Evaluation of Modified Plucking Pole for Harvesting Coconuts

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Abstract: The modified coconut plucking pole which supports farmers who are willing to harvest nuts from coconut trees has been developed as a solution for scarcity of coconut tree climbers in coconut plantation sector, Sri Lanka. This research was conducted by NERDC to develop efficient coconut plucking pole to harvest nuts from coconut trees from the ground level. Modified pole is a height adjustable, light weight, self-controllable, safe to operate, easy to fabricate and economically viable. It consists with two adjustable aluminium alloy poles, harvesting knife, nylon hinged clamps and a protective grip. The minimum and maximum harvesting length of the plucking pole are 7 m and 17 m respectively. Nuts could be harvested from the coconut tree as individuals or bunches. Required average plucking time per tree which has two average coconut bunches is 1 minute. Harvesting efficiency of the developed plucking pole is 7 times higher than the climbing trees. Average harvesting rate is 55 trees per hour. Modified plucking pole is a solution for harvesting problem of coconut plantations in Sri Lanka and save time and money in addition to solving labour scarcity problem.

Keywords: Coconut, Plucking pole, Height adjustable, Knife

1. Introduction

Coconut is one of the major perennial plantation crop in Sri Lanka [1]. It is scientifically named *Cocos nucifera* and it is generally called as "tree of life" [2]. Each and every part of the coconut tree use as food, timber, firewood and shelter. Coconut play an important role in the daily life of Sri Lankans because most of the Sri Lankan cuisines are made by using coconut milk, coconut oil and scraped coconut. Therefore, maintaining a coconut plantation, harvesting, de-husking and all other processes of the coconut industry have become very important.

The most common method for harvesting nuts is by climbing trees in Sri Lanka. It is a time and energy consuming task. Further, if there is a small mistake happened in climbing, serious accidents could happen [3]. Therefore, the probability of having lifetime injuries in

climbing coconut trees without climbing skills is very high. Nowadays, it becomes a very big issue due to the labour scarcity and reluctance of the young generation's involvement in the activity. Harvesting from the tall trees is a very hardy work even for skilled labours [4]. Generally, in Sri Lanka, there are 4 - 5 coconut palms in home gardens and harvesting have to be done every 40 - 45 days. Unfortunately, finding out labourers to harvest nuts from the coconut palms is an extremely difficult task due to the scarcity of skilled labourers [5]. Even if those labourers are found through above difficulties, it may not be economical. Therefore, if people have the facility to harvest nuts by themselves in their home gardens, they can fulfil their day to day coconut requirement.

The other method of harvesting nuts is by using bamboo sticks [5]. However, bamboo sticks have following drawbacks; it is not height adjustable, it is not controllable, heavyweight and not smooth for hands. Moreover, in general, coconut harvesters who are using bamboo sticks use several sticks of different heights. It is a quite strenuous activity. And also, finding suitable bamboo poles is a difficult task due to unavailability of bamboo trees with rapid urbanization and decreasing of arable lands.

Thus, height adjustable, light weight, portable, easily transportable and self-controllable coconut plucking pole has a high demand. Therefore, the major objective of this research was to develop an efficient coconut plucking pole including following characteristics; height adjustability, light weight, and portability.

2. Materials and Method

The Preliminary field investigations of coconut harvesting show two traditional coconut harvesting methods; by climbing trees and by using bamboo sticks. Based on the preliminary investigations, we identified following characteristics should be included to the coconut plucking pole; portability, height adjustability, controllability, light weight, and durability. Subsequently, we identified the harvesting methods used for other palm trees like oil palm and areca palm. In both cases bamboo poles are being used. Other than that, the pluckers are using an aluminium alloy pole and a sickle together as a plucking pole which is imported from Malaysia used in oil palm industry. We have carefully studied and have followed that plucking pole and have done some modifications.

2.1 Description of the NERDC developed coconut plucking pole

The developed plucking pole consists of two adjustable aluminium alloy poles, harvesting knife, nylon hinged clamps and a protective grip. The length of the one aluminium pipe is 8 m and cumulatively it is 16 m (Figure 1). The inner and outer diameters of the bottom pipe are 38 mm and 45 mm respectively. The inner and outer diameters of the top pipe are 33 mm and 38 mm respectively. The inside of the pipes consisted with longitudinal grooves (Figure 2). Because of that, top pole could be inserted into the bottom pole which supports to change the height of the plucking pole. Connection of the two aluminium poles was done by using nylon hinged clamps (Figure 3).

Protective polymer grip (Figure 5) is attached to the end of the bottom pipe for easy handling. Length of the protective grip is 100 cm. The Knife of the pole consists with a steel blade and a wooden handle (figure 4). The handle of the knife is inserted to the top of the pole and fixed with a clip. There are two splits on the top of the pole as in Figure 2. These splits are facilitated for proper tighten of knife using clips. It is made with steel blade. It is 20 cm in length and 2 cm in width and 2 mm in thickness (Figure 4). Sharpness of the knife is very high therefore it supports to harvest nuts with less effort. The handle length of the knife is 19.5 cm. The total weight of the plucking pole is 8 kg.

Figure 1: Aluminium alloy poles

Figure 2: Longitudinal grooves

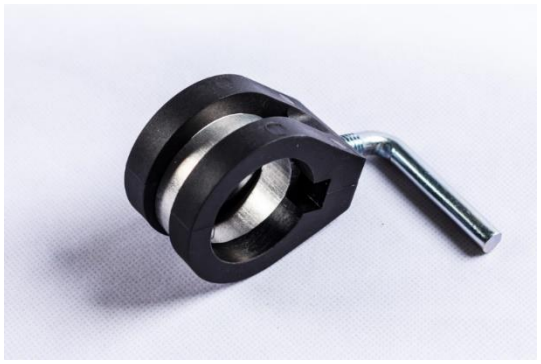

Figure 3: Hinged clamp

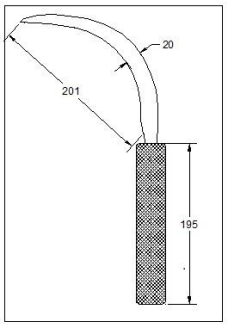

Figure 4: Knife

Figure 5: Bottom pole with protective grip

3. Results and Discussion

3.1 Field tests

Filed tests were carried out with 500 plants in 5 different coconut plantations in Gampaha and Puttalam district. Further, developed coconut plucking pole is compared with the traditional bamboo poles and climbing method. By the general practice of the bamboo pole, the team of the harvesting coconut includes three labourers. Therefore, we used same labourers for field tests of the developed plucking pole. The average age and weight of the labourers were 40 years and 65 kg respectively. It is confirmed that there was no any significant physical disability. Counting of the time (T1, T2 and T3) was measured with a stopwatch for three different methods.

T1 = time duration for harvesting two bunches from one tree by NERDC developed plucking pole.
T2 = time duration for harvesting two bunches from one tree by bamboo poles.
T3 = time duration for harvesting two bunches from one tree by climbing tree.

Generally, two bunches of nuts per tree are harvesting at a time. Finally, we measured the total number of trees per hour.

3.2 Harvesting range

The developed plucking pole supports to harvest nuts from the coconut palms. Maximum length of the coconut pole is 16 m and average height of the Sri Lankan users is 1.5 m. Therefore, the maximum harvesting height becomes 17.5 m. Consequently, it supports to harvest nuts from the trees which are shorter than 17.5 m. The minimum height of the pole is 8 m. Therefore, it supports to harvest nuts from the trees in range of 7 m to 17.5 m (Figure 6). The top pole could be inserted to the bottom pole which supports to change the height of the pole in between 8-16 m. Since the length variability of the pole, this could be able

Figure 6: Harvesting nuts from tall plants

to conveniently harvest different height trees on different plots. The same diameter is maintaining within two poles is an advantage when comparing bamboo sticks.

According to the Table 1, there is a significant difference between plucking pole and the climbing trees for the average number of trees per hour. Generally, climbing trees is a tedious task, therefore, it can be used only for the morning session. Further, it is a problem in the wet season too. Since climbing trees is a tedious task it requires 8-10 minutes to complete one tree.

3.3 Strength of the pole

Because of the different diameters of the bottom and top aluminium pipes and the longitudinal grooves they are well fitted each other. Because of the inside vertical grooves, it can be maintained controllability of the plucking pole. Moreover, the connection of the two aluminium poles was done by using nylon hinged clamps. They are very strong, durable and easy to

handle. And also, this could be operated on the ground level.

The protective grip is attached to the end of the bottom pipe for easy handling. This is very important to reduce the slippery exception of the handling area due to the hand sweating. Further, it protects the user from the damages by friction.

Knife which is made by steel is attached to the top of the aluminium pipes. Due to the sharpness of the knife and the angle of the knife, it supports to harvest nuts with less effort. Pruning of the coconut leaves also could be easily done.

Due to the light weight of the plucking pole, one person can bring and handle the coconut plucking pole. Based on the field tests it reveals that the developed plucking pole supports to reduce the harvesting time per tree (Table 1) than climbing trees. There was a significant difference between the developed pole and the climbing trees and there was no significant difference between the developed pole and the bamboo sticks. Table 2 clearly shows the advantages and disadvantages of the developed tree with the comparison of bamboo poles. It reveals that the bamboo poles could be replaced with the NERDC developed pole.

Table 1: Comparison of Climbing trees, bamboo sticks and developed plucking **pole**

	A	B	C
Average number of tress per hour:	55	55	8
Number of harvested bunches per hour	110	110	16
Average time per tree (Minutes)	1	1	8

A = developed plucking pole, B = bamboo sticks and C = Climbing trees

Table 2: Comparison between NERDC developed plucking pole and Bamboo sticks

NERDC developed pole	Bamboo pole
Low weight and no weight changes with weather conditions	Weight increase in rainy season and low weight when poles are short
Long lasting	Short life time – 1-1.5 years.
No decaying	Decaying takes place over time.
Extendable – one pole can be used for a range of height	Need several bamboo poles in different sizes
Easy transportation	Difficult to transport
Cost is comparatively high	Cost is comparatively less
No any changes for the poles when it storing or keeping inside or outside	Warping could be happened when it storing or keeping inside or outside
No need to do seasoning for the poles	Need 2-2.5 months seasoning to make straight bamboo poles
Unstable at high elevations	Stable at low elevations (due to the continuous decreasing of the diameter of the pole)
Materials are available in the market	Difficult to find proper long bamboos with low weight and straight trunk

4. Conclusion

Modified height adjustable coconut plucking pole has been successfully developed. It would be a very important tool for harvesting nuts from coconut palms. The conventional bamboo sticks could be replaced with this plucking pole. This could be enhanced the comfort and safety of the operators. This could be used for a large coconut plantation as well as small-scale home gardens. Finally, bamboo poles could be replaced with the NERDC developed pole.

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References

[1] Jayalath K.V.N.N., Pathiraja P.M.E.K., Jayasinghe -Mudalige U.K. and Fernando M.T.N., "An Empirical Investigation on the Effect of Land Size on its Productivity of Coconut Plantations in Sri Lanka", *COCOS*, 2010: 19: pp. 67-75.

[2] Alonge A.F. and Adetunji W.B., "Properties of Coconut (*Cocos nucifera* L.) Relevant to Its Dehusking", *Journal of Agricultural Science and Technology*, 2011, pp. 1089-1094.

[3] Mani A. and Jothilingam A., "Design and fabrication of coconut harvesting robot: COCOBOT", *International Journal of Innovative Research in Science, Engineering and Technology,* Vol 3 (3)

[4] Mohankumar A.P., Anantha Krishnan D. and Kathirvel K., "Development of ergo refined coconut tree climbing device" *African Journal of Agricultural Research, 2013,* Vol. 8(44), pp. 5530-5537

[5] Pathiraja P..E.K., Fernando M.T.N., Abeysekara A.W.A.D.R. an Subasinghe S.D.J.N. "An Assessment ofLabour Availability in Major Coconut Growing Areas in Coconut Triangle", *COCOS*, 2010: 19, pp. 13-26