Renewable and Sustainable Energy Reviews 51 (2015) 1338–1344

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Social entrepreneurship through forest bioresidue briquetting: An approach to mitigate forest fires in Pine areas of Western Himalaya, India

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ARTICLE INFO

Article history:
Received 4 January 2015
Received in revised form
12 May 2015
Accepted 10 July 2015

Keywords:
Forest bioresidue
Briquettes
Social entrepreneurship
Reflexive approach
Community

ABSTRACT

This paper accounts for a methodology to address the management of forest bioresidue in western Himalayan region of India. The genesis of the paper lies in cause and effect relationship, where one of the authors of this paper has seen numerous forest fires during the course of his careers as a natural resource manager. The methodology tackles linkages between forest and it's users by involving them in hazardous forest bioresidue waste management. Though the methodology is self evolutionary in nature but during the course of it's evolution two major findings come forth. Traces of social entrepreneurship among the villagers and the requirement for an appropriate machine to handle the forest bioresidue were largely seen during the study. Both the above mentioned facts lead to an Innovation of eco friendly bioresidue briquetting machine. The paper in addition equally deals with the complete innovation cycle in addition to the methodological context of forest bioresidue resource utilization.

Contents

1. Introduction

The Indian Himalayan region consists of Ten Indian States and is responsible for providing water to a large part of Indian subcontinent. It covers an area of about half a million square kilometers, which is about 16.2% of country's total geographical area. This contributes three major geographical entities named as the Himadri (greater Himalaya), Himanchal (lesser Himalaya) and

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http://dx.doi.org/10.1016/j.rser.2015.07.057
1364-0321/

the Siwaliks (outer Himalaya). Starting from foothills in the South (Siwaliks), Indian Himalayan region extends up to Tibet plateau in the north and border's seven countries. Most of the area is covered by snow clad peaks, glaciers of higher Himalaya and dense forests of mid-Himalaya. The region shows a thin and dispersed human population as compared to the national figures due to it's physiographic condition and poor infrastructural development. Interestingly, the growth rate in this region is much higher than the national average. The percentage contribution of it's population has gone up to 3.86% in 2001 from 3.6% in 1991 due to the higher decadal growth rate [30]. It reached about 25.4% as compared to national average of 21.35% during 1991–2001 [36]. Outer Himalayan region which is popularly known as Siwalik hills lies with an average height of 1500–2000 m and runs across parts of Jammu, Himanchal, Uttarakhand and Sikkim. This area has extremely rich flora and fauna. At it's lower levels some of the best known tropical forests are found. Chir Pine (*Pinus roxburghii*) is a commonly grown tree of this area which on conservation status is designated as the least concern species by International Union on Conservation of Nature. The Himalayan subtropical Pine forest are a large sub tropical coniferous ecosystem covering parts of Bhutan, India, Nepal and Pakistan. The huge Pine forest stretches for 3000 km^2 across the lower elevations of the great Himalayan range for almost its entire length covering an area of over 76,200 km^2. Pine trees shed their dry leaves every year in the months of Jan, Feb., March and April. These dry needles have about 70.03% of mean volatile matter content, which makes them highly inflammable [31]. During the summer season dry and fallen pine leaves are burnt either accidently or intentionally by the villagers there by releasing large volumes of Green house gases into the atmosphere. The thickly carpeted forest floor is cleared after burning the Pine needles and this gives way to the growth of fresh and palatable grasses in the area.

Millions of tons of pine needles [47] in the outer Himalayan region fall every year on the forest floor which is ultimately turned to ashes causing great losses to the environment in the form of release of carbon dioxide, soil erosion, loss of soil fertility and damage to regeneration. In a rough estimate over 2–3 million t of dry and fallen pine needles are produced in the state of Uttarakhand annually from the total .34 million ha reserve Forest area [38,46].

An experiment was conducted in the Uttarakhand state of India where in one of it's thirteen districts i.e. in Nainital, a public private partnership agreement was done between the government and a private entrepreneur to collect the dry and fallen pine needles from the forest areas for pine briquette manufacturing (Government order no 350/8-3-10-9(2)/209 dated 18.8.2010). It was an ambitious project with the involvement of villagers, entrepreneur and the government. This project aimed at providing economic benefit to the local villagers, an alternative to the fossil fuel and protection of Chir Pine forest from the forest fire. The Project started well in the initial two years but finally came to it's termination by the year 2012–13. Strong stakeholder of the project like the entrepreneur attributed this closure as a result of the top down approach, a non flexible and rigid mechanism, lack of stake holder's consultation and many other factors of local, national and international level [33]. An activity which could have been a socially acceptable, economically viable and environmentally appropriate act to mitigate climate change came to its sudden end without leaving even any scope to take the corrective measures. The failed experiment became the genesis of the present study. Tropical Pine forests are suffering with continued threat of forest fire because of the dry and fallen pine needles lying on the forest floor. These Pine needles have the potential of being utilized in a much better manner as in case of the biobriquettes. An environmental, social and economic acceptance of the community linked forest bioresidue resource management practices may fulfill the double purpose of climate change mitigation and the economic wellness of the nearby communities.

2. Study objectives

The objective of the current study may be summarized as to unearth and establish an implementable methodology between forest user and forest bioresidue resource management while achieving a much vital goal of climate change mitigation with economic empowerment of local communities through basic technological interventions.

3. Literature review

Forest fires, throughout the world result in tree mortality that can cause substantial timber and carbon loss [9]. Forest, grass and peat fires release approximately 2 petagrams of carbon into the atmosphere each year, influencing weather, climate and air quality [48]. These emissions effect planetary processes such as radioactive forcing and hydrological cycles [6]. Most emission originate fires set in tropical rain forest and savannas, where they cause recurrent episodes of severe pollution that effect some of the poorest regions of the world. Smoke from the combustion of biomass is composed of hundreds of chemicals, many of which all known to be harmful to human health [26]. The most important risk-related measure of smoke is particulate matter with an aerodynamic diameter $< 2.5\ \mu m$ (Pm2.5) [13]. Fire emissions all also a n important contributor to global mortality. The average mortality to landscape fire smoke was 339,000 deaths annually and the region most affected were sub-Saharan Africa and South East Asia [22].

The South Asian forest fires of 1997 were an environmental disaster. Over 2 million ha of Indonesia Island were burnt and the Green house gases so generated equaled the entire European output [43]. In the summer of 2004, wildfire raged over 5.7 million ha of Alaska and Canada's northern boreal forest. The number of very large mega fires in the circumpolar region in increasing [44]. There exists an unexpected risk of release of stored mercury into the atmosphere as a result of the wildfire activity in these peat lands.

Devine the last week of June 2008, Central and Northern California experienced thousand of forest and brush fires, giving rise to a week of severe fire-related particulate air pollution throughout the region [45]. Some spectacular fires broke out across different parts of the US recently especially in Wyoming, Utah and Colorado. The Fontenelle blaze was so bad in Wyoming that firefighters were brought in from Alaska to help put out the hungry flames that have burned 150 square miles of the landscape. In Colorado, it was reported that half of the US's fire suppression equipment was being used there alone on 25 June. The fires in Colorado even threatened the National Center for Atmospheric Research in Colorado Springs; tens of thousands of people living there were given evacuation warnings. The High Park fire started by lightning on 9 June 2012. It consumed 83,205 acres (33,672 ha), making it the second largest fire in Colorado's history next to the Hayman fire in 2002 set by a forestry technician [21].

What it does have is a set of environmental circumstances in which very large, very intense fires can recur with some regularity. The fire regime of any location has six components; fire frequency, size, intensity, seasonality, type and severity. It is a complex interaction between fuel, topography, ignition and weather. Availability of fuel on the forest floor is an important characteristic for determining the extent and scope of the fire regime of an area [16].