

# Assessment of Fruits Handling in Tanzania- Case of Orange Fruit

Dr. Christopher T. Mgonja<sup>1</sup>, Dr. Frumence E. Utou<sup>2</sup>

Senior Lecturers, Department of Mechanical Engineering, Dar es Salaam Institute of Technology (DIT),  
Dar es Salaam, Tanzania<sup>1,2</sup>

**ABSTRACT:** Appropriate farming practices involve, careful crop raising, harvesting, and proper means of handling such as sorting, packaging, packing, transportation, storage and point to point distribution. These activities are the major contributing factors towards enhancing quality of the product. Current handling system for fresh fruits in Tanzania shows that substantial loss is incurred during the transitional period from the points of harvesting to the consumption. This has been a major root cause of having inefficiency in the entire cycle of fruits handling. Postharvest handling practices are important to reduce postharvest losses and improve overall harvest quality. However, inevitable postharvest losses occur during postharvest handling at different levels of the distribution chain. This paper attempts to identify some areas for improvements of fruit handling using the available facts obtained in some sampled areas within Dar es Salaam and Coast regions. The paper also addresses the current practice, as well as recommending appropriate ways of handling the harvested fruits. The study has mainly focused on orange fruits which seem to occupy large segment of seasonal fruits. It has been revealed that out of 87,320 oranges that were used in the experiment, 6,658 equal to 7.6% oranges were spoiled. It was also observed the harvesting methods, packaging method, mode of transport used and storage to be the contributing factors. This paper recommends the use of proper orange handling systems all the way from harvesting to consumer.

**KEYWORDS:** Fruits handling, postharvest, oranges, fruits transportation, fruits losses.

## I. INTRODUCTION

In Tanzania, orange trees were planted in Muheza district of Tanga Region in early 1900's by Anglican missionaries at Magila mission and then spread in the neighbourhood with rapid expansion to other villages such as Potwe (Potwe ward), Semungano (Kilulu ward) and Tanga town. However, effective propagation of oranges has started during the period 1930 to 1940, through the nursery run by Mlingano Sisal research station. Plants of different varieties and other citrus species produced by the station by vegetative propagation were distributed to farmers free of charge. Orange is one of the food-cash crops produced in Tanzania. Regions producing oranges are Tanga, Coast, Morogoro, Dar es Salaam, Mwanza, Lindi and Mtwara. Among all regions, Tanga is the largest orange producer in Tanzania. It is mostly produced in Muheza, Handeni and Korogwe districts. Muheza district is the largest orange producer in Tanga region relatively. The orange farmers are growing a mixture of the following varieties: Jafa, Early Valencia, Washington, Late Valencia, Zanzibar, Pemba and Nairobi. Oranges produced are marketed both at local and distant markets such as Nairobi in Kenya, Dar-es-Salaam, Arusha, Kilimanjaro, Mwanza, Shinyanga, Morogoro regions etc. [1, 2, 3].

It is estimated that in 2008, a total production of orange fruits by small holders in Tanzania was around 194,978 tons per annum, harvested from 23,062 ha at an average yield of 8.5 t/ha. About 109,413 households in Tanzania are estimated to be involved in orange production, with an average of 0.4 ha per household. The main producing regions (tons/ha/year) include Tanga (22.41), Coast (18.31), Morogoro (10.9), Mwanza (6.9) and Ruvuma (6.8) whereby Arusha region is the least orange producer (0.1) in the country [4]. In 2013 Tanzania was ranked 25<sup>th</sup> worldwide in production of orange fruits and reported to produce 360,024 Tons [5].

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In the citrus fruit group, orange is the largest crop, but also grown in rather small volumes and mainly for home consumption are lemon, lime, mandarin and grapefruit. The citrus fruits in Tanzania have good growth conditions and are suitable crops for many horticulture farmers. In terms of citrus, Tanzania is generally self-sufficient and citrus fruits are available all year round. Despite the favourable conditions for citrus fruits in Tanzania, farmers still do not take advantage of it and very limited value addition takes place hence the main outlet for citrus is the fresh market [6]. Apart from citrus, the most common fruits in Tanzania are mangoes, pineapples, banana, watermelon, avocado, and papaya [7].

Tanzania climate allows cultivation of fruits and vegetables however, the postharvest loss is so enormous [8]. Postharvest losses can occur at any stage in the supply value chain hence there is need to consider the whole supply chain to determine the losses. For farmers, postharvest losses can be quantified in absolute terms for produce lost after harvest, and then calculated as a percentage based on total harvested quantity [9]. Postharvest loss of fruits and vegetables is estimated to be 30-40% in developing countries [8, 14], Tanzania inclusive [8]. Due to absence of proper storage and marketing facilities, farmers are forced to sell their produces at throw away prices leading to economic losses [4, 9, 10].

Orange fruit production as an important part in horticultural industry has emerged as a major economic activity in developing countries, especially those which were hitherto heavily dependent on agricultural production, often at subsistence levels. Horticultural producers in developing countries are mostly small farmers, and they are rarely organized into a formal cooperative or association [4].

Controlling and/or preventing postharvest losses is less costly as compared to producing the similar amount of the fruit loss. Postharvest management determines not only quality and safety of food but competitiveness on the market. In developing countries, the horticultural supply chains lack sustainable postharvest management systems. Major constraints of postharvest management in these countries include inefficient handling from harvesting to consumption [9].

Most of the fruits are grown in remote distances from the centre of demand, and therefore need to be transported. The infrastructure to enable effective transportation from the points of harvest to the places of common market (Semi-final destination) is not adequate. This leads to delay in time, which eventually get rotten. Lack of proper storage facilities is another barrier to the effective handling of fruits. Temperature management is critical during long distance transport, so loads must be stacked to enable proper air circulation to carry away heat from the produce itself as well as incoming heat from the atmosphere and off the road. Transport vehicles should be well insulated to maintain cool environments for pre-cooled commodities and well ventilated to allow air movement through the produce. During transport, produce must be stacked in ways that minimize damage, then be braced and secured. An open air vehicle can be loaded in such a way that air can pass through the load, and provide some cooling of the produce as the vehicle moves. Traveling during the night and early morning can reduce the heat load on a vehicle that is transporting produce. Drivers of vehicles used for shipping produce must be trained on how to load and handle their cargoes [11].

## II. RELATED WORKS

The Postharvest loss is a “measurable quantitative and qualitative loss of a product at any moment during the postharvest chain” and includes the “change in the availability, edibility, wholesomeness or quality of the food that prevents its consumption”. Both quantitative and qualitative losses of extremely variable magnitudes occurring at all stages in the postharvest system from harvesting, through handling, storage, processing and marketing to final delivery to the consumer [8, 12, 13]. Efforts to reduce postharvest losses of high perishable produce such as fruits and vegetables in developing countries are considered crucial not only to avoid wastage but also to reduce the cost of preventing food losses [14]. The Postharvest losses survey made in tropical countries, fruits vary widely from 10

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percent to 40 percent in both developed and developing countries [15]. The magnitude of these losses and their impact on farm income varies greatly from place to place and has often been difficult to calculate since the postharvest handling chain includes all the steps between harvesting and consumption, including sorting, cleaning, packing, cooling, storage, transport and processing [16]. In most developing countries, this is mainly due to the combination of things like carelessness during harvesting, poverty, poor infrastructures and logistics, storage, poor technologies for storage, lack of appropriate processing technology, packaging; involvement of too many diverse actors; poor farm practices, lack of postharvest handling knowledge and a convoluted marketing system [12, 14, 17, 18, 19, 20]. It has been further observed that the reason for waste could be also due to high rates of bruising, water loss and subsequent decay during postharvest handling [16, 17]. These losses are observed at harvesting, during packing, transportation, in wholesale and retail markets, and during delays at different stages of handling [17].

The countries such as Japan, the Republic of Korea and Taiwan province of China, have the fruits postharvest losses of about 10 percent. In Philippines, generally, postharvest losses could range from 15 to 35 percent. In Tanzania the postharvest losses has been reported to range from 30 to 40 percent where rotting has been mentioned as a major type of loss during handling followed by physiological losses and mechanical damage [4].

Too early harvesting results in chilling sensitivity, while too late cause fruit deformation puffing, granulation and senescent disorder of rind. Manual harvesting is the common practice worldwide. Improper harvesting techniques often cause damage like stem end bruising and torn skin [18].

The mode of transport also contributes to mechanical and physiological damage of fruits. The practice of poor arrangement of sacks on top of each other and making a huge heap of packed fruits during transportation cause fruits damage due to shaking of the vehicle especially on corrugated roads. Meanwhile the accumulation of unarranged packed fresh fruits in lorries during transportation may also lead to increased heat due to metabolic reaction of the cells and it may accelerate their mechanical damage. The breakdowns of vehicles can be a significant cause of losses in some areas as perishable produce can be left in the sun for a day or more while repairs are carried out [8].

In Tanzania, the postharvest orange fruit chain i.e. harvesting, handling, transportation, processing and marketing are uncertainty due to poor facilities and methods for harvesting, handling and packages which mainly includes sacks and baskets. This allows the produce to be bruised, squashed and receive abrasions from farm to market, and this damage allows postharvest decay organisms to gain easy entry. Lack of markets for horticultural products in Tanzania could be among the obstacle to developing the horticulture subsector in the country. This is because the orange fruit markets is largely linked to seasonality production particularly in the peak production and scarcity period. Because of the limited capacity for processing the horticultural produce relative to surplus production in the peak harvesting period, coupled with unavailability of technologies for storing surplus perishable horticultural products, most of the produce gets spoilt hence causing great losses to producers [4].

In light of the incidence of the huge postharvest losses, serious efforts are needed to reduce losses, especially of fruits. This would include linking operations and actors involved more closely and systematically, modernizing marketing infrastructure and technologies, capacity building of individual actors, and strengthening the policy/institutional settings for better marketing. The concerted efforts of all, including the private and public sectors, are required to alleviate these constraints [14].

Fresh fruits can be kept at room temperature, until they ripen and the ripe fruits are kept in the refrigerator or freezer. The fruits should be sorted before storing because the bruised or decayed fruits will contaminate good fruits. Most fruits stay good for 8 – 12 months when frozen. Fresh oranges can be kept at room temperature for 2 weeks and in the refrigerator up to 2 months [16, 14, 21, 22, 23]. Shelf life may be defined as the period of time from harvest to manufacture to consumption that a food product remains safe and wholesome recommended production and storage conditions. Shelf life is affected by intrinsic factors such as respiration, biological structure, ethylene production and

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sensitivity, transpiration, compositional changes, developmental processes and physiological breakdown [24]. There are currently few fruits and vegetables processing plants in Tanzania [25].

## III. METHODOLOGY

**Study area:** The study was conducted in Kisarawe District and Dar es Salaam city located at Coast and Dar es Salaam regions respectively. Kisarawe district experiences general tropical climate condition characterised by hot and humid weather throughout the year and has two distinct rain seasons namely short and long seasons. Kisarawe is one of the popular orange fruits producer in Tanzania while Dar es Salaam city is the main consumer. Three famous producers of orange fruits wards in Kisarawe District namely Manerumango, Msanga and Chole were visited. In Dar es Salaam city, Kariakoo market, Buguruni market and Tabata retail points were involved in the study.

**Sampling procedures and sample size:** The study adopted a cross sectional research design whereby data were collected at Kisarawe and Dar es Salaam city. The study employed random techniques for selection of farmers for interview and employed purposive sampling technique to select buyers, transporters, wholesalers, retailers and consumers. In most cases site visits were carried out prior to interviews and questionnaire. However, physical observations were key tool to establish the areas where the relevant data could be easily obtained. The total of 119 respondents were sampled and interviewed and within the same group, 110 responded to the structured questionnaire. These included 25 farmers, 20 buyers, 10 transporters, 16 wholesalers, 23 retailers, and 25 consumers. The experiment was carried out three times at the retail points to get the quantitative losses. The first is conducted at the beginning of August when harvesting starts, the second at the mid of August when harvesting is at the peak and the last at the end of August when harvesting ends. Four selling points were identified and one pile on each point for each period was assessed. The amount of oranges for each pile ranged from 6000 to 8000.

**Data collection:** Primary data were collected which included the field survey on orange harvest and postharvest handling practices along the food chain. Farmers and traders were interviewed using structured questionnaire with open and closed questions. The questions sought to obtain information on orange handling at each stage (harvesting up to consumer). Also the number of spoiled oranges at retail points were counted every day and the total spoiled oranges was recorded and compiled ready for analysis.

**Data analysis:** The cost and statistical data analysis were carried out using Microsoft office excel 2013 and the results were presented in pie, line and column chart graphs.

## IV. FINDINGS

**Observations during Harvesting:** The observation during visits in most places shows that the practice of harvest of oranges was done in a traditional way that people are climbing up the trees and pick oranges and throw or toss them down and caught by someone at the ground. This shows how the harvesting method is difficult. In this method, not all oranges that are being thrown are caught. Some of them are dropping on the ground and get mechanical injuries like bruises and other damages. In this case, the injured area begins to decay. Unprepared surface of the ground under the orange trees was one of the causes to the injuries which consequently increase losses of the harvested oranges. It was also observed that some of farmers do not adhere to an appropriate time of harvesting. The farmers are tempted to harvest their oranges pre-maturely when approached by the buyers. In this case the quality of oranges is jeopardized. Sometimes the harvesting time takes more than two days before transportation. This is due to the fact that to fill the truck volumetric can take time as clients tend to load the oranges themselves in order to reduce hiring costs. Again this contributes much to lowering the quality of fruits.

**Observations during Packing and Transportation:** Transportation of the fruits from the destinations of harvest to the distribution points of macro and micro markets are done by the trucks and they are transported at lengthy distances. The construction of most of these trucks is not meant to transport fruits but they are of general purposes. It was also observed that, at the harvesting site oranges are not packed appropriately. There are no special packaging containers; instead the oranges are just packed freely in the lorry or truck which cause some of them to get spoilt through

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compression especially the ones at the far bottom of the truck. It was also noted that the oranges are not gently packed, instead they thrown or tossed with impact to cause mechanical damages. It was also observed that most of people dealing with fruit business are not quite aware of the proper packaging facilities. The observation shows that practically there are no dedicated trucks with air condition facilities to transport fruits from one region to another.

**Observations during Storage and Transportation within the Cities:** The arrival of the fruits to the central markets in cities is another destination, before the distribution to small markets and individual small selling points. However, it is unfortunate that during all these transitions, there is no provision of central storage facilities. The clients of whole sale and those of retail get their oranges only with expectation that all will be sold. The packages like bamboo baskets, polyethylene sacks, woven sacks, woven bamboo baskets, wooden crates and plastic bags are employed during the transportation within the city and plastic packets are used by consumers.

**Postharvest Losses of Fruits:** Apart from the observed losses during harvesting, postharvest losses play another big part in the entire period between harvesting and consumption. Postharvest losses were noted in the classification of damage causes, such as mechanical vibration, compression, puncturing, bio degradation, shrinkage, overstay etc.

**Loss Due to Orange Pile Up:** Several visits show that fruit handling practice in most populated and concentrated business centres in the city is of improper manner. The fruits are piled into the open air, with contaminations of moisture, dust, sun rays and all sort of pollution. This exposure causes rapid deterioration of fruits and hence lowering the price value of the fruits. The piles attract many customers at the beginning but slowly deteriorates as time goes and consequently, massive rotten fruits are trashed and thrown away as waste.

## V. RESULTS AND DISCUSSIONS

Fig. 1 indicates the results of respondents on the methods used during harvesting, the way on how the oranges were loaded ready for transportation, the means of transport used for transportation, the storage facilities used at the market places, the condition of piling sites and finally checking whether the value is added if the handling system is improved.

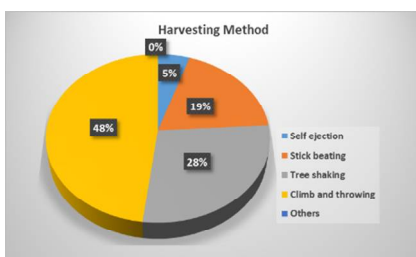


Fig. 1a: The Harvesting Methods

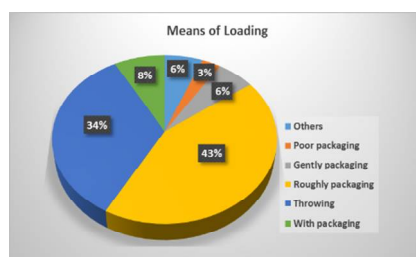


Fig. 1b: Means of Loading

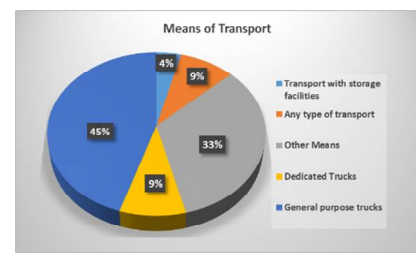


Fig. 1c: Means of Transportation



Fig. 1d: Storage Facilities

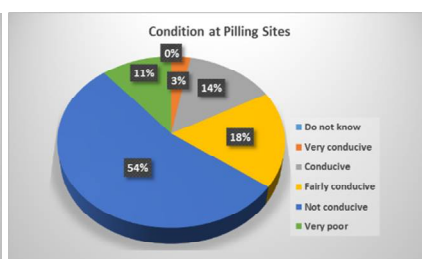


Fig. 1e: Condition of Piling Sites

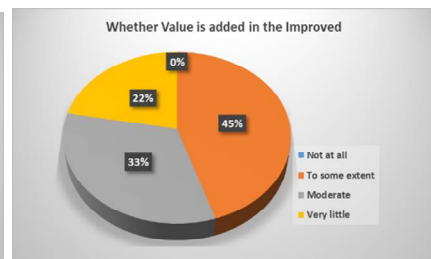


Fig. 1f: Value Added of the Handling System

Fig. 1: The Response from people that were involved in the

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Fig. 1 indicates the response from people that were involved in the study. The results from fig. 1a show that the respondents on the means of fruit harvesting method 48% were using manual harvesting by climbing picking and throwing, while 19% admitted to use stick beating. Fig. 1b shows that only 6% were loading the oranges appropriately in the trucks while 43% were using unacceptable ways of loading. On the mode of transport, fig. 1c indicates that the general purpose vehicles contributed about 45%. Proper storage at market place as shown in fig. 1d occupies only 2% and the worse cases (without storage facilities) constituted 76%. Fig. 1e shows that the existing conditions at the fruit pilling site have only a maximum satisfaction of 3%, and majority i.e. 54% commented that the sites are not environmentally conducive. Fig. 1f indicates that the value can be added if the fruit handling system improves. 45% respond that to some extent there can be improvements while 22% said very little improvements.

**Experimental Results:** The experimental method through sampling which gives the trend of losses incurred due to current handling system is shown in Figs 2a and 2b. Fig. 2a indicates the losses of oranges at the selected four selling points where three piles were assessed at each point. Fig. 2b shows the average orange losses at each pilling point.

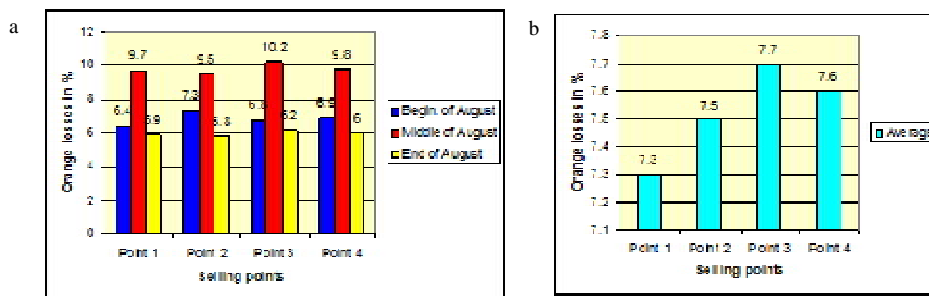


Fig. 2: a) Losses of oranges at the selected four selling points each having three piles. b) The average of orange losses at each selling point.

A study on fruits handling specifically on orange fruits has been carried out in Dar es Salaam and Coast regions and shows that, despite having a huge number of consumers in Dar es Salaam city, still there is a considerable loss. Out of 87,320 oranges from all four points that were used in the experiment, 6,658 equal to 7.6% oranges were spoiled. It was observed that the losses were caused by improper harvesting, packaging, transporting and storing.

The results in fig. 2a indicate that at the beginning of August the spoiled oranges were at the average of 1,821 (6.85%) from 26,580 oranges. At the mid of August the spoiled oranges average was 3,076 (9.8%) from 31,390 while at the end of August the spoiled oranges were at the average of 1,760 (6%) from 29,350 oranges. Hence, the total spoiled oranges in the whole month was 6,657 (7.6%) from 87,320 oranges. The trend shows that at the beginning of August the harvests of oranges start when the shortage of oranges in Dar es Salaam city is high. In this respect, the demand was high and the spoiled oranges were fewer 6.4% to 6.8% than at the mid-August when the oranges were plenty in market and the spoilage ranged from 9.5% to 10.2%. The same implies to end of August which indicates few spoiled oranges that ranged from 5.8% to 6.2%. This shows that there was already a shortage of oranges and more demand due to reason that it was the end of harvesting season. Fig. 2b indicates the average of spoiled oranges at each point and shows that at point 1 the demand was high that is why the spoilage was low while point 3 indicated low demand.

**Results on Cost Implication Analysis:** Fig. 3 shows the cost implications comparison between the traditional method and improved method. In the assessment, the shelf-life was considered that the fresh orange kept in the room temperature can only last for 2 weeks while in the refrigerator can take more than 2 months. The duration of analysis was considered to be 31 days.

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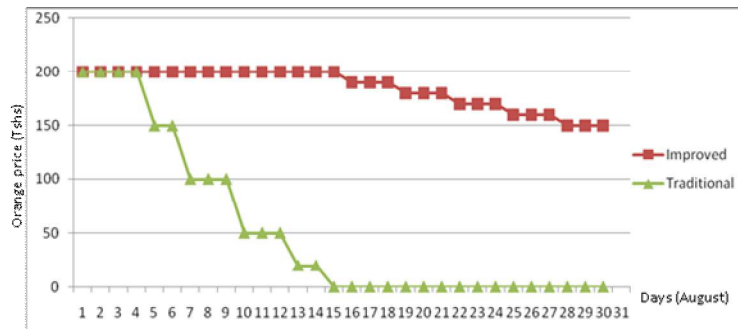


Fig. 3: Comparison of oranges selling methods (Improved and Traditional)

Finally, the cost analysis for one cycle (batch) in fig. 3 shows the trend of using the traditional ways of handling and the improved practice. It has been revealed that using the improved practice increases the shelf life and maintains the quality of orange and hence the price maintained for longer time and further minimizes the fruits losses. It has been further observed that the price of orange with the improved storage method remains stable for two weeks and can go down only from 200/= to 150/= Tanzania shillings in the duration of one month. The oranges that were stored using traditional methods had to be sold within two weeks to avoid spoilage and the price went down very fast due to storage condition. Hence, the analysis shows clearly that the income can be improved using the improved storage method.

Fig. 4 indicates the storage situation of oranges where fig. 4a shows the long keeping of oranges on the inconvenient area at the market that results to mass spoilage while fig. 4b shows the piles of oranges at the selling points.



Fig. 4a: Long keeping of oranges on the inconvenient area at the market without getting clients which increased the spoilage



Fig. 4b: Some of the piles of oranges at Dar es Salaam City for retail selling used for experiment

Fig. 4. Storage of oranges at the market retail selling points

During the survey it was observed that a lot of oranges were spoiling simply because of the poor storage (Fig. 4). The temperature at the market and retail points was around 19<sup>0</sup>C at nights and 27<sup>0</sup>C at day time. It was also revealed that the orange handling chain from harvesting to consumers was very rough. At the markets and retail selling points, most of oranges were kept on unfloored and unshaded area which was one of the contributing factors of big amount of oranges spoilage especially during the peak season of harvesting i.e. at the mid of August.

## VI. CONCLUSIONS AND RECOMMENDATIONS

**Conclusions:** During the survey it was noted that most of people who are involved in orange business are not aware on the proper ways of fruits handling. It was revealed that there is little fruit handling awareness training conducted to these people. Postharvest losses of fruits are considered to be a major problem that affects many farmers in Tanzania. Many oranges damage due to impact and compression during harvesting and transportation which is the result of improper packaging. Consumers were complaining that many oranges are not in good quality as they are exposed into open air for long time which is the consequence of poor storage. It was further observed that the selling points of farmers,

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wholesalers, retailers and even big markets in Dar es Salaam have no good and sufficient fruits storage facilities like warehouses, refrigerators, freezers, cold rooms, etc., which contribute much on fruits losses. Economically, it has been identified that there is a substantial saving financially when using appropriate method of handling the fruits.

**Recommendations:** Rough handling of fruits should be avoided to reduce physical damage. Stakeholders should be made aware on the magnitude of losses occurring at each stage of the supply chain and their role to reduce or eliminate these losses. There is a need to improve the existing postharvest methods which include designing, developing, testing and disseminating appropriate and affordable technologies such as small scale handling and storage structures and facilities. It is therefore important to promote the development and utilization of appropriate and affordable pre and postharvest handling methods and packaging materials to be used by farmers and other actors that will gradually replace local technologies. Stakeholders be advised to use postharvest management practice that includes: cleaning, washing, selection, grading, disinfection, drying, packing and storage. These eliminate undesirable elements and improve product appearance, as well as ensuring the product to comply with established quality standards for fresh and processed products. Attraction for Investors in this area should also be encouraged. The engineering training institutions like DIT and engineering community as a whole are encouraged to contribute on research and innovations in finding out the appropriate fruits handling technologies that can minimize the losses in the whole fruits handling chain.

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