce is significantly important. Although regulatory controls governing the establishment and operation of warehouses exist in Tanzania, most of the warehouses/stores had not applied for any license. The ability to operate without obtaining a license is evident, even though other legislation, such as labor laws, may apply. Many of the problems witnessed during the assessment process could be rectified by robust management supported by enforced regulatory controls. The criteria is to ensure a clean, safe, efficient, and cost-effective environment to ensure that storage facilities meet the needs of the value chains and do not become choke points and unnecessary cost elements.

It is recommended that regulatory controls are established / revised / updated to provide a sound basis for the management of warehouses used to store produce. The regulations should cover the following headings:

- Management, control, responsibilities
- Qualification of warehouse managers
- Training programs
- Applicable law, enforcement, and penalties
- Construction standards
- Ventilation
- Health and safety – Hazard Analysis and Critical Control Points (HACCP)
- Fire precautions and countermeasures
- Pest control
- Rules for lot separation
- Rules / standards for grading
- Hygiene
- Staff facilities
- Provision of utilities (electricity and water)
- Cargo Handling
- Security
- Maintenance of records

It is essential that such regulatory controls are ratified and promulgated as a precursor to the possible establishment of the use of Warehouse Receipts in the four districts inspected.

District authorities should have a clearer idea of the current capacity within their district. Without this, and the ability to inspect facilities, no enforcement of standards will be possible. The information provided regarding district warehouses at the local government level within each district was not up to date, and identified no more than 30% of existing capacity at best.

There is a clear requirement for training and capacity building in warehouse management techniques and warehouse operations. It is recommended that a 'training needs' analysis is conducted, syllabus prepared, and regional training programs rolled out including a training the trainer element. The training should be multi-media (dependent on level of beneficiary) and should include awareness posters / materials and on site and classroom training as appropriate. It is worth considering developing modular training leading to a national warehouse management qualification. All the recommendations detailed below would require training support to varying extents.

Although stock does not move daily, Warehouse/stores in Tanzania do have regular movement of stock. This can range from 1 to 1000 sacks. Owners store their produce for varying amounts of time, and any movement is generally based on the current market price, demand, the size of their total harvest, and in some cases use of grain for personal needs. A farmer may sell all, or a fraction of his stock on any given day, and keep the remainder in the warehouse for the remainder of the year. During the survey, with the exception of rice stock located in the major warehouses in Mlimba and Ifakara, or the International Maize market in Kibaigwa, very little movement from warehouses was actually observed. At the rice mills in Kilombero, small quantities for private use or local sale were constantly being milled and moving daily.

Maintain the integrity of cargoes throughout the storage cycle

Maintenance of the integrity of produce throughout the supply chain requires regulation and co-ordination of storage, transport and handling operations. Standard Operating Procedures (SOPs) need to be formulated to provide instruction on the importance of maintaining the integrity of produce stored. Sub-sections of the SOP should cover handling, separation, stacking, ventilation, pest control, and record keeping, which are expanded upon below. It is essential that stakeholders have confidence in the storage elements of the value chain / supply chains and it is also important if aspirations to enter regional and international markets are to be achieved.

Correct Warehouse Siting

It was noted that many of the warehouses are within 'farmyard' environments which is to be expected. Consideration should be given to surfacing yards and access points adjacent to such warehouses. This will be a pre-cursor if there is to be a migration to the use of MHE at any time. It will facilitate vehicle movement, loading, discharging activities, and provide a safer, more efficient environment, particularly during the rainy season.

A simple model showing best practices and minimum requirements for construction of secure, efficient, pest resistant, scalable warehousing should be made available at the district level. This would include:

- Raised floors to prevent flooding, with access ramps
- Where to site, with respect to location, access to store from road.
- Correct Ventilation methods
- Pest resistance and control.

Internal and external construction and weatherproofing

A general program of refurbishment should be considered to address construction and structural defects incurred due to a lack of regular preventative maintenance or, to a lesser extent, bad construction practice. Typical requirements include:

- Roof repairs.
- Re-leveling and surfacing of floors.
- Internal painting.
- External pointing repair of ventilation openings / re-grilling.
- Replacement of doors.
- In those warehouses where there is a step/or steps to the main access doors, these should be replaced by ramps to facilitate operations while still deterring the ingress of water into the warehouse.
- Where there is a requirement to store input materials in the same facility as produce, construction of a dividing wall should be considered.

Healthy and safe operating environment for staff

Health and Safety (H&S) is an area which needs urgent attention:

- Whether manual or mechanical resources are utilized there must be detailed SOPs covering H&S requirements. Each warehouse should undergo an initial detailed Health & Safety assessment and this should be followed by periodic compliance inspections.
- If a warehousing licensing regime is initiated, licensing should be conditional on satisfactory audit.
- Warehouses must provide a clean environment for staff and ergonomics should be considered. This will involve a culture change in attitudes to warehouse operation.
- If, even a partial, migration to the use of mechanical aids is to be considered H&S requirements will expand hugely to ensure safe operation of such equipment and other ancillary operations such as battery charging, fuelling etc.
- In the short term a poster campaign is recommended to protect staff carrying out manual operations.
- In many countries the provision of bathroom facilities for staff is a statutory requirement but is often overlooked, this requirement should be included in regulatory controls.

Appropriate access for good in / goods out

The requirement is dependent on the size of the warehouse and the average number of cargo movements per day:

- It is good practice to separate goods in and goods out and is essential in busy warehouses where concurrent activity takes place on a regular basis.
- To aid the process some warehouses would benefit from replacing standard doors with sliding varieties.
- In most of the sites it would be challenging to develop the vehicle parks to allow for streamlined operations (although this should be considered for the most active warehouses) to avoid waiting time and any subsequent costs.
- All warehouses, apart from the smaller 'store-rooms' should have defined access aisles to the main doors which should always be left clear.

Stacking / stowage of cargoes

- The practice of stacking cargoes to the roof (or close to the roof) should be stopped, as should the practice of stowage directly against walls.
- As a minimum, pallets should be utilized to raise stacks off the ground. These measures are essential to allow sufficient airflow and ventilation around the produce and thus to maintain the condition of the produce.
- The use of intermediate vertical-racking / separation systems should be considered as it allows safer high stacking without the risk of compacting. However such systems operate best where mechanical retrieval systems / MHE are used.
- Regulatory controls must include rules for maximum stack heights. This is a safety criterion but is also important in relation to damage to produce. The different products in the value chain will have varying compacting qualities (depending on density) and this will dictate the maximum height of each stack. This control is also important in defining floor space required in any new warehouse facility, which may be considered (size of floor space required is dependent on the cubic measurement per metric ton, known as the Specific Volume, stored divided by the height of stacks – this gives the square footage of floor space required).
- As a rule of thumb jute bags should not be stacked higher than 4 meters and plastic / polypropylene bags (which are prone to slippage) no higher than 3 meters.

Capacity for lot separation

- It has to be appreciated that the best use of space in a warehouse is achieved by storing in one stack and, in the smaller facilities, there was little option. For example, in small warehouses with capacity up to around 30 tons, only about 20% of the space is usable. However, the appropriate use of lot separation needs to be better understood and accommodated. Lot separation is essential where:
 1. Different commodities are stored.
 2. Grading is taking place.
 3. Product condition is time sensitive.
 4. Warehouse Receipt systems are used.
 5. Export products have track-ability / traceability requirements.
 6. Owners are moving stock in small quantities.
- Where there is a requirement for lot separation, bays should be marked using a grid system and assigned as required. Stacks should be separated by a one meter spaces (and one meter away from walls) with an access areas of at least two meters wide, for outgoing and incoming stock handling, should be provided. Each lot should be clearly marked on at least two sides.
- Warehouse staff should understand the need for, and operational considerations of, lot separation. They should also understand the requirement for lot separation for safety reasons.
- Likewise, commodity separation is an important issue, with the need to separate different commodities, especially fertilizer/fuel stocks into different locations for health reasons.

Maintenance of correct ambient temperature

- As identified, it is unlikely that any efficient temperature control system will be used for some time in any of the warehouses surveyed.
- Those warehouses where ventilation openings were not present, inadequate or poorly sited (too low) should consider modification.
- In most of the warehouses mesh coverings need replacing. The requirement is 20mm mesh on the outsides (anti bird grills) with 1mm mesh on the inside which will deter the majority of insects. The inside mesh system should be removable for regular cleaning.

- Although unlikely to be viable at present, in an ideal world, most of the larger warehouses would benefit having fans fitted to ensure the adequate and regular circulation of air to ensure produce is maintained in prime condition.

Security

As indicated, security is not considered to be a high priority due to the low risk as a result of the size and difficulty of moving the product. And the risk of theft is relatively low level in the majority of cases. However, the impact of a security breach could be high. For example, if produce were to be maliciously interfered with posing a health / safety risk:

- This would probably need to be improved if produce were for export outside of the region
- Warehouse operators should understand that warehouse security is based on sound processes and SOPs supported by the necessary hardware / aids to security, rather than the other way around. Each facility should produce and enforce a set of Security Standing Instructions which should be supported by awareness campaigns and should be an element of Warehouse Management training.
- Fire security is a major issue with very few possessing any sort of fire prevention or fire extinguishers.

Pest

In developing countries, pests pose a continuous problem generally because of climatic conditions, food supply, and relatively open or poorly constructed structures. Pest control is a management issue and constant monitoring is essential; together with good record keeping. Raised floor levels provide an aid to pest control but this cannot always be achieved. Simple countermeasures should be employed including:

- Maintenance of openings / vents and use of correct gauge grills.
- Paint walls white (making insect infestations more visible).
- Ensure effectiveness of spraying (where used) by correct stowage (separation and away from walls).
- Food sources outside or inside the facilities should be eliminated and cleanliness enforced.
- Render brick walls with cement to prevent access by climbing (this would also reduce maintenance of building)

A program to implement the above, in the more permanent structures would immediately benefit a lot of warehouses and farmers and reduce pest issues without involving any major investment.

Access to, and retrieval of, cargoes

In most of the warehouses stowage of cargo was relatively haphazard with no formal allocated access lanes. Certainly, in the larger facilities this should be rectified and can be easily achieved by superimposing markings on the floor of the warehouse leading to and from the access doors. This is an easy enhancement and experience shows that, where this is done, better and more organized stowage practices follow. The requirement is an important precursor to any future migration from manual to mechanical handling of cargoes.

Where lot separation is a feature, access aisles around bays should be marked appropriately.

Mechanical Handling Equipment (MHE)

- No levels of MHE usage was in evidence during the assessments. The issue is a difficult one because manual labor provides employment and is relatively low cost at present. In the short term, while sacks are the common method of storage rather than loose grain in silos, it is probably the most cost effective and efficient

method for most warehouses, especially those with difficult access. However, sacks of paddy rice often weigh 130-150kg, and a lack of even basic MHE together with unsafe manual practices are standard, with stacking of sacks 10 or more high creating a serious risk for laborers. Consideration should be given to, at least, a partial migration to the use of mechanical aids. The basic options are, in order of sophistication (low to high level):

- The use of Sack trucks / pallet trucks for movement of sacks to and from the warehouse would be of immediate benefit to laborers employed and would reduce the chance of injury thru carrying. This would require some improvement of access points such as steps and a level pavement.
- Basic Conveyor systems could also be used effectively in some locations, and would reduce the likelihood of injury to laborers involved in stacking.

The survey did not identify any warehouses that could efficiently make use of the following, with the exception of those already using this type of equipment (KPL and Tan Rice)

- Fork lift trucks.
- Automated cargo retrieval systems.

The higher the level of sophistication the larger the reduction in labor requirement. It is inevitable that, at some stage, MHE will be incorporated to bring efficiencies into the supply chain and to increase competitiveness. However, with relatively small warehouses being the norm, this is presently unlikely. The use of MHE also helps to maintain the integrity and condition of cargoes by eliminating poor manual handling techniques. In most developing countries the migration is gradual and has to be combined with retraining and skilling initiatives and operations. Even the most basic progression has to be chronologically approached. Until pallets are used purchasing pneumatic pallet trucks would not assist.

A pilot program of palletization rolled out at a number of ideal locations, together with the provision of pallet trucks, which will aid handling and correct stowage, would be of immediate benefit, provided some training was provided at the same time. Further use of more sophisticated MHE / automation can be considered for the larger and more active warehouses at a later date. Such enhancements must be supported by training programs covering operation of the equipment, maintenance and health and safety.

Inventory control

All inventory control was informal, with very little paperwork. At some levels this works perfectly well and there is a case for allowing such systems to remain. However, increasing traceability requirements and entry to regional / international markets (where relevant) would require more sophisticated automated inventory control systems. Without access to IT equipment, and, a consistent reliable power supply, the use of even the most basic automated inventory control systems and the lack of current capacity to use and maintain such systems makes it unlikely this would be a benefit at this stage.

Improving and standardizing the recordkeeping for all warehouses in each district would possibly encourage those farmers who currently do not use warehousing to have trust in doing so. A copy of each farmer's inventory to be held by the farmer would provide a level of transparency that is likely necessary for this to happen.

Training and Capacity Building

This is a cross-cutting requirement at all levels, from strategic warehouse management at one end of the scale to cargo handling / stowage at the other end. Neither investment in improvement to warehouses nor construction of new facilities will be fully effective or sustainable without the delivery of appropriate training and capacity building as a

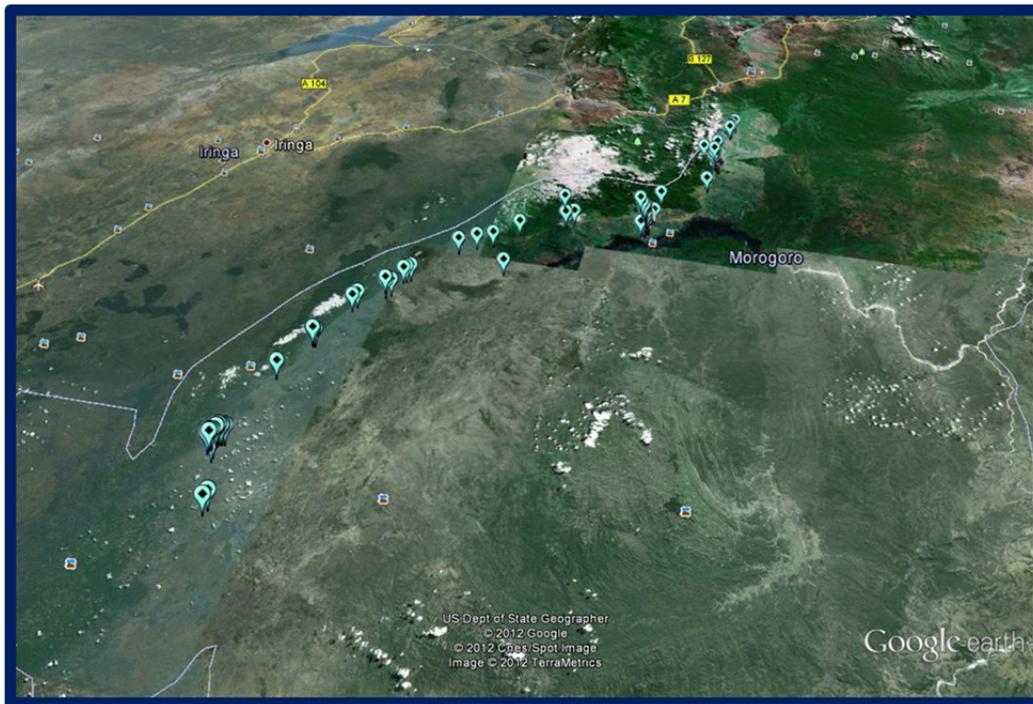
precursor. As an example, private sector warehousing operated by KPL in Kilombero is well organized with very good operating procedures.

Access to market

Although applicable to all districts, this applies to Kilombero especially. In Kilombero there are no options with only one major arterial route and consideration should be given to improving/grading feeder roads, and or bridges along these roads. Where access to market was economically viable for farmers, and given sufficient storage facilities to allow for the storing of produce in anticipation of price increases, even with rain fed methods, there is a major potential for an increase in the production of rice/ maize in each of the districts.

Long term transport methods in Kilombero should include the use of rail transport. The effectiveness of this method is, at present, probably not a viable consideration with the restrictions/barriers placed by the current infrastructure or current methodology regarding operating of the railways. However that should not prevent efforts aimed at improving the efficacy of the day to day operations of the Zambia –Dar es Salaam railway. This would in turn allow for a more direct method of transporting large quantities of grain from Ifakara and Mlimba to Dar es Salaam at a much reduced cost, and with less impact. Current transport along the main Kilombero road is limited to 10ton trucks at present due to road conditions.

Graphical analysis of spatial distribution of warehousing is provided in the electronic mapping appended to this report. An example is shown below.



Capacity building SHF

Training/workshops regarding best practices for production should also include the benefits to SHF of storage of grain after harvest; not only thru storage at the individual level, but also through storage in warehouses where space is leased at cost. Training should include how to calculate the cost/benefit of storage and how to best manage inventory.

CONCLUSIONS

- Improvement of grain storage facilities and advocacy on acceptable construction standards are required; common observable issues included lack of, or sub-optimal, foundations, access ramps, loading and offloading bays, ventilation, pest, and moisture control.
- In spite of being available for use by Farmers Cooperative Unions (FCUs), most village /village government warehouses are either underutilized or used for purposes other than storage i.e. used for meeting halls/social activities. This is due to poor state of the structures, lack of proper security, and unclear facility management and storage procedures. This capacity will be readily available for storage if these issues are addressed.
- Trade centers with adequate storage facilities such as:
 - Kibaigwa, Mkoka, Hembahemba, and Kibaya for maize grains
 - Mang'ula, Ifakara, Viwandani, and Mlimba for paddy

make good aggregation points for traders and transporters and together stimulate productivity. If prioritization is needed, potential productive areas without such arrangements should be piloted with model warehouses and improved accessibility.

- Supply and installation of Mechanical Handling Equipment and pallets is required for suitable warehouses identified as being able to make use of such equipment.
- Standardization of inventory control tools and procedures is required for ease of learning and sharing of skills involved in their use, in addition to providing greater transparency for end-users.
- Training on basic warehouse management is vital including more efficient stacking and layout; especially where more than one farmer leases storage capacity within the same warehouse.
- A simple model showing best practices and minimum requirements for construction of cost effective, secure, efficient, pest resistant, warehousing should be made available at each of the district levels to ensure that common mistakes are not repeated. This should include:
 - Scalable in dimensions from 200Mt to 2500MT
 - Orientation
 - Where to site for market access/transport
 - Construction methods/design

APPENDIX A – PRE-ASSESSMENT INSPECTION TEMPLATE

PRE-ASSESSMENT QUESTIONNAIRE

FCU Name	
Warehouse Location	
Name of warehouse manager	
Contact details	
Number of staff employed	

Please provide the rules / operating procedures for the warehouse

SECTION 1 – GENERAL

1.1 When was the warehouse built:

1.2 Is it owned or rented:

1.3 What is the size of the warehouse:

1.4 What is the capacity of the warehouse:

1.5 What commodities are stored at the warehouse:

1.6 Is mains electricity available

1.7 Is the warehouse dry and suitably ventilated

1.8 Is there a pest problem at the warehouse and, if so, how is it treated

SECTION 2 – WAREHOUSE ACTIVITY / INWARDS

2.1 Goods In – On average how many deliveries are made each day

2.2 Goods In – Maximum number of deliveries per day

2.3 Goods In – Minimum number of deliveries per day

2.4 Goods In – What is the average weight of each delivery

2.5 Goods In – What is the maximum weight of a delivery

2.6 Goods In – What is the minimum weight of a delivery

SECTION 3 – WAREHOUSE ACTIVITY / OUTWARDS

- 3.1 Goods Out - On average how many collections are made each day
- 3.2 Goods Out – Maximum number of collections per day
- 3.3 Goods Out – Minimum number of collections per day
- 3.4 Goods Out – What is the average weight of each collection
- 3.5 Goods Out – What is the maximum weight of a collection
- 3.6 Goods Out – What is the minimum weight of a collection

SECTION 4 – WAREHOUSE ACTIVITY – GENERAL

- 4.1 Are collections and deliveries scheduled or pre-booked
- 4.2 Are there extended waiting times for handling of collections and deliveries at peak periods.
- 4.3 At what times of year is there a space shortage at the warehouse
- 4.4 What are the consequences at times of space shortage
- 4.5 At what times of year is there a surplus of space at the warehouse

SECTION 5 - EQUIPMENT

- 5.1 What, if any, mechanical handling equipment is available (including retrieval equipment)
- 5.2 Is packing, bagging and labelling equipment available
- 5.2 If equipment is available, is it regularly maintained
- 5.3 Are racking systems used, if so please describe them.

SECTION 6 – INVENTORY CONTROL

- 6.1 What inventory control system is in use – manual or automated
- 6.2 If automated, is it linked to other stakeholders
- 6.3 If manual, how is it validated / checked
- 6.4 How regularly are stock audits / balances carried out

APPENDIX B – WAREHOUSE ASSESSMENT CHECKLIST

Location of Warehouse:..... **Size** **Capacity**

Assessor:..... **Date:**

Criteria	Acceptable (Yes/No)	Unacceptable (Yes/No)	Detail	Priority 1/2/3 see note (2)	Cost (US\$ approx) see note (1)
Access / Ramps					
State of construction					
Security					
Floor Surface					
Cleanliness					
Space Available					
Overall layout / aisles / ergonomics					
Ventilation / Airflow					
Fans / AC					
Racking / Storage					
Electricity					
Office / Admin area					
Fire precautions					
Fork lift truck / MHE					
Pallet Truck (hand)					
Staff capacity / H & S					
Stock recording					

Notes:

(1) Cost reflects initial estimate in US\$

(2) Priority key:
 1 = Critical action required
 2 = Action beneficial but not essential
 3 = Action would improve long-term sustainability

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