A Review on the Status of Rubber Plantations in Cambodia

Im Hol1*, Serey Mardy3
1National University of Cheasim Kamchaymear, Graduate School, 2Svay Rieng University, Faculty of Agriculture

Corresponding Author: Im Hol imholtorn@gmail.com

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Abstract
The rubber tree (natural rubber) is a tropical crop around the world. In Cambodia, rubber is one of the most popular agro-industrial crops introduced since the 1910s. This study review article aims to demonstrate the methods for planting and harvesting techniques in rubber plantations. Cultivation is the most important factor in the rubber sector, and planting is done during June and July. Moreover, selecting varieties of clonal rubber is the best way to improve high production, high initial vigor, tolerance to climate change, pests, wind damage, and diseases, and to be a good secondary characteristic. In addition, harvesting techniques are vital elements in the status of rubber plantations. So, improving the methods of cultivation and the techniques of harvesting is very important in order to get a high amount of rubber production.
INTRODUCTION

The rubber tree (natural rubber) is a tropical crop around the world. Rubber is indigenous to the Amazonian tropical rainforests of central South America. It thrives in regions with average yearly temperatures between 26°C and 28°C and rainfall between 1800 and 2500 mm (Masson & Monteuuis, 2017). Marginal regions tend to be drier or colder. Some traditional places will become less advantageous due to drought or excessive precipitation as a result of climate change (Thaler et al., 2021), whereas warming will make some marginally cooler areas more beneficial (Gohet et al., 2021). It also has a life span of around thirty years, can grow to a height of eighteen to twenty meters, and can withstand a water table that is 100 centimeters below the surface (Malaysia Rubber Board, 2009). It can grow on deep, hard soil of loam texture with free drainage. More than 5,000 products employ natural rubber as a strategic component (Pinizzotto et al., 2021). Currently, this region—which includes Thailand, Vietnam, Indonesia, India, China, and Malaysia—produces 89% of the rubber consumed globally, with Thailand and Indonesia accounting for 60% of this total. In Cambodia, rubber is one of the most popular agro-industrial crops introduced since the 1910s (GDR, 2022). Recently, rubber has been one of Cambodia’s most important crops, and after rice paddies, it is predicted to be the second-biggest source of income (Bandumula, 2018). Along with the privatization of former state rubber plantations, the price of rubber in the international market has risen steadily, and at the same time, the Royal Government has granted economic land concessions to local and foreign investors, boosting the natural rubber industry in Cambodia and the agro-industry. And family rubber plantations have started to grow and have made energetic progress in cultivating, harvesting, and exporting rubber products. Up to the end of 2022, Cambodia has a total land area of 404,578 hectares of rubber plantations; industrial rubber plantations cover 239,422 hectares (59.18%), and smallholder rubber plantations cover 165,156 hectares (40.82%). Furthermore, the tapping area was 315,332 hectares, and the maintenance area was 89,246 hectares, with a production of around 382,000 tons per year (GDR, 2022). With the increasing demand for natural rubber production either in the local or global market, the topic "A Review on the Status of Rubber Plantations in Cambodia" was studied to understand the situation of rubber cultivation and harvesting in Cambodia.

LITERATURE REVIEW

Rubber Plantation

Cultivation is the most important factor in the rubber sector, and planting is done during June and July, depending on the amount of rainfall. Furthermore, the wind is seen to be a desirable secondary attribute. Choosing a rubber clonal is the best approach to increase the high output, high initial vigor rate after opening, and tolerance to climate change and illnesses (George et al., 2002). In addition, the tapping panel dryness (brown bast) incidence is low and the response to stimulation is good. The planting materials are such as cut-back polybag, 1-whorl polybag, 2-whorl polybag, and root trainers. In the case of planting with a 1-whorl polybag plant (CRRI, 2005), a hole of the same size as
the 1-whorl polybag plant has to be dug in the center of the refilled pit. The 1-whorl polybag needs to be inserted into the opening that has been made in the bag's bottom. To prevent disturbing the soil surrounding the plant, a vertical incision is made in the bottom half of the polybag, leaving a blank hole that is filled with soil. The polybag is then carefully removed. Usually, the density of rubber trees per hectare is 555 trees that can be planted (CRRI, 2005).

Varieties of rubber in Cambodia: GT1, PB217, PB235, PB260, PB280, PB310, PB314, PB330, RRIM600, RRIM712, IRCA18, IRCA41, IRCA109, IRCA111, IRCA130, IRCA230, IRCA317, IRCA331, RRIC100, RRIC101, RRIC110, RRIC121, PR107, PR255, PR261, PR300, PR303, PR306, RRIV2, RRIV4, KV4, PMB1, FRD5788, FRD5665, FDR624, CDC56, CDC312, AF261, RRIT251, GT12, and GT19, etc. Among many clones, only two varieties belong to the Cambodian clones, such as GT12 and GT19 (CRRI, 2018).

The future of rubber plantations in Cambodia will depend on balancing economic benefits with environmental and social considerations. By adopting sustainable practices and addressing the concerns mentioned above, the industry can play a positive role in Cambodia's development.

Process of Rubber Plantation

In the process of planting, there are a few steps:

Planting Pattern

There are two kinds of planting methods, such as single row and double row; the single row is (3m * 6m = 555 trees/ha), and the double is (13m + 3m x 2.25m = 555 trees/ha) (CRRI, 2018).

Planting Materials

There are four types of planting materials: cut-back polybag, 1 whorl polybag, 2 whorl polybag, and root trainer. In Cambodia, the 1 whorl polybag is a very popular one to be selected.

Maintenance

After planting for one or two months, replacement is done, and the 2-whorl polybag is to be selected. In addition, fertilizer is a very important element for keeping rubber healthy, and it should be applied two times per year during June and September (CRRI, 2005).

Diseases

Rubber, like other crops, has been affected by many diseases, such as leaf diseases (12), stem and branch diseases (7), and root diseases (12) (RRII, 2011).

METHODODOLOGY

Since this is a review study, the research results are mainly based on the published information collected from published materials such as scientific journals, books, statistics, newspapers, and online documents. Descriptive statistics are the principal analytical method used in this article to reflect the
status of rubber plantations in Cambodia. The result also discusses the rubber tapping system management which is very essential both for small-scale rubber plantations or industrial-scale plantations.

RESULTS AND DISCUSSION

Tapping System Management

Rubber tapping system management refers to the practices and techniques used to optimize the extraction of latex from rubber trees (Hevea brasiliensis) while maintaining the health and productivity of the trees.

Standard of Tapping

Rubber trees are not tapped until they reach a standard diameter. It is commonly recognized that rubber tree development is inhibited by tapping. Therefore, it's essential to keep the trees under tap growing at a suitable rate to get a consistent production over several years. If trees are tapped before attaining the specified girth, the yield obtained will not be economical in the long run (Abraham & Hashim, 1983). Hence, a standard for capability has been fixed after considering all these aspects. The standard is different for seedlings and budding owing to the difference in the anatomy of the bark and the shape of the trunk. When the girth is 50 cm at that height, seedling trees are opened. When the girth is 50 cm at a height of 90 cm, it is usually best to open at that level. However, 100 cm is the height at which successive panels on a seedling tree must be opened (Abraham & Hashim, 1983).

When bud trees reach a height of 125 cm from the bud union and a girth of 50 cm, they are deemed capable. The panels that follow are likewise opened at the same height. This height has been fixed after considering the average height of tapers and the convenience of tapping. Although opening for tapping at 175 cm did not show much variation in yield (Abraham & Hashim, 1983), it resulted in excessive wounding and spillage. In Thailand, when the girth measures 50 cm at a height of 150 cm from the bud union, the budded tree is ready for tapping (IRRDB, 2003).

Marking

It is advised to start tapping when 70% of the trees in a chosen area reach the standard tapping girth. Usually, it takes six to seven years to get to this point. On the other hand, the immaturity phase can be shortened by using sophisticated planting materials, including polybag plants. To help with an efficient tapping operation, the panel is marked on the trees that have been chosen for tapping using a template and marking knife, parallel to the contour terrace or planting line. A flexible metal strip, 16 to 18 cm broad for seedlings and 20 to 23 cm wide for blossoming, serves as the template. Seedlings and budding require different templates, which should be designed such that the cut's slope when marking is 25° for seedlings and 30° for blossoming. The front channel line, a vertical line, is drawn once the panel's location has been determined. The opening height is marked on this line. The industry standard is shafting spiral tapping, where the diameter of the tree's haft at the aperture is measured.
Marked on the haft spiral point above the opening height is another vertical line known as the back-channel line. The tapping line is cut and a few guidelines are marked through the grooves with the help of the template positioned between these two lines at the opening height, guaranteeing a high left to low right. The spout and cup hanger are fixed after the guidelines have been marked. Every year, before the start of tapping, subsequent criteria are noted.

**Tapping Practices**

Rubber trees are harvested by periodically removing a thin shaving of bark from the surface of the tapping cut. Tapping is the method of extracting latex from the bark of these trees; it is thought of as a controlled injuring of the bark. From low left to high right, the latex vessels in the bark are orientated at an angle ranging from 2 to 7° from the vertical. Moreover, a considerable reduction in the maximum number of latex vessels would result from cutting the stem from the high left to the low right.

On seedling trees, tapping cuttings should be rather thick and slope at a 25° angle. Given that budded trees' bark should slant 30 degrees horizontally when tapping approaches, the base of the tree, a too steep cut results in a waste of bark, and an overly flat cut cause latex to overflow (spill). Every year, the slope needs to be marked using the proper templates. Slopes have not increased yield in any way except from the advice given (de Jonge, 1919). The tapping cut ought to trend inward in the direction of the cambium. A lack of such a slope may also result in spills.

**Depth of Tapping and Bark Consumption**

Tapping is a highly skilled operation. The tapping cut should be sufficiently deep but should not injure the cambium. A proficient taper develops this ability via repetition and will tap to the ideal depth within 0.5 mm of the cambium to maximize yield without damaging the cambium. Shallow tapping causes a significant loss of agricultural yield. At each tapping, it is sufficient to remove a tiny layer of bark to free the plugs of coagulated latex at the cut ends of the latex vessels. An increase in bark shaving illness does not result in a further rise in yield (de Jonge & Warriae, 1965). However, a significantly thicker bark shaving needs to be removed with each tapping under low-frequency tapping systems. Even the removal of bark along the whole length of the tapping cut up to the correct depth is important. Average annual bark consumption on half spiral cuts of different frequencies is 20–23 cm for every alternative day, 16–18 cm for every three-day interval, and 14–16 cm for every four-day interval (de Jonge & Warriae, 1965). Activity in the cambium is what causes regeneration of the bark. The innate genetic qualities of the planting material, soil fertility, environment, tapping mechanism, depth and quality of tapping, planting density, frequency of disease, etc. all affect the rate and extent of renewal.
**Tapping Times**

Starting early in the morning is essential since tapping after midday will result in less latex output because of higher transpiration and decreased turgor pressure. The summer is when this decrease is most noticeable. Headlights are a useful tool for pre-down tapping. According to RRISL (2001), the task’s start and finish points are often adjusted regularly to let a similar amount of latex flow from every tree in the block. In Cambodia, the tapping system is $1/2 S d/3$, and the rubber farmers initially tap at five to six a.m. in the early morning. They collect latex production from 11 a.m. to 12 p.m., the same time of day, and transport it to the factory for processing to be made into a crumb or rubber smoke sheet (CRRI, 2003).

In Cambodia, the best time for opening new fields for tapping is in March. The trees that are left behind to meet the requirement of standard girth may be considered for opening in September. The tapping cut is opened along the uppermost template marking. The markings below serve as guidelines for subsequent tapping to maintain the slope of the cut and control bark consumption.

**Tapping Task**

The "Tapping Task" is the total number of trees that a tapper is tasked with tapping each day (RRISL, 2001). The topography of the land and the number of stands per hectare are used to determine the task size. The recommendation for tapping tasks varies from 275 to 550 trees; in Sri Lanka, it is 275 to 325; in India, it is 300; and it is 500 in Malaysia, Thailand, and Cambodia. In Vietnam, the task size is 400–500 trees (IRRDB, 2003).

**CONCLUSION**

Rubber cultivation and harvesting play a crucial role in various aspects of our society and economy. The global demand for rubber continues to grow, driven by industries such as automotive, construction, and manufacturing. Rubber plantations, distributed across several countries, contribute significantly to meeting this demand.

The cultivation practices employed in rubber plantations have evolved, incorporating modern techniques and technologies. This has led to increased productivity, improved quality of rubber, and enhanced sustainability. Mechanized harvesting methods have reduced labor requirements while maximizing efficiency. However, rubber cultivation also faces challenges, such as the threat of diseases, pests, and environmental impacts. It is essential to prioritize sustainable practices, promote biodiversity conservation, and mitigate the negative effects of deforestation associated with rubber plantations. Continued research and innovation are necessary to develop disease-resistant rubber tree varieties and environmentally friendly cultivation methods.

Overall, rubber cultivation and harvesting are vital for meeting the global demand for this versatile commodity. By implementing sustainable practices, supporting research and development, and promoting responsible sourcing, we can ensure the long-term viability of rubber plantations while minimizing their environmental impact. The status of rubber plantations is an
ever-evolving landscape, and continued efforts are required to ensure their sustainability and economic significance in the years to come.

FURTHER STUDY
This research still has limitations so further research on the topic still needs to be done “A Review on the Status of Rubber Plantations.”

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