ISSN (Print) : 0974-6846
**Indian Journal of Science and Technology,** *Vol 9(42), DOI: 10.17485/ijst/2016/v9i42/89790, November 2016* ISSN (Online) : 0974-5645

# Tea Waste Management: A Case Study from West Bengal, India

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## Abstract

**Objectives:** The purpose of the present study is to focus on the types of wastages that generated as a byproduct from tea processing industries. Quality and quantities of tea waste and their proper management or waste disposal method were determined in Terai and Duars region of West Bengal. There are very few companies or societies who buy a very little amount of tea waste that does not have any significant impact on the tea waste management as a whole. Lastly, there is a lack of comprehensive and uniform guidelines towards tea waste management in this area. **Methods:** Random cluster sampling technique in selecting 20 study sites, out of the 30 tea factories that are spread in four major tea producing districts namely foothills of Darjeeling, Jalpaiguri, Alipurduar and a part of Cooch Behar were performed. Primary and secondary data are documented during data collection, using questionnaires, interviews, observation and necessary photographs were taken. **Findings:** Authors have attempted to bring out this work to develop some management strategy of tea waste. Our survey report indicated that effective management strategies would improvise socio-economic status of tea garden workers as well as owners by utilizing this waste in poultry and fish feed, garden manure and caffeine extraction. **Applications/Improvement:** Fibers from tea waste can now be converted into different industrially implemented products like low cost absorbent during removal of pollutants from waste water. New technologies are emerged through which factory tea waste might be utilized for the preparation of *n*-triacontanol, which is commercially valuable bio-nutrient and has important growth promoting activities of leaf primordia.

**Keywords:** Disposal Method and Management, Tea Plantation, Tea Waste, West Bengal

## 1. Introduction

Terai & Duars are located in the foothills of the Himalaya and rich in large and small sized tea gardens in both banks of river Tista. Tea plantation is one of the noblest professions in this area due to the favourable climatic conditions. The people of rural ethnic groups of this region are very much dependent on tea gardens for their economy. Tribal women are the major workers who are mainly appointed as tea leaf puckers. Tea is the major prime crop leading to the economy of North Bengal. As a result, most of the other crop fields of North Bengal are being replaced gradually by the tea gardens as it yields higher profit. The cultivation of tea for its commercial purpose is gaining popularity among the farmers in a faster manner. Very recently a large number of tea growers in the Terai and Duars regions of West Bengal have been crumpled by a drastic drop of the prices of green tea leaves

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coming down to Rs. 6 – 7/kg as compared with a normal market average value of Rs. 15 – 16/kg[1,2].

Most of the tea factories do not obey the rules of Tea Board of India regarding the disposal of tea waste. Every tea factory produces a large amount of tea waste, but tea waste buyer is lesser in number in this region. This waste may be the alternative income source for the tea growers as well as the owners of tea factories.

The wastes derived from tea factories are called tea waste. This waste includes discarded tea leaves, buds and tender stems of tea plants. If the tea waste is not disposed properly, it can pollute the environment like soil, water and air[3].

There shall be a minimum volume of tea waste and made tea at the ratio of 2:100 kilograms[4,5]. Before exporting, selling or holding stock of tea waste, it shall be denatured by the admixture of urea not less than five percent, cow dung, slack lime or such other denaturants as may be specified by the Tea Board of India[6]. Mainly the by-product of tea industry is treated as waste, sometimes it is used in caffeine industries for the extraction of caffeine[7]. In some part of the Assam, tea wastes are sometimes used as poultry and piggery feed[8]. In the present study, the various ways for utilization of tea wastes, alternative earning source through selling tea waste and their appropriate management were discussed.

## 2. Methodology

This work is a preliminary work that is generally based on the extensive survey in various garden and tea factories in the study area. The study applied a random cluster sampling technique in selecting 20 study sites, out of the 30 tea factories that are spread in four major tea producing districts namely foothills of Darjeeling, Jalpaiguri, Alipurduar and a part of Cooch Behar. Both primary and secondary data are documented during data collection, using questionnaires, interviews, observation and necessary photographs were taken. Some modern technique has been discussed to analyze or separate the chemical components of tea waste.

## 3. Observation and Discussion

The present study confirms that mainly two types of tea wastes are produced as a byproduct in the tea industry. A little amount of tea waste is purchased by one or two companies for the extraction of caffeine. The rest of the byproducts are deposited in one corner of tea factory (Figure 1) or in the tea garden areas. Decaffeinated tea wastes are discarded, but this byproduct can be used as poultry and pig feed. Tea byproduct has a little effect on the environment. The two types of tea wastes are:

- **Factory Tea Waste (FTW)**

During the tea processing in the factory the fiber portion of leaves is removed and discarded as Tea Waste which also contains some tea leaves and dust. FTW contains tannic acid that is one of the limiting factors for utilization of tea by-product in Poultry and Pigs feed[9].

- **Decaffeinated Tea Waste (DCTW)**

Decaffeinated Tea Waste (DCTW) is the waste available in the Caffeine factories after the extraction of caffeine from Factory Tea Waste. The interesting feature of this industrial waste is that it contains little quantity of tannic acid (0.4–1.0% on a DM basis)[9]. If the DCTW is washed with boiled water, then it becomes good feed for Poultry, Pig and Fishes.

### 3.1 Effects of Tea Waste

Factory tea wastes have a little bit pollution effect on the environment. Caffeine of tea waste is responsible for the acidity of soil and ultimately it effects on the quality of tea.

### 3.2 Method of Tea Waste Disposal

'Disposal of waste' means 'to get rid of waste'. The disposal of waste should be done in a scientific way. There are different methods of tea waste disposal. Some of the important modes of tea waste disposal:

- By selling
- By exporting
- By using the feed for poultry
- By using the feed for fish
- By separating the bioactive chemical components
- By utilizing it in the manufacture of caffeine or instant Tea making
- By using for Bio-nutrient and Bio-fertilizer
- By burning


**Figure 1.** Deposition of tea waster in different places of tea factories: (A) Inside factory shade (B) waste warehouse (C) processing centre.

### *3.2.1 By Selling*

We can dispose the factory tea waste by selling to the caffeine industry. In Siliguri, one industry is present who buys the factory tea waste for extraction of caffeine and they supply it to the pharmaceutical industry.

### *3.2.2 By Exporting*

By exporting one can dispose the factory tea waste in other places where available caffeine industry is present. Assam is one of the states of India where a large number of caffeine industry is present and they are always searching for factory tea waste.

### *3.2.3 Instant Tea Processing*

Tea wastes are used for production of instant tea. Caffeine is separated from tea waste before instant tea manufacture[10]. In the process of production of instant tea from tea waste, excess tannin is also reduced[11].

### *3.2.4 By using Feed for Poultry and Pig*

One can use the factory tea waste after the separation of caffeine. Decaffeinated tea waste has the immense potentiality for the preparation of poultry and pigs' feed. Factory Tea Waste showing the highest level of tannic acid beyond 5% has a deleterious effect on the growth and performances of broiler chicken[9]. Tannic acids possibly act as anti-nutritive factors in broiler chicken, so the existence of tannic acid in tea waste might perturb the growth of those animals[12]. This kind of food also increased the immune response in finishing pigs[13] and increased the egg laying capacity in hens[14].

### *3.2.5 By using the Feed for Fish*

Locally, one can use the decaffeinated tea waste as a fish feed with the mixture of mustard cake and water, as revealed from our survey report. DCTW contains eight times lesser tannic acid content than FTW, so DCTW can be effectively used as fish feed for growth and development.

### *3.2.6 By Separating the Bioactive Chemical Components*

Considering the large scale availability of tea waste in this region, both FTW and DCTW can be used as a source of feed for livestock and poultry after separating the toxic chemical components up to tolerance level. For example, 5% level of tannic acid or phosphorus present in the tea waste showed stress tolerance if used as livestock feed. Fluoride and pesticide residues can also be found in tea waste. Identification of toxic and bioactive chemicals from the waste can be made by using UV-Vis, Fluroscence Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR), Atomic Absorption Spectrometry (AAS) and Atmospheric Pressure Chemical Ionization-Mass Spectrometry (LC/APCI-MS)[15]. The subsequent separation of chemicals from the waste can be made by means of Low Pressure Liquid Column Chromatography (LPLC), Gas Chromatography (GC) and High Pressure Liquid Chromatography (HPLC). Further, Tea waste can be used as a low cost adsorbent for the removal of Cu and Pb from wastewater[16]. Activated tea waste can also be used as a potential low-cost adsorbent for the removal of ρ-nitrophenol from wastewater. The chemical analysis and separation of tea waste can be performed at University of North Bengal, Darjeeling and Tea Research Centre of Tea Board, New Jalpaiguri of this region. Re-processing of tea fiber waste for the production of valuable biological products might be another option of its utilization, because tea fiber waste contains several polyphenols and cellulosic materials as analyzed previously[17]. Recycling of plant fibers obtained from *Calotropisgigantea* through enzymatic hydrolysis of cellulose for bioethanol production has been reported very recently[18]. Also, there are appropriate scientific methods for evaluation of physical and mechanical properties of wood fibers as already implied on *Quercus*, *Fagus*, *Alnus* and *Fraxinus* hardwood plants[19]. For improvement of tea fibers isolated from waste, those attributes might be standardized with functional group modification of biopolymer components.

### *3.2.7 By Utilizing It in the Manufacture of Caffeine or Instant Tea Making*

After the chemical separation, caffeine is extracted from the factory tea waste and utilized in the pharmaceutical laboratory.

### *3.2.8 By using for Bio-nutrient and Bio-fertilizer*

Most of tea factories of this area utilized their tea waste in the plantation area. Due to caffeine, tea waste increases the acidity of soil. But if we mixed the factory tea waste with 5% urea and cow dung for at least 45 days and kept in soil, then it will be converted into a good bio-nutrient and bio-fertilizer. Tea waste also contains significant amounts of *n*-triacontanol[20]. The compound *n*-triacontanol has tea plant growth promoting properties and might also regulate different other physiological properties like the formation of leaf primordial and development of primary leaves[21].

### *3.2.9 By Burning*

In some cases, the factory tea waste can be disposed by burning.

## 3.3 Rate of Tea Waste

There is no fixed rate determined by Tea Board of India for the sale of tea waste. Generally, rupees 25/- to 30/- profit margin could be achieved by selling one kg of tea

waste in this region. In this region a large amount of tea waste is deposited in tea factories and tea growers will be benefited financially by selling it.

### 3.4 Rules and Regulation for Sale of Tea Waste

Tea Board of India (TBI) has mentioned some rules and regulations regarding the tea waste disposal. According to Tea Board of India, no person shall dispose of any tea waste except in the following manner, namely:

- By selling to any person holding a license.
- By exporting through proper channel.

### 3.5 Suggested Protocol for Managing Tea Waste

To prevent damage, losses or contravention of legislation it is very essential to manage waste properly. A suitable protocol of waste management is:

- There should be proper identification, nature and quantity of tea waste for further steps.
- The producer must not allow any person/company to dispose tea waste without having a proper waste management license.
- The producer must provide an authenticated detailed document explaining about the tea waste before the transfer of the same.
- There should be no excuse of exemption on behalf of the producers in tea waste management.
- There should be scientific and eco-friendly guidelines on disposal of tea waste.
- Government and local bodies need to be more pro-active in the management of tea waste.
- Environmentalists, researchers as well as the common people need to be much aware of the hazards of tea waste.

Tea waste can be used as many useful ways. Tea industries produce 2-4% of tea waste of their total production. So, huge quantity of tea wastes is produced in that area by the industries. But in Siliguri, West Bengal only one company is actually situated for buying those tea wastes. In our initial survey, it was observed that most of the tea waste remains useless. If the industries are pressurized to emphasize on proper management and alternative uses of tea waste it will be economically beneficial for industries as well as common people. In this region tea industries might have an existing knowledge gap about the alternative uses of tea waste and awareness program or suitable training would supplement the issues in near future.

## 4. Conclusion

Tea waste is an important byproduct of different tea factories of this region. The huge amount of such by-product should be utilized in various ways by arranging fruitful management program by factory owners. Tea Board of India also instructs the tea growers and factory owners to manage those byproducts and also trained the people towards alternative utilization of such good amount of tea waste for production of caffeine for pharmaceutical companies and after caffeine extraction as feed for domestic animals.

## 5. Acknowledgement

Authors are thankful to all dignitaries of tea factories, tea garden workers of Tea Estate of *Terai* & *Duars* for allowing and assisting our survey works in various locations. The first author is also grateful to UGC (RGNF) for its financial assistance to complete the said work.

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