Introducing a status of access to raw material resources for manufacturers of cellulosic industries

Majid Azizi [a,*], Charles Ray [b]

[a] Faculty of Natural Resources, College of Agriculture and Natural Resources, University of Tehran, Iran
[b] School of Forest Resources, College of Agriculture, Pennsylvania State University, USA

ARTICLE INFO

ABSTRACT

Due to the implementation of Iran's Northern Forest Protection Plan for wood resources, manufacturers of wood and paper have a major problem in raw material supply in Iran; hence, they have to search for other resources to supply and procure their required raw material. Although there are some available substitutes for northern forests' timber resource, such as poplar plantation, agricultural wastes, and recycled papers, the present status of access to the resources presents a significant constraint on the viability of cellulosic product manufacturing. Accordingly, this research presents a decision-making model developed to select the best solution for raw material supply to the wood-cellulosic industry.

Three possibilities can be considered as potential solutions: (1) implementation of poplar plantation and other agricultural products by manufacturers, (2) short-term contracts with public and private firms and farmers, and (3) long-term contracts with public and private firms and farmers. The Analytic Network Process and Analytic Hierarchy Process were used to synthesize and analyze the model. Our analysis using these techniques shows that all calculated decisions are influenced by external factors.

A value-weighted competency model was calculated in the first stage with the influence of external factors on the competency model. Hierarchical design decisions were made for each of the competencies and their subsets. Paired comparison matrices associated with the degree of importance of each of the competencies were achieved in the second stage. In the final stage, subsets of competencies' weights and their sub-options were identified with the combination of the competencies and the best solution was obtained. Finally a sensitivity analysis of the model was performed.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

1.1. Regional biomass supply chain models

The Research Institute of Forests and Rangelands shows that approximately 122,000 ha of forests in the north of Iran, especially in the upstream regions, have been harvested during the years 1989–2004. On average, then, each year more than 8000 ha from the northern forests are harvested or converted (Research Institute of Forests and Rangelands, 2012). Subsequently, it is of paramount importance to sustainably produce the required raw materials for the forest biomass industry. Due to the current implementation of Iran's Northern Forest Protection Plan (Council of ministers, 2003), providing raw materials from sources other than the native northern forests is considered as the optimal solution. This provision can be met through ways such as planting fast growing tree species in managed plantations. In addition,

agricultural wastes and recycled papers can be considered as alternative raw material sources to biomass harvested from the northern forests.

To meet the growing demand for biomass resources and to promote pulpwood plantations according to the guidelines of the 1988 forest policy, these biomass-dependent industries have initiated farm and agro-forestry plantations through a contract farming system. Contract farming is an effective and efficient system for production and consumption for the agricultural and allied sectors. It is an essentially an agreement between unequal parties, which include the growers, processors and consumers. Contract farming is viewed as essentially benefitting the promoters or user agencies by enabling them to obtain the necessary raw material on a sustainable basis. The biggest challenge faced by wood-based industries in the study region is the ongoing and worsening shortage of suitable raw material. A conservative forest policy coupled with promotion of farmer-industry linked plantation activities on under-utilized cultivatable and marginal agricultural lands will help to mitigate the crisis. This necessitates a business farm-forestry model, in order to expand the area under farm and agro-forestry plantations through multi-stakeholder participation. A multi-functional agro-forestry system in India has already been successfully demonstrated (Parthiban et al., 2010).

* Corresponding author at. P.O.Box 31585-4314, Department of wood & paper sciences and technology, Faculty of Natural Resources, College of Agriculture and Natural Resources, University of Tehran, Daneshkadeh Street, Karaj, Alborz Province, Iran
E-mail addresses: mazizi@ut.ac.ir (M. Azizi), cdr14@psu.edu (C. Ray).

For instance, the success of WIMCO Seedling Ltd. (Indian Mercantile Chambers) for poplar in the North-Western states, and ITC (Imperial Tobacco Company of India Limited) for clone eucalyptus are the resultant initiatives of multi-stakeholder's partnership on quality planting stock, marketing, finances, etc. A quad-partite model contract farming system through public–private partnership has been introduced in the state of Tamil Nadu through a project funded by NAIP (National Agricultural Innovation Project). This project involved various levels of stakeholders and was implemented successfully in five districts directly, and through horizontal expansion it has spread across the state. In this system, the Forest College and Research Institute (Tamil Nadu Agricultural University) plays a significant role for technological advancements through varietal development and advising site-specific silvicultural technology to the growers (Seenivasan et al., 2010).

Numerous strategies have been developed for trading wood between growers and the processing industry. For example, some companies obtain their supplies through trading intermediaries (i.e. market agents) and do not have a direct relationship with growers. Other companies lease land under contract from landholders for growing trees, or contract farmers to grow trees.

Under contract tree farming, the company may provide inputs or technical support to the grower, and guarantees a market for the product. Industrial forest companies are often the initiators of out-grower schemes, with variations allowing the company to access additional, more secure, or perhaps cheaper raw materials. Growers or landholders receive a range of potential benefits throughout grower partnerships. In Brazil, India and the Philippines some farmers have been able to secure land tenure and increase the clarity over rights to trees being grown; gain access to financial support or sources of income while trees mature; receive higher net returns from trees than from traditional land uses; secure markets for wood; and have a good means of participating with the company (Race and Desmond, 2001).

Woodchip and pulp and paper companies have three main strategies to ensure wood supply for their processing plants: (i) purchase smallholders' land, (ii) contract smallholders or (iii) buy from smallholders and middlemen on an open market. Forest-based companies that contract tree growers in Thailand (Advance Agro, Phoenix Pulp and Paper and Siam Forestry) have around 80,000 ha, 108,000 ha and 44,800 ha respectively of eucalypt plantations under contract farming. Individual contract tree growers sign a contract with the company. The company thus contracted must provide good quality and low-price eucalypt plants and fertilizer, technical advice and training. The company also guarantees to buy the wood after a rotation of four or five years (Silva and Rankin, 2013).

In Iran, there are four different raw material solutions for the country's cellulosic industries. These are poplar plantation, agricultural wastes, recycled papers and imported raw materials. We describe each of these possibilities in the sections that follow.

1.2. Poplar plantation

At the present, the poplar tree (*Populus alba* and *Populous nigra*) is the most traditionally planted species in Iran; however, its price is volatile and based on market conditions and availability. Price of poplar has varied from 1,300,000 rials in December 2012 to 2,400,000 rials in December 2013 (Pourghasem, 2014). There is about 150,000 ha of poplar cultivation in Iran (Moshirvaziri and Makhtoomi, 1992).

If favorable financial support of industrialists is available in the form of providing improved seedlings, granting appropriate land with long-term payment, etc., the implementation of poplar plantations will ease the problem of raw material supply significantly. As the cost of raw material supply decreases, paper products' prices will correspond and become more competitive in the marketplace, making Iranian production of these products possible.

Fast growing poplars were touted to be more similar to agricultural products than most other plantation species, in that investment returns might be realized over shorter terms due to growth rates. For this reason, poplar plantations were favored by paper companies as a potential source of low-cost and reliable pulp supply. However, over longer term periods, a lower-than-expected return on investment of many of these ventures has resulted in these plantations being grown for longer rotations and harvested for solid wood and engineered wood products (Davison and Riggs, 2004).

1.3. Agricultural wastes

Increasing demands for paper and environmental concerns have increased the need for non-wood pulp as a low cost raw material for paper production. This has also led to the development of alternate pulping technologies that are environmentally benign. Annual plants and agricultural residues appear to be well-suited for paper-making due to their abundance and renewability (Sridach, 2010).

There is a large volume of unused agricultural waste which is available in places such as Khoozestan province (bagasse), Khorasan and Fars provinces (wheat and barley straw), and Northern Iran (rice and cotton stalks). Using only 4% of these wastes of rice, wheat, sugar cane, barley, cotton and corn from a capacity of 1 million tons per year, the country can be self-sufficient in the production of paper. Accordingly, the annual output of around one billion dollars for pulp and paper importation could be reduced over time. Moreover, by utilizing only 10% of the wastes, production of more than 1 million tons of pulp and paper for the country will be possible (Barzegarshiri et al., 2009).

The total area of cultivation of agricultural products in Iran from which wastes can be used as raw material are as follows: wheat, 722,2311 ha; barley, 1,641,829 ha; rice, 630,561 ha; corn, 307,015 ha; sugar cane, 61,178 ha; and cotton, 7,222,311 ha (Barzegarshiri et al, 2009).

1.4. Recycled paper

Recycled papers are typically used for packaging and other industrial applications; their use as fine papers for printing, writing papers and newsprint paper is far less common. Recycled paper is used in producing industrial paperboard and paper for two reasons. The pulp produced from recycled paper is better suited to production of industrial packaging, where strength is required but print and surface quality is variable; and the process to produce recycled paper for these applications is both ecologically and economically sustainable.

America consumes 30% of all paper in the world, and from 521 paper making factories in the United States, 450 factories use recycled paper to produce paper. On a global scale, more than 95 million tons per year are recycled to produce new paper. Rates of paper recycling in Germany, South Korea, Sweden, the USA, Japan, France, Finland, Italy and China are 72%, 66%, 55%, 50%, 53%, 41%, 35%, 31%, and 27% respectively (Rohamin, 2011).

Currently, the total of collected recycled cellulosic material in Iran is only 2%. Isfahan province ranked first with 15% of recyclability of paperboard and paper in 2008 and Tehran and Shiraz provinces with 5.38% of recyclability rank next (Asadpour et al., 2011).

1.5. Imported raw material

Softwood or poplar chips and African hardwood chips are raw materials imported to Iran. However, there are constraints on the supply of these materials from abroad. Many problems associated with bureaucratic control of resource importation — rules and regulations of import, limitations of foreign exchange and intensive increase in exchange rate, face the importer attempting to bring these raw materials into the country.

The cases mentioned in this introduction are alternatives to Iran's northern forest wood as raw material for the country's wood and paper industries. The basic problem is a shortage of raw material