

Pre and Post - Harvest Losses of Cashew (*Anacardium occidentale* L.) in Batticaloa District, Sri Lanka; Preliminary Investigation of the Causes

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Abstract

The cashew nut industry has great economic importance in developing countries like Sri Lanka, and in the local and global market. However, the market price per kilogramme of the nuts reveals, the demand for cashew nut and the gap between need and the production. Though, Batticaloa is one of the major districts for cashew production in Sri Lanka, no studies have been undertaken to estimate the postharvest losses and the causes of such losses. Hence, a survey was conducted to find out the possible reasons for pre and post-harvest losses of cashew nut and cashew-apple in Batticaloa district. The survey was conducted in five Divisional Secretariat (DS) with 95 individual questionnaires. The semi-structured questionnaires were carried out through opportunistic non-random sampling (Convenience sampling) method, interviewing cashew farmers, cashew nut and apple sellers. Key informant interviews and field verification were also conducted during this study. Descriptive statistics and the one- way ANOVA were used to analyse the data, statistically. The study revealed that the average production of cashew nut /tree/year is 8.63 kg. The unorganized orchards, poor cultural practices, old heterogeneous population of trees and poor or low yielding varieties are some of the major reasons for poor yield. Also, 15% of loss occurs due to the natural enemies, including parrots, bats etc. Further, the results showed that poor harvesting, drying and storing practices also contribute to the postharvest losses. The survey revealed that the majority of the farmers discard the cashew apple after collecting the nuts. Hence, awareness on management of cashew plantations and proper pre and post-harvesting practices are some of the vital aspects to enhance the cashew industry. In addition, improve the value-added products of cashew apple could also lead to have better economic returns to the local industries.

Kew Words- Cashew Nut and Apple; pre and postharvest management practices; value-added products

1. Introduction

Cashew (*Anacardium occidentale* L.), is an important tropical cash crop and is commonly referred to as ‘Wonder nut’. The crop is a member of the family *Anacardiaceae* with the natural order Sapinales. It is an evergreen perennial tree (Ganesh *et al.*, 2015; Muthu Kumar *et al.*, 2015, Mandal, 2000; Dendena and Corsi, 2014). The nut is the real fruit from the cashew tree. The cashew apple (peduncle) is a pseudo-fruit, and nut is attached to it (Das and Arora, 2017).

The cashew is also a multipurpose crop and has great economic importance to the emerging countries like Brazil, Guinea Bissau, Ghana, Mozambique, Nigeria, Philippines, Tanzania, India, Vietnam and Sri Lanka (Adeigbe *et al.*, 2015). The production of cashew can solve the economic, social and environmental problems in the world. It is economically grown for its nut, apple and wood. From the nut, it produces the roasted kernel snacks, kernel oil, cashew nut shell liquid, and from the apple: juice, jam and alcohol. The wood is used for the furniture and fishing boats (Adeigbe *et al.*, 2015; Balogoun *et al.*, 2016). The cashew apple considered as a by-product of the cashew nut industry also as a waste. As well, 10-15kg of cashew apple can be obtained as a by-product for each of 1kg of nut. However, the majority of the cashew apple production is lost or underutilized. (Das and Arora, 2017; Runjala and Kella, 2017; Honorato *et al.*, 2007). However, there is a high demand for the cashew nut (kernels) in the world market especially as the nut snacks, due to desirable nutritional and sensory attributes. The cashew is with protein (21.2 %), carbohydrates (22 %), fat (47 %), amino acid and minerals, which are not regularly found in the daily meal. It also provides 575 kcal of energy per 100 g (Das *et al.*, 2014; Karthickumar *et al.*, 2014; Ogunsina, 2013).

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It was found that cashew kernels have ability to a reduced the risk of cardiovascular disease and mortality, risk of metabolic syndrome, diabetes, risk of depression, weight gain and obesity (Adeigbe *et al.*, 2016; Rico *et al.*, 2016). However, attention should be made to the cashew apple as well.

The cashew apple also consists of a significant amount of minerals, such as copper, zinc, sodium, potassium, calcium, iron, phosphorous and magnesium. Besides, cashew apple rich with vitamin C. Nevertheless, unlike cashew nut, the apple is not well recognized in the consumer market (Das and Arora, 2017; Akinwale, 2000).

The cashew is native to South America and during the early Portuguese settlers; the plant is introduced to Sri Lanka from Brazil, in the 16th century. Thereafter, it is spread as a dryland crop in the drier part of the island and now it has become an important agricultural crop and currently grown all the districts. However more than half of the cashew cultivation belongs to the drier part of the island (Monteiro *et al.*, 2017; Dendena, and Corsi, 2014; Jayasekera and Jayasekera, 2003; Abeysinghe *et al.*, 2003).

According to the annual report and account of Sri Lanka Cashew Corporation (2016), cashew is grown in 142608 acres (88% of lands have belonged to cashew smallholdings) in the island and earned Rs. 174.06 million by exporting 105.66 metric tons of value-added cashew kernel. In Sri Lanka, more than half of the cashew cultivation is carrying out in the dry zone. Puttalam, Kurunegala, Anuradhapura, Mannar, Hambanthota, and Batticaloa are the areas where the cashew cultivation is mainly extended (Ginigaddara *et al.*, 2016).

There is higher acceptability on the global market for Sri Lankan cashew kernels due to higher taste, as well for size, and even for the colour. The product also has extended local market opportunities for the farmers. However, Sri Lanka does not have enough capacity to fulfil this demand. Yet, the production is fulfilling 50% of local market requirements. Hence, it should be to increase the productivity of cashew to satisfy the local and the world market. However, post-harvest losses (due to lack of proper marketing system and poor storage facilities etc.) higher labour cost and seasonality in production become challenges to Sri Lanka to satisfy the world market. (Sri Lanka Cashew Corporation: Annual report and Account, 2015; Athapattu *et al.*, 2013).

District Batticaloa, located at the Eastern part of Sri Lanka and after the thirty years civil war of the area, the government has taken several steps to improve the cashew production in the district (Sri Lanka Cashew Corporation: Annual report and Account, 2015). The crop has significant characters like drought resistance and adaptable to poor soil conditions (Gyedu-Akoto *et al.*, 2014). Hence, improving the cashew production in Batticaloa will certainly be one of the important factors in the income generation of the local community of this district. In this study, we have assessed the major causes of postharvest losses of cashew in Batticaloa district and the challenges, faced by the community to overcome the pre and post-harvest losses of cashew nut and apple in increasing the yield, obtaining annually.

2. Materials and Methods

The field survey was conducted during the cashew production season by covering five Divisional Secretariat (DS) divisions, named Manmunai North, Eravur Pattu, Eravur Town, Koralai Pattu South and Manmunai Pattu, Batticaloa district, Sri Lanka (Fig. 3.1A). The survey was conducted by means of opportunistic non-random sampling (Convenience sampling) method by interviewing 65 of cashew farmers. Further, Key-informant interviews, local market visits, and field verification conduct to gather the necessary information. Overall relevant information were collected through questionnaires during this study. Semi-structured questionnaires were carried out in order to gather the information about the pre and post-harvest practices of cashew nut and apple, including the annual income and yield vary with years, drying method and drying period, storing method, and harvesting method, etc. The data were analyzed with the help of descriptive statistics and the one- way ANOVA. Statistical analysis was carried out using Minitab 14.0 (version 14) for windows.

3. Results and Discussion

3.1. Cashew Nut

Cultivation of Cashew in Batticaloa district is predominantly carried out by small-scale farmers. The mature nut (Fig.3.1B) is highly favoured by the collectors or the buyers. The kernel (3.1C) is sold average at Sri Lanka Rupee (LKR) 2500-3000 per kilogram (kg). The industry also responsible to give significant profit to the sellers and according to the respondents, it's about LKR 25,000- 50,000 (average) per month. Also, the average income for the farmers by selling nuts recorded as about LKR 1900 per tree/ season during the study period.

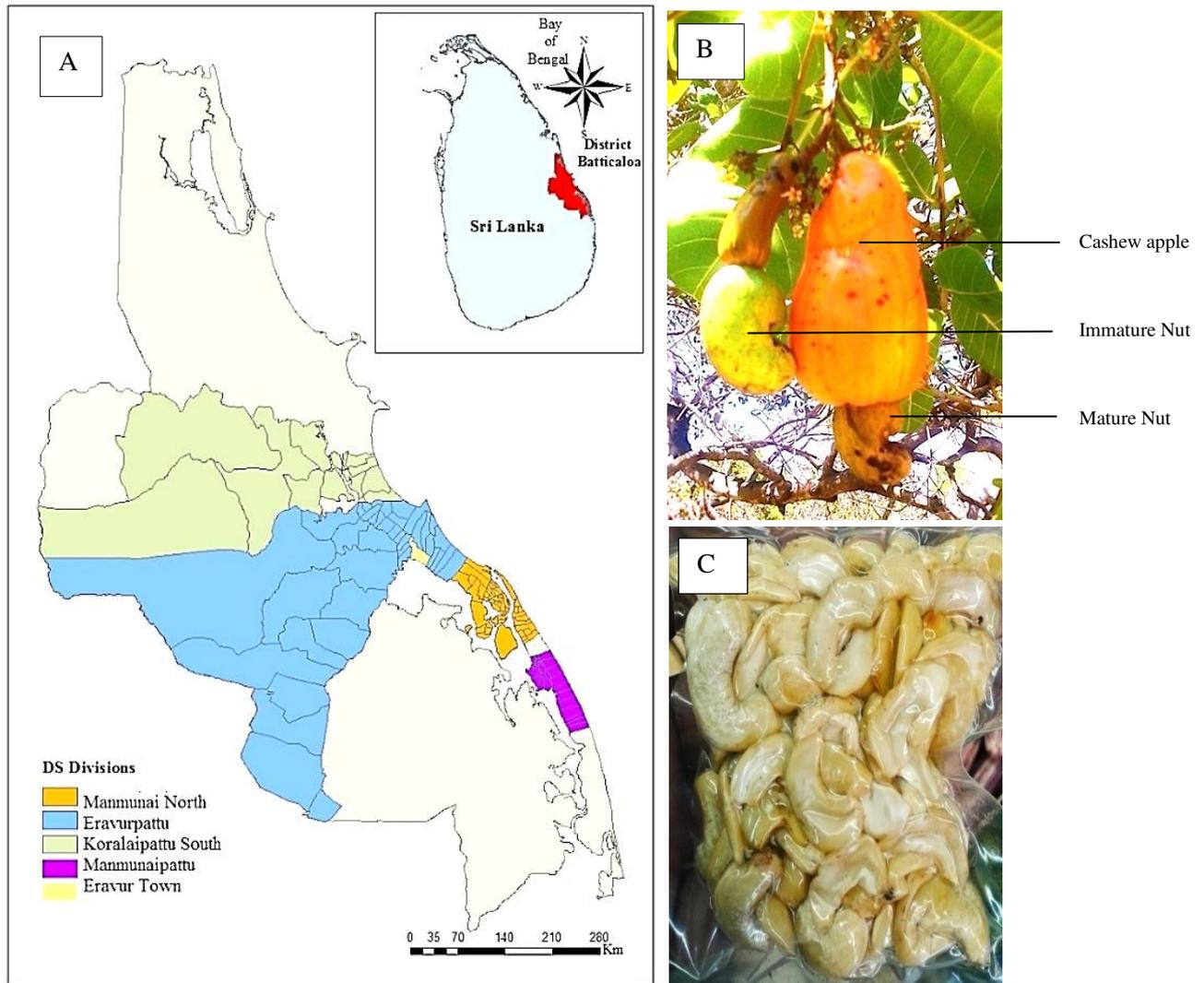


Fig.3.1.A. Study area. B. Cashew nut and apple. C. Packed cashew Kernels (Peeled)

However, poor pre and post-harvesting practices used by farmers have a negative impact on the quality of the kernel. Process of proper drying is important to preserve the nuts in next post-harvest chains such as storage, transportation, and processing. Cashew has about two months of harvesting period and has only one season per year (Gyedu-Akoto *et al.*, 2014).

Questionnaires revealed that 44.5 % (Fig.3.2A) of the farmers are plugged raw nuts by using crooks. 37 % of farmers are harvested (nuts) by shaking the tree branches and picking fruits after fallen down on to the ground. While 16.75 % of farmers are harvested by hand plugging from the tree. However, another about 1.75 % of farmers are harvested by ground picking.

However, the most accepted method of cashew nut harvesting is collecting nuts as dropped from the tree after the fully ripe of the whole fruit. The freshly fallen fruit need to be collected as soon as possible (Dendena and Corsi, 2014).

Besides, harvesting of cashew nuts are carrying out as a daily practice by some of the farmers. Harvesting of nuts on a daily bias is important to minimise the rodents, birds, and thieves impacts on cashew harvest.

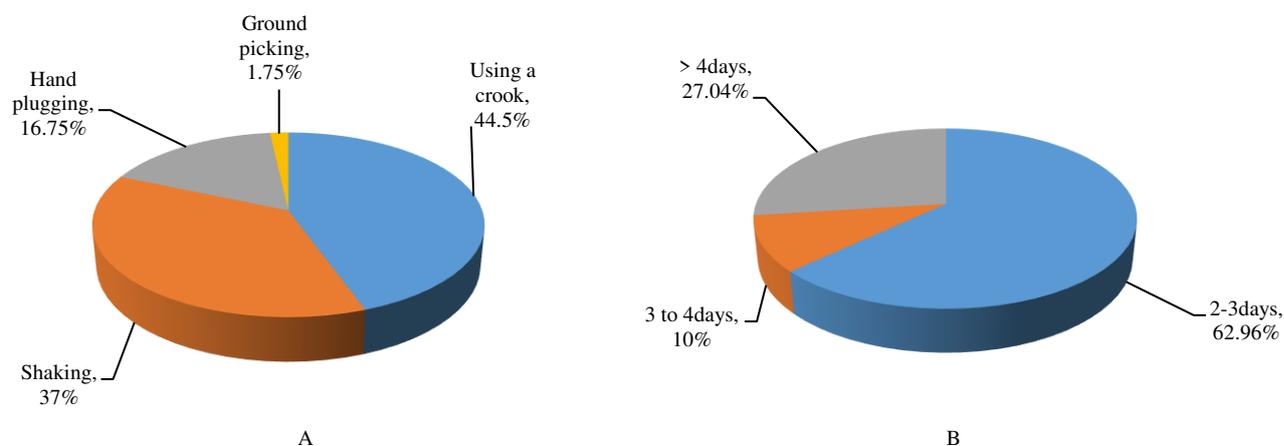


Fig.3.2. A. Harvesting methods and B) drying practices (duration) of cashew nut.

Drying of cashew nut is one of the very important practices in the post-harvest chain. Proper drying of nuts immediately after harvesting is necessary to retain the flavour and quality of the kernels (Gyedu-Akoto *et al.*, 2014).

Majority of farmers are (85.70%) carrying out the drying practices before they sell the nuts. Out of them, only 62.96% are carrying out proper drying practices, 2-3 days (Fig.3.2B). However, the rest of others (14.30 %) does not practice drying at all. This is due to the frequent visit of cashew collectors to buy the harvest and hence farmers are selling their harvest without drying.

Drying of cashew nuts is done by spreading out it on mat/bags or cement floor. The majority (78.84 %) of farmers are used mat/bags to dry the nuts and rest of others are practised the drying on the cement floor. In addition, repeated drying also carried out by the sellers' level. Drying of cashew nuts after harvest for 2-3 days is essential to reduce the moisture from 25% to 8 - 9%. However, by proper drying of nut into 10-12% in the post-harvest chain is critical to avoid the damage of cashew kernel from mould or bacterial attack or enzyme action (Mohod *et al.*, 2011; Gyedu-Akoto *et al.*, 2014; Eang and Tippayawong, 2018; Azam-Ali, and Judge, 2001). Nevertheless, proper storage of dried nut also most commonly not practised in the study area. As well as, polypropylene bags (fertilizer sacks) are commonly used to store the nuts. Besides, the majority of the respondent (94%) stored cashew nut inside the polypropylene bags and then the stack is placed on the bare floor without having the aid of raised (wooden) platform. Stack on the raised wooden platform is essential to prevent moisture from being drawn from the floor to the cashew nuts (Azam-Ali, and Judge, 2001).

The references indicated that the average harvested cashew yield per a tree /season is lower than, like countries such as Vietnam and India gain, 10 -15 kg per a tree /season (Sri Lanka Cashew Corporation: Annual report and Account, 2015). The present study reveals that there is a significant difference ($p < 0.05$) in the yield within the study area. The average yield ranges between 2.78 to 11.24 Kg / tree/year in the study area and overall average production of cashew nut /tree/year is 8.63 kg.

The study revealed that adverse climatic condition (heavy rainfall) during the fruiting season leads to the loss of cashew yield. The results revealed that about 25 % of dry weight losses caused due to the unexpected rain and contributes to the losses in the total income of this area. It was noted that after the processing of 5kg raw nut yields in 1kg of the kernel. Thus, 6.25kg of raw nut needed to obtain 1kg of kernel due to the dry weight loss due to the change of climate condition.

However, the results revealed that many other factors also lead in lowering the yield than the potential expectation, in the study areas. It was reported that the, well trained (pruned) cashew trees can give a higher yield (Fig.3.3). Evidence showed that such trees could yield up to about 20kg of cashew nut per season.

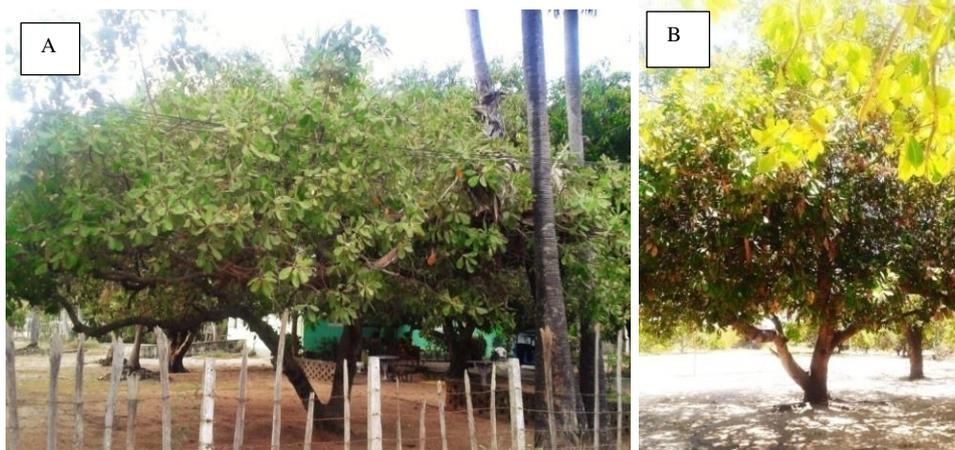


Fig.3.3. Well trained cashew plant and untrained cashew plant in the study area.

The majority of Cashew farmlands are in an unorganized manner with inappropriate spacing. It also found that the majority of orchards consist of old heterogeneous population trees, poor and low yielding varieties and originated from unknown pedigree stocks or poor-quality seeds. Such traditional varieties are responsible to yield small-sized nut too. The farmers at the area are also hesitated to replace their traditional cashew trees with new improved varieties.

Cashew plant shows a stable harvest from 8 years of age and more commonly between 12 and 14 (Dendena, and Corsi, 2014), and reduce their yield with the age of 30 to 35. However, Eradasappa and Mohana (2016), indicated that the inadequate pollination also causes low productivity of cashew nut.

The present study revealed that the heterogeneous cashew varieties, grown in the area are responsible for the bigger cashew nut and having a low preference by the whole sellers owing to poor taste kernel and hence preferred to have the medium-sized seeds (Fig.3.4). Adeigbe *et al* (2015), highlighted that trees, which are bearing heavier nuts, may responsible for the lower-yielding than lighter nut-bearing trees.



Fig.3.4. Different sizes of cashew nuts. A) Small sized traditional variety. B) Standard sized medium seed. C) Large seed.

3.2. Pest and Animal effect

Stem and root borer (*Plocaederus ferrugineus* L.) are coleopteran insects that are attacking the root and the stem of the cashew and causes yield reduction of crops (Senguttuvan, and Mahadevan, 1999; Sahu and Sharma, 2008). The incident of cashew Stem and root reported at the area is about 4 %. The animals and birds are also responsible

to cause 15% of harvest losses. Rodents (bats and Squirrel) and, birds (parrots) are some of them. However, attack by parrots is a major problem on the immature nuts.

3.3. Cashew apple

Evidence indicated that cashew apples are being either thrown or sold at very low price in the study areas, after collecting the nuts from the fruits. However, due to the lack of information, losses could not exactly be quantified here. However, 83% of farmers indicated that they do not consider the cashew apple as a value product. They do not much prefer the consumption of raw cashew apple due to the acidic nature and potentiality to have allergic reactions (personal interviews).

17% of farmers give attention to the use of cashew apple for an extra income (Fig.3.5.). They sold out the cashew apple for the collectors for the low price (about LKR 1 per fruit). Harvesting of the cashew apple is mostly done by hand plucking or with the help of hooked long poles by minimizing the fruit falling on to the ground. However, shaking the branches to obtain cashew apple is also a common practice at the farm level.

Results indicate that 42% of cashew-apple is being lost mainly due to the inappropriate harvesting practices. Unlike, cashew nut harvesting the cashew apple need to be harvested without fallen on to the ground. As well, it is better not to wait until the fallen down the fruit by naturally (Dendena and Corsi, 2014). Damage of cashew apple due to the birds and rodents are also another causes for quality loss. Other than the selling of raw cashew apple, farmers also practising preparation of cashew-apple jam and syrup. However, these preparations are not very much popular and mostly used by the farmers for domestic uses by themselves.



Fig.3.5. A and B. Preparation of cashew apple syrup, C. Use of cashew apple as a fertilizer. D) Roadside selling of cashew apple.

4. Conclusions

Improve the production of cashew nut is vital to increase the income of the country. As well, the improvement of cashew yield is important to increase the livelihood security of the rural cashew farmers in the Batticaloa district. Overall production of cashew nut in the Batticaloa district is in below the potential expectation. This is due various reasons, such as unorganized orchards, poor cultural practices, old heterogeneous population of trees, poor or low yielding varieties, poor harvesting and post-harvesting practices, changes on the climate condition and the damages caused by birds and other animals etc. It needs to improve the knowledge and awareness of cashew farmers on cashew plantation and post-harvest practices. Old and traditional varieties in the area should be replaced with the better yielding new varieties. In addition, it needs to be reduced the wastage of cashew apple by introducing and popularizing value-added products. Government and the private sector have a huge responsibility to improve the cashew production in the district.

References

- Abeyasinghe, D.C., Sangakkara, U.R., and Jayasekera, S.J.B.A. (2003). Intercropping of Young Cashew (*Anacardium occidentale* L.) and Its Effects on Crop Productivity and Land Utilization. *Tropical Agricultural Research*, 15, 10-19.
- Adeigbe, O. O., Adewale, B. D., Muyiwa, A. A., Olasupo, F. O., Olaniyi, O. O., Adenuga, O. O., Williams, O. A., and Aliyu, O. M. (2016). Quantitative Descriptors of Cashew Nut Categories in Nigeria: Providing Indices for Superior Nut Selection. *ARPN Journal of Agricultural and Biological Science*, 11 (4), 142-148.
- Adeigbe, O. O., Olasupo, F. O., Adewale, B. D., and Muyiwa, A. A. (2015). A Review on Cashew Research and Production in Nigeria in the Last Four Decades. *Scientific Research and Essays*, 10 (5), 196–209.
- Akinwale, T. O. (2000). Cashew Apple Juice: Its Use In Fortifying The Nutritional Quality Of Some Tropical Fruits. *European Food Research and Technology*, 211(3), 205–207.
- Athapattu, A. M. H. K., Fernando, A. P. S., Ginigaddara, G. A. S., and Wijethunge, P. M. A. P. K. (2013). Cashew (*Anacardium occidentale* L.) Market Channel Analysis in Puttalam District, Sri Lanka. *Undergraduate Research Symposium*, 201, 19.
- Azam-Ali, S., and Judge, E. (2001). Small-Scale Cashew Nut Processing. *Food and Agriculture Organization of the United Nations*, (Schumacher Centre for Technology and Development), 1–70. Retrieved from: <http://www.fao.org/3/a-ac306e.pdf> (Accessed on 12 august 2019).
- Balogoun, I., Ahoton, E.L., Saïdou, A., Bello, O.D., Ezin, V., Amadji, G.L., Ahohuendo, B.C., Babatoundé, S., Chougourou, D.C., and Ahanchede, A. (2016). Effect of Climatic Factors on Cashew (*Anacardium occidentale* L.) Productivity in Benin (West Africa). *Journal of Earth Science and Climatic Change*, 7 (1), 1-10.
- Das, I., and Arora, A. (2017). Post-Harvest Processing Technology for Cashew Apple – A Review. *Journal of Food Engineering*, 194, 87-98.
- Das, I., Shah, N. G., and Kumar, G. (2014). Cashew Nut Quality As Influenced By Microwave Heating Used for Stored Grain Insect Control. *International Journal of Food Science*, 2014, 1–7.
- Dendena, B., and Corsi, S. (2014). Cashew, From Seed to Market: A Review. *Agronomy for Sustainable Development*, 34,753–772.
- Eang, R., and Tippayawong, N. (2018). Optimization of Process Variables for Drying of Cashew Nuts by Superheated Steam. *Cogent Engineering*, 5 (1), 1–13.
- Eradasappa, E., and Mohana, G. S. (2016). Role of Pollination in Improving Productivity of Cashew – A Review. *Agricultural Reviews*, 37 (1), 61-65.
- Ganesh, S., Kannan, M., and Jawaharlal, M. (2015). Cashew Industry - An Outlook. *ISHS Acta Horticulturae*, 1080, 89–95.
- Ginigaddara, G.A.S., Fernando, A.P.S., and Wijethunga, P. M. A. P. K. (2016). Technical Feasibility of Coconut (*Cocos nucifera*) Cashew (*Anacardium occidentale*) Intercropping System in Puttalam District, Sri Lanka. *International journal of Advanced Scientific Research and Management*, 1 (10), 79-85.
- Gyedu-Akoto, E., Lowor, S. T., Assuah, M., Kumi, W., and Dwomoh, E. A. (2014). Assessment of Post-Harvest Handling Effects on Quality of Cashew Nuts and Kernels in Ghana. *Journal of Scientific Research and Reports*, 3 (7), 953–965.
- Honorato, T. L., Rabelo, M. C., Gonçalves, L. R. B., Pinto, G. A. S., and Rodrigues, S. (2007). Fermentation of Cashew Apple Juice To Produce High Added Value Products. *World Journal of Microbiology and Biotechnology*, 23 (10), 1409–1415.
- Jayasekera, S. B. J. A., and Jayasekera, N. E. M. (2003). *Cashew Cultivation: Principles and Techniques*. Sri Lanka Cashew Corporation. Nugegoda.
- Karthickumar, P., Sinija, V. R., and Alagusundaram, K. (2014). Indian Cashew Processing Industry-An Overview. *Journal of Food Research and Technology*, 2 (2), 60-66.
- Mandal, R. C. (2000). Cashew Production and Processing Technology. *Annis Offset Printers*. New Delhi.
- Mohod, A., Jain, S., and Powar, A. G., (2011). Cashew Nut Processing: Sources of Environmental Pollution and Standards. *BIOINFO Environment and Pollution*, 1 (1), 5-11.
- Monteiro, F., Catarino, L., Batista, D., Indjai, B., Duarte, M. C., and Romeiras, M. M. (2017). Cashew as a High Agricultural Commodity in West Africa: Insights towards Sustainable Production in Guinea-Bissau. *Sustainability*, 9 (9), 1- 14.
- Muthu Kumar, S., Ponnuswami, V., and Padmadevi, K. (2015). Cashew Industry in India. *ISHS Acta Horticulturae*, 1080, 97-10.
- Ogunsina, B. S. (2013). Crackability and Chemical Composition of Pre-Treated Cashew Nuts Using a Hand-Operated Knife Cutter. *Agricultural Engineering International: CIGR Journal*, 15 (2), 275–283.
- Rico, R., Bulló, M., and Salas-Salvadó, J. (2016). Nutritional Composition of Raw Fresh Cashew (*Anacardium occidentale* L.) Kernels from Different Origin. *Food Science and Nutrition*, 4 (2), 329–338.
- Runjala, S., and Kella, L. (2017). Cashew Apple (*Anacardium occidentale* L.) Therapeutic Benefits, Processing and Product Development: An Over View. *The Pharma Innovation Journals*, 6 (7), 260–264.

- Sahu, K.R., and Sharma, D. (2008). Management of Cashew Stem and Root Borer, *Plocaederus ferrugineus* L. by Microbial and Plant Products. *Journal of Biopesticides*, 1 (2), 121 – 123.
- Senguttuvan, T., and Mahadevan, N. R. (1999). Prophylactic Control of Stem and Root Borer (*Plocaederus ferrugineus*) in Cashew (*Anacardium occidentale*). *Indian Journal of Agricultural Sciences*, 69 (2), 163–165.
- Sri Lanka Cashew Corporation: Annual Report and Account. (2015). Retrieved from: <https://www.parliament.lk/uploads/documents/paperspresented/annual-report-srilanka-cashew-corporation-2015.pdf> (Accessed on 05 May 2019).
- Sri Lanka Cashew Corporation: Annual Report and Account. (2016). Retrieved from: <https://www.parliament.lk/uploads/documents/paperspresented/annual-report-srilanka-cashew-corporation-2016.pdf> (Accessed on 05 May 2019).