

# Modification and Verification of Hand Operated Avocado and Mango Harvester

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**Abstract**— Improvement and adoption of agricultural technologies is one of the strategies favoring technology transfer approach of agricultural mechanization research program. Following the trend, modification works were done in Jimma Agricultural Mechanization Research Center on fruits harvesting equipment to minimize post-harvest losses due to mechanical wounding. Traditional fruit harvesting is being practiced using picking hooks, hand picking by climbing tree branches, shaking actions and knocking down the fruits on to the ground after picking, exposing it to physical injury and contributing to post harvest loss through wounding fruits. To solve fruit wounding and hence safely harvest fruits that would eventually possess better market value, a hand operated fruit harvester was developed in the center and evaluated for its performance on most abundant and sensitive fruits; mango and avocado. Following evaluation results one was selected between two types of modified harvesters based on their effect on fruit wounding, maneuverability and operators picking safety. According to test results, the modified harvester was found to be encouraging with respect to the mentioned evaluation parameters and recommendable for popularization to replace traditional fruit harvesting and consequently minimize post-harvest losses due to harvesting mechanisms.

**Keywords**— Harvester; mechanical damage; hand picking; wound;

## I. INTRODUCTION

Worldwide emphasis on the awareness of the health benefits of fruit and vegetable consumption needs to be increased. In addition, accelerated national initiatives are required to produce and efficiently market more affordable horticultural products, while ensuring that they are safe and that fewer losses occur along the post-harvest handling chain [1]. Agriculture is the mainstay of the Ethiopian economy, contributing 43% of the gross domestic product, providing 85% of export revenue and employing over 86% of the population. Ethiopia has highly-diversified agro-ecological conditions which are suitable for the production of various types of fruit and vegetables. However, the contribution of horticultural crops both to the diet and income of Ethiopians is insignificant. With the aim of enhancing agricultural development, the Government considers various

projects, including small-scale irrigation mainly through rainfall harvesting and home gardening, to be of crucial importance. As a result, vegetable and fruit production is being more widely adopted, primarily to ensure food security and to promote production of high-value crops for the market to improve living conditions of smallholders [2].

Among fruits, avocado, banana, orange, papaya and guava are commonly produced. Commercial horticultural crop production is carried out mainly in the central rift valley and eastern part of the country. Most of the vegetables and fruit produced in the eastern region are exported to Djibouti and small amounts of fruit and vegetables are also exported to Europe, Pakistan, Saudi Arabia and Yemen. Ethiopians consume on average 97g of fruit and vegetables per day. Cereals contribute about 75% of the Ethiopian diet. Pulses are a source of protein and widely consumed. The main constraint with regard to fruit and vegetable production is that, because of market and food security concerns, rural farmers prefer to produce cereals and pulses. Other constraining factors include low production and productivity, lack of adequate pest control, poor soil fertility management practices, lack of attention to product quality and prevention of physical damage, as well as the lack of storage and packaging facilities [3].

The Government of Ethiopia has formulated a national program designed in such a way as to bring about meaningful improvements in productivity and quality of horticultural crops of different species to enhance their competitiveness in the market. Jimma and Illubabor zones are among potential fruit growing areas in the country [4]. However, tremendous loss had been encountering fruit growers. The loss is usually related to its sensitivity and perishability in nature which might be of harvest and/or Post harvest.

Fruit harvesting system practiced in these area is hand picking by climbing the tree branches, the use of picking hooks, shaking actions and knocking down fruits with long wooden or bamboo sticks for detaching. Such harvesting method in every case involves dropping the produce down on to the ground after picking; exposing it to physical injury. Physical damage that may occur at any time from harvest until the fruit is consumed, causes fruit surface wounding which facilitates entrance and development of rot organisms [5]. Furthermore, cuts, punctures and bruises to the fruit will usually increase ethylene production, accelerating softening of surrounding fruit causing them to become more susceptible to mechanical injuries, thus, decay [6].

In this research project effort was done to improve the existing traditional mango and avocado harvesting system and replace by improved ones having fruit picking mechanism and collection bags. Performance of the harvester was tested and the result was found encouraging replacing the traditional harvesting system. The Objective of the study is to modify and verify a hand operated avocado and mango harvester.

## II. MATERIALS AND METHOD

### A. Methodology

Two different prototypes of a modified fruit harvester were manufactured in the workshop before the conduction of the test. Equipment test was conducted along with traditional picking method on most abundant and sensitive fruits; avocado and mango fruits. The equipment was preliminarily checked that it could pick other hanging fruits like orange and lemon. However, much attention was given during the test on harvesting avocado and mango fruits for their extent of production, handling sensitivity and commercial values. Samples were taken among avocado and mango fruits picked by each of the three harvesting methods and inspected after harvest for physical wounding effects due to harvesting mechanisms. Data collected and analyzed.

### B. Operation of the harvesters

The operation of the harvester is in such a way that the harvester picks by its multi serrated cutting blades and a fruit collection nylon bag stretched over circular ring to catch fruits as it is cut. Pulling the stainless steel blades through long bamboo handle plugged in to the end of the ring allows fruit stalk to be cut (figure 1).



Fig. 1. Harvester

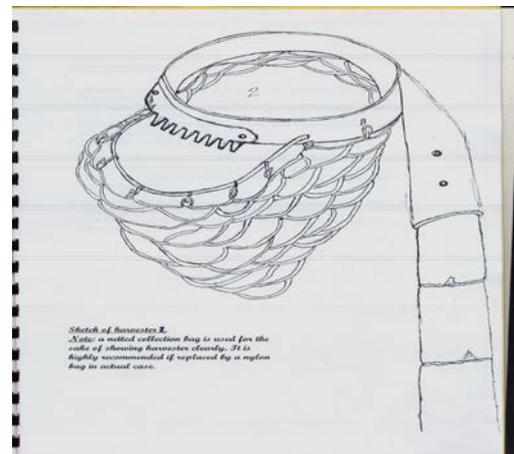


Fig. 2. Harvester 2

## III. RESULT AND DISCUSSION

Different performance parameters on the harvesting mechanisms and effects on physical wounding were considered during the test.

### A. MANUEVERABILITY OF HARVESTERS

Harvester 1 was observed to be more maneuverable than harvester 2. Harvester 2 also performs well under specific conditions as when the harvesting is done using a multi stand ladder from outside of the tree canopy but with limitation that the picked fruits sometimes miss the collection bag. It was also commented by operators that it was less comfortable during harvesting than harvester 1.

### B. WOUND DIAMETER ON THE SKIN

The percentages of mango fruit wounds of diameter greater than 5mm (wide enough for visibility by eye) and picked by harvester 1, harvester 2, and traditional method was 33.33%, 41.66%, and 66% respectively. The percentages of avocado fruit wound diameter greater than 5mm (wide enough for visibility by eye) and picked by harvester1, harvester2 and traditional method was 33.33%, and 50% and 58.33% respectively. Harvester1 was observed to leave the minimum number of fruits whose wound/cut is wide enough for visibility by eye than both of harvester 2 and traditional picking methods. Size of wound on fruit skin affects market value or its sale ability due to ugly appeal resulted besides aggravating rate of deterioration

### C. RISK OF FALLING OFF

Doing the harvesting operation using harvesters was observed to be free of risks of falling off the tree because one does the harvesting without standing on the weak points of tree branches. According to comments from participant farmers during the test regarding fruit harvester, they were able to notice its advantage in minimizing fruit skin breakages upon dropping and risk of falling off the tree, which they sometimes face.

#### IV. CONCLUSION

Harvester 2 showed limitations in sometimes allowing the picked fruits miss the collection bag, its less maneuverability, and leaving greater numbers of fruits with visible wounds than harvester 1. Therefore, harvester 1 is recommended to replace the traditional picking for harvesting least numbers of wound fruits with minimum risk of falling off the tree during harvesting. Taking efforts done in improving the traditional fruit harvesting as a base, demonstration of the improved harvester is recommended to avail users' feedback for further improvement works to still harvest less number of wounded fruits.

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