One Belt One Road Initiative: Pakistan's forest-based sector investment opportunities within the context of globalization

Recebimento dos originais: 04/04/2019
Aceitação para publicação: 31/01/2020

Muhammad Arif
PhD in Forestry Economics and Management
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: **muhammadarif@nefu.edu.cn**

Amna Hussain
PhD candidate in Forest Management
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: **amnahussain@nefu.edu.cn**

Muhammad Khurram Shahzad
PhD candidate in Forest Management
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: **muhammad@nefu.edu**

Waseem Razzaq Khan
PhD candidate in Forest Management
Faculty of Forestry University Putra Malaysia,43400, Malaysia
E-mail: **waseemjatoi@gmail.com**

Ni Na
MBA Finance
Institution: Harbin Institute of Technology
Address: No. 2-Yi Kuang Street, Harbin-150040, Heilongjiang Province, China
E-mail: **1539614481@qq.com**

Nowsherwan Zarif
PhD candidate in Silviculture
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: **nowsherwanzarif@nefu.edu.cn**

Xiangyue Liu
Master Ideological and Political Education
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: **1335759586@qq.com**

Hira Amin
PhD student in Forestry Economics and Management
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: hiraamin@yahoo.com

Cao Yukun (Corresponding author)
Professor, doctoral supervisor Forestry Economics and Management
Institution: Northeast Forestry University
Address: No. 26-Hexing Road Harbin-150040, Heilongjiang Province, China
E-mail: caoyukun.nefu@yahoo.com and cyklk@163.com

Abstract

China's One Belt One Road (OBOR), a momentous initiative, is going to trigger off multidimensional geo- strategic and geo-economical changes across the globe. Chinese's enterprises are going to hire agricultural lands under China-Pakistan Economic Corridor (CPEC) coalition agreements in Pakistan. Simultaneously, the government of Punjab, Pakistan has promulgated a new set of forest regulations in 2017, which aims at the expansion of forest cover by stimulating private-sector investment (up to 15-years both foreign and local) on potentially productive blank areas of forests. This paper presents potential economic returns of investment for Chinese companies within the forest-sector of Punjab in Pakistan. To take up this endeavor, the diversity in rotation period and assortment of site quality could be significant that can affect the forest-based sector investment. Tree growth and monetary data were collected from seven prominent plantations in the adjacent areas. Interpolative growth of three main tree species (i.e., *Dalbergia sissoo*, *Eucalyptus camaldulensis* and *Acacia nilotica*) was established via regression analysis whereas, financial analysis (conceivable costs and returns) was carried out via Net Present Value (NPV) on a five-year interval age-classes basis. Study revealed that tree growth and financial returns directly corresponded to different site qualities and tree ages. Tree growth of *D. sissoo*, *E. camaldulensis* and *A. nilotica* at site qualities I, II & III were in the range of 104.2±36.8, 84.2±23.4 & 57.8±14.4 (m^3 ha^{-1}); 152.8±96.2, 114.4±71.3 & 89.7±33.8 (m^3 ha^{-1}) and 173.8±94.1, 145.7±53.8 & 95.8±43.8 (m^3 ha^{-1}), respectively. Similarly, their returns came out as 40,941- 25,821 & 8,371 (US$ ha^{-1}); 25,564- 16,760 & 10,338 (US$ ha^{-1}) and 16,209- 11,562 & 4,341 (US$ ha^{-1}), respectively. It is evident that *E. camaldulensis* and *A. nilotica* grew noticeably faster than *D. sissoo* but provided fewer net-returns at site qualities, I and II, while *E. camaldulensis* produced more earnings at site quality III. Investor can fetch maximum returns by restoring the blank forest areas with *D. sissoo* and *E. camaldulensis* and maintaining a 15-years rotation plan in current scenario. In view of this attractive opportunity, it is a pioneer study. The information from study is comprehensive, and results are satisfactory to decide about investment in the South Punjab Forest Company (SPFC) for 15-years periods under CPEC agreements.

Keywords: One Belt One Road. China-Pakistan Economic Corridor. Irrigated plantation.

1. Introduction

Globalization is a natural and spontaneous process, and it is the way of interaction and integration among countries to develop a single economic system (Hajdúchová *et al.*, 2016). The concept of globalization is not new, whereas Silk Road across central Asia has been contributing massive role in trading from the Middle-Ages. It connected lots of people and lately have grown-up corporations between China and Europe (Glock, 2017). Recently, different countries around the world have allied through geo-strategic and geo-economical partnerships, and states have started reforming their policies conferring to their interests (Ali *et al.*, 2017a). Nations realized that practically it is impossible to protect their own interests in isolation in current-century. So, countries started to explore different ways to meet their needs, and diplomatic and high-level talk got great importance in current times (Hajdúchová *et al.*, 2016). Similarly, each country is trying to promote cooperation multilateral according to their interests and capacities (Ali *et al.*, 2017b). Chinese "Belt and Road Initiatives" are the perfect example of this mechanism and are melodramatically connecting the globe (Cheng, 2016). The OBOR initiative, as per 2017, encompasses more than 68 countries. Moreover, 40% of the world's GDP and 65% of the global population is directly or indirectly linked with it (Glock, 2017).

Pakistan and China signed an agreement to link Gwadar Port with China's Xinjiang autonomous region under CPEC agreement in April 2015. CPEC collation's agreements are the perfect illustrations of "all-weather strategic partners" (Sial, 2014). China is going to invest its capital, technology and experience in multiple sectors of Pakistan. It is a program of economic-cooperation that includes agriculture, energy, transport infrastructure and industrial cooperation (Cheng, 2016). CPEC projects encompass the estimated cost of $46 billion, and agriculture-sector is going to be a main beneficiary sector (Ahmed and Mustafa, 2014). Unfortunately, during the recent times, agriculture sector is facing low productivity issues in Pakistan, and it has been continuously reducing from the last decades (Glock, 2017). Conventional technology and traditional techniques are major reasons of its downfall. It has reported earlier that investment is directly linked with agriculture growth (Antle, 1984, Hussain and Hanjra, 2004). So, an amount of ¥15.374 million will be spent for agricultural research and development in Pakistan under Pak-China cooperation (Ali *et al.*, 2017a). China is emerging progressively in the terms of investment, technology, modern cultivation and research around the world. All these factors can enhance the output development and are required for the agricultural growth in the Pakistan (Cheng, 2016). These factors will also improve the opportunities of employment generation and agricultural expansion, which are the core objectives in the OBOR initiatives. This collaboration is expected to improve agriculture production by introducing modern farming machinery and tolls. All these steps can help to strengthen the infrastructure of the irrigation system, enhance the water-use efficiency, integrate the nutrient's management that reduces the post-harvest losses (Ali *et al.,* 2017a; Shah *et al.,* 2006). Furthermore, these agreements also include the provision of seed supplies and construction of agriculture demonstration centers (Ahmed and Mustafa, 2014).

Generally, the effects of globalization are multiple, so it has been considered as a theory of global economic growth since 2004. This process is influencing the living conditions in developing countries, whereas, advanced countries have started investing for the sake of progress in quality life (Bhagwati, 2004). It is also a process of internationalization of markets. It is increasing the goods and services, technology, competition, financial market and systems, corporations and industries among the countries (Smith *et al.,* 2014; Mayer-Foulkes, 2015). Moreover, globalization effects are beyond the economic activities, and it also impacts on the trans-cultural and trans-national integration (Ioris, 2014). It claimed that the deregulations of financial-services and capital-movement liberalization can open market for investment and trade. However, it increases the international competitiveness, and it improves the technologies that help in the development mechanism (Norback and Persson, 2014).

The roles of the governments are important during the process of globalization. It is a process of alliance of countries, and it takes place through international organizations and groups, such as the OBOR and CPEC initiatives (McMillan *et al.,* 2014). Globalization mechanism has a deep impact on the global economy, and its features are diversified. It emphasizes positively on the strong regional associations, human creativity, business economies, multinational corporations, proportional relationship and competitiveness of the economy (Potrafke, 2015). However, globalization impact on the forestry and its interrelated industries is noticed as uneven and unpredictable. The economic impacts can be positive and negative and are depending on the various parameters (Paschalis-Jakubowicz, 2010; Meller, 2013).

Several forest agencies defined different parameters for the forest-based sector investment, such as the European Commission demarcated the forest resources into upstream and downstream resources. Besides, they counted the ancillary activities into the downstream forest-based industries (Strategy, 2013). Forestry enterprises are facing serious consequences in the rich woodland resource's countries, where management of the forest resources is very important (Paschalis-Jakubowicz, 2010). Forest industry impact is varying with the change in time and timber demand is getting higher continuously (Parobek *et al.,* 2014; Birdsey and Pan, 2015). Rationalization policy and competition factors can affect the local and regional economies, which can influence the market negatively (Choi and Schellhase, 2015). The competitiveness for the forest raw materials is changing due to the high-standards of forest certifications in the developed countries. Globalization is working positively for the consumers in this situation, and it is boosting the employment, environment and forest-based sector investment (Paschalis-Jakubowicz, 2010). Globalization is affecting the forest policies as reviewed by Bond-O'Byrne and Kliestik-Cug (Bond and J. O'Byrne, 2014; Kliestik and Cug, 2015), and its changing levels can be measured by different ways as used by previous researchers (Dreher, 2006; Chang *et al.,* 2015; Potrafke, 2015).

2. Literature Review

Earlier, few researchers conducted the financial evaluation of the eminent irrigated plantations in the Punjab, Pakistan on the different economic parameters. So, the results from each study come out in the dissimilar directions. Such as, Asif *et al.* conducted that appraisal value of the Changa Manga plantation in 2014, and they compared the last 22-years aggregated expenditures and revenues. Their research concluded Benefit Cost Ratio (BCR) and Net Present Worth (NPW) values as 0.74097 and 81.23 million with the negative signs. It was clearly portraying that plantation were running in the loss during their research period (Asif *et al,* 2014). Anjum *et al.* carried out the economic evaluation of the Kamalia plantation in 2011. They compared average cost and worth of plantation on per hectare per annum basis. The results from their study showed that NPW, BCR and Return on Investment (ROI) outcome as -0.014 million, -0.11 and -89.15 for their study period. It was visibly showing that plantation was running in the loss during that period (Anjum *et al.,* 2013). Azhar *et al.* performed the economic evaluation for the Dapher plantation in 2011. They examined the last 23-years financial data and compared the study into two different parts. Part first, that coated initial 12-years produced BCR value as 1.06, while the part second, that covered next 11-years was having the BCR as 2.08. Results of their study claimed dissimilar results for the same site for two different time periods. It showed that big trees produced more revenues over small trees. Furthermore, their NPW and Internal Rate of Return (IRR) have the values as 13,251,170 and 19.39% for the whole plantation and period (Azhar et *al.*, 2011)

Majid calculated the financial analysis of raising *Eucalyptus camaldulensis* in the compact and linear plantations existing in the Faisalabad during the year 1995. He assessed the BCR, NWP, Average Annual Benefits (AAB) and IRR values as 7.16, RS. 373242, 83% and Rs. 92250, respectively, for the whole area. Results from his study depicted that confer specie was found highly-lucrative both in the compact as well as in the linear forms. He further stated that 6-8-years rotation ages were found as the most economic viable for the linear plantations, whereas, 5-6-years rotation ages were suggested as most productive for the compact plantations (Majid, 1995). Anwar calculated the financial evaluation of Kamalia forest in 1994. Results have shown that discuss plantation had mean cost and revenue values as Rs. 19,653 and Rs. 171,116 per hectare and were having the net returns as Rs. 151,463 at that time (Anwar and Qureshi, 1994).

Financial evaluation of the pure forestry and agroforestry can be seen from the researches of other scholars outside Pakistan. Mutana *let al.* described that net-returns form the farm-crops get higher when *Dalbergia* trees are inter-cropped with farm-crops. Results from their research reported NPW, BCR and ROI values as Rs. 10,870.2, 1.77 and 77% (Mutunal *et al.*, 2009). Paul and Arvind conducted the financial analysis of agroforestry system during the year 2000. They did the research for wheat-rice crops with the trees, and their research reported the BCR and ROI values as 1.63 and 63% (Sharma and Kumar, 2000).

Friday *et al.* carried out the financial analysis of raising the *Tectona grandis* (teak) plantation during the year 2000. They founded the IRR values were ranging from 6 to 8.01, depending on the stumpage, at the rotation-age of 35-years (Friday *et al.*, 2000). Financial analysis of raising *Azadirachta indica* (neem) was conducted on the hectare basis in one study. The results of the study have BCR, IRR and NPW values as 3.59, 45.88% and Rs. 40,838 (Foundation, 2018).

Harrison *et al.* carried out the financial evaluation for agronomy of *Gmelina arborea* and *Acacia mangium* during the year 2005. They conducted their study on the hectare basis, and their results were having NPW and IRR values as 12,641 to 30,782 and 17 to 31% for *Gmelina arborea* and *Acacia mangium* (Harrison *et al.*, 2005). Mahapatra and Tewari conducted the financial evaluation for raising of dry deciduous forests in the interior and coastal areas during the year 2005. The results from their study stated that people could get higher revenues for planting dry deciduous forests over other farming purposes. Non-timber forest products were having NPW values as 1,348 and 1,016 dollars per hectare for the interior and coastal areas (Mahapatra and Tewari, 2005).

It is obvious from the previous literature that this study highlights the forest-based sector investment within the context of globalization, particularly under OBOR and CPEC initiatives. China's OBOR pursues many objectives, and various researchers conducted their researches for such objectives. However, no one has assessed the economic returns of investment potential for Chinese's enterprises in the forest-based sector of Pakistan yet. This paper presents a current potential of investment returns for Chinese's enterprises in the forest-based sector in Pakistan. In Pakistan, government of Punjab has promulgated new forest policy in 2017. The objectives of the government are to increase the forest cover and to meet the local demands of forest produces in the country. In Pakistan, agricultural-lands are strategically leased out to Chinese's enterprises under CPEC coalition agreements. In view of this attractive opportunity, SPFC is seeking for investment up to 15 years (both foreign and local) on the profit-sharing basis. Forest land, presently lying blank due to certain limiting factors, consisting of 40095 ha will be offered for raising tree plantations (SPFC, 2018). This research has addressed four main objectives. First objective of this research was to measure the interpolative tree growths (m^3 ha^{-1}) of three prominent tree species. Secondly, measure the possible cost (\$ ha^{-1}) of raising tree species in the area. Then explore the market price value for the different timber and fuelwood categories. Finally, compared the possible costs and returns in order to make recommendations for investors. This research has implications for the forest-based sector investment in the forest plantations throughout the Southern Zone of Punjab and even into other irrigated plantations in Pakistan.

3. Materials and Methods

3.1. Study sites description

The information of growing stocks and monetary data were collected in 2014-2015 from the seven central plantations (i.e. Chichawatni; Khanewal; Machu; Inayat; Rajan Shah; Bahawalpur and Chak Katora plantations) situated amidst latitude 31°10'13.46" and longitude N 72º42'34.98" E in the Southern Zone Punjab, Pakistan (Figures 1 and 2). These plantations are located on the upper Indus plain, and their combined gross and net areas are 19212±13066.6 ha. Gross and net areas of these plantations vary from 4666.7 ±507.9 ha to 3823 ±460.9 ha (FWF, 2016). Geographically, these plantations fall in the same area, so their seasonal, climatic and soil-quality characteristics are almost similar with minute differences, and their altitude, mean annual temperature & mean annual rain fall varied from 176.1±114.9 m, from 46±3 °C and from 516.5±6.6 mm respectively between July 2004 to December 2014. Soil analysis reports show that soil texture is porous, well aerated and is composed of alluvial deposits having proportions of sand, silt and clay at different sites. In general, soil is loamy to sandy loamy in nature. Soils are well-drained, stone free and acidic (pH 9.65±7.75). It contains organic matter (0.83±0.31%) and available phosphorus (14.6±4.7 ppm) with base saturation (50±34%) (Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; Arif *et al.*, 2017; Arif, 2018).

All these plantations are man-made, and their establishment was started since 1913 in Pakistan (Arif *et al.*, 2017). Originally, these plantations fall in the dry-tropical forests. The indigenous flora was relatively slow-growing and economically unviable to be cultivated for commercial purposes (i.e., *Tamarix articulata, Salvadora oleoides, Capparis aphylla* and *Prosopis cineraria*). The existing crops in these forests are comparatively fast-growing and economically viable and mainly comprised of *E. camaldulensis, D. sissoo,* and *A. nilotica* (Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015). These plantations are principally depending on the irrigation channels and water received from different canals of the areas. Irrigation system contains an extensive structure of channels, which are categorized as canal, distributary, minor, main, khal, passel and trench. Usually, 0.34 m^3 water per second is provided for 400 hectares for forest land (Rahim, 2010; Khaggah, 2015). At present, Pakistan is facing water-shortage issues, and generally such water supply cannot be maintained at the diversion points of channels (Khaggah, 2015). Primarily, these plantations made for timber, firewood and another minor forest produced. In the methods of treatments, all tree species are raised at a spacing of 3 × 1.8 m (1794 plants ha^{-1}) and are regenerated from root-shoot cuttings (*D. sissoo*) and through potted plants (*E. camaldulensis* and *A. nilotica*). Selection of appropriate tree species depends on the water-supply and soil-conditions of the sites (Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; Arif *et al.*, 2017).

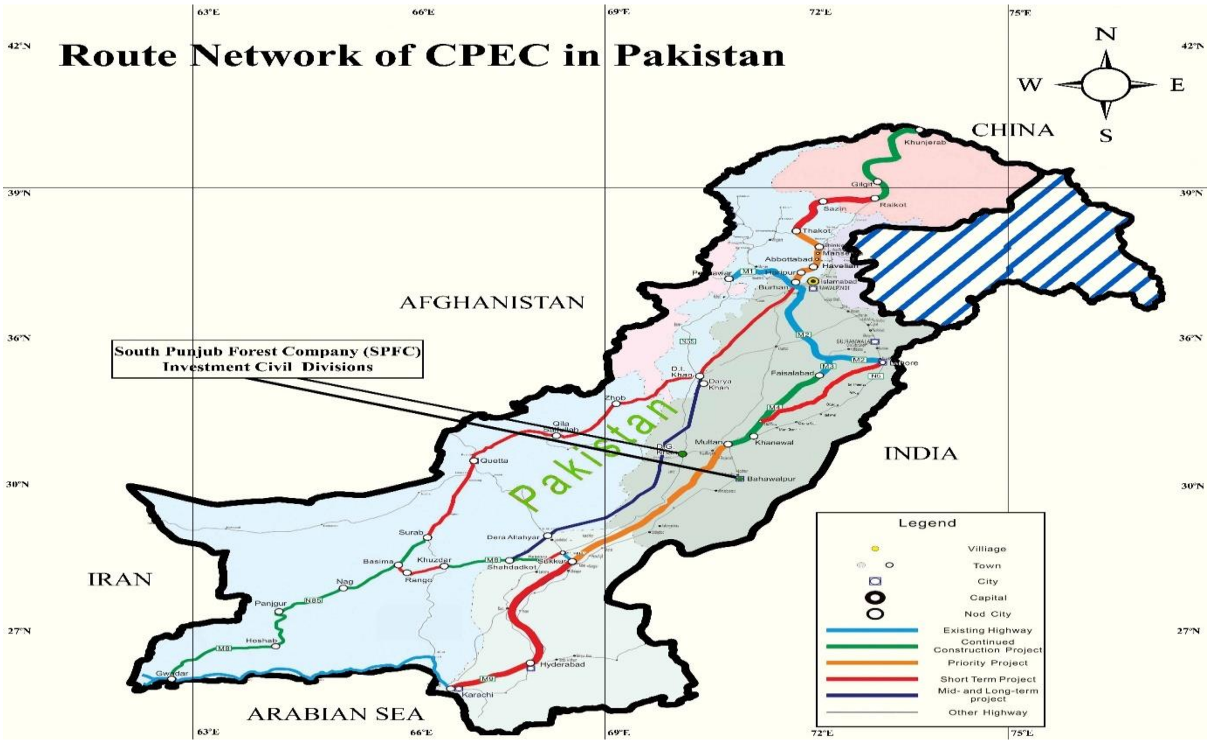

Figure 1: Route network of China-Pakistan Economic Corridor and South Punjab Forest Company civil divisions in Pakistan

3.2. South Punjab Forest Company (SPFC)

SPFC is a public-sector company and is established by the Government of Punjab under section 42 of Companies Act in September 2015 (FWF, 2016). SPFC is seeking for 15-years private investment (both foreign and local) on the profit-sharing basis. Table I shows the detail of areas available for forest sector investment under SPFC. The aims of the company are to increase forest cover and conserve the forests on the sustained basis. SPFC is containing the blank areas at various sites exists in the Bahawalpur and Dera Ghazi Khan civil divisions. The company is responsible for all the technical assistance and is ensuring the long-term profitable investment under the prevailing rules (FWF, 2016; SPFC, 2018).

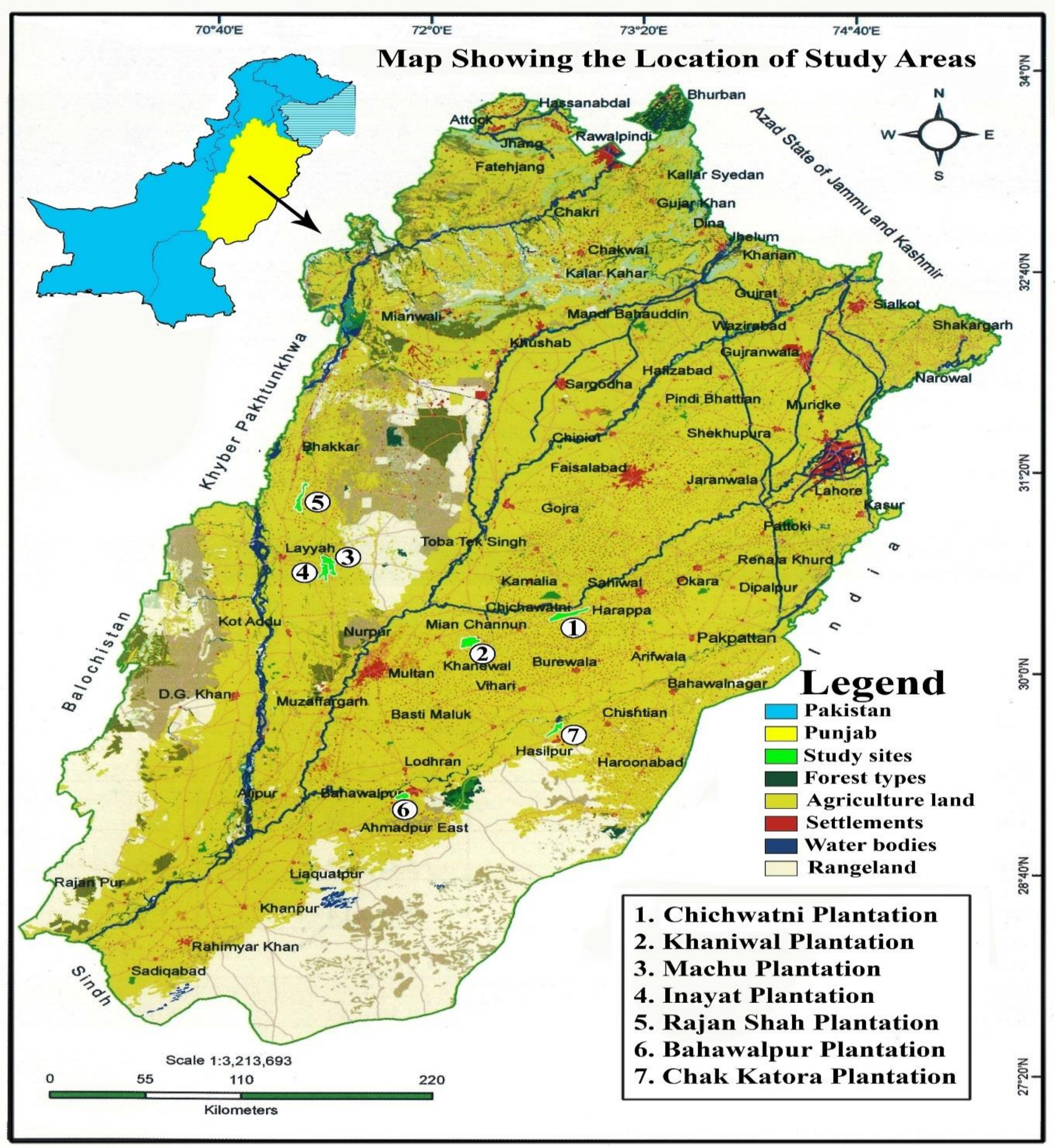

Figure 2: Location of study area in Punjab, Pakistan

3.3. Data collection

History of the plantations was noted from the confer plantation's working plans. The age and silvicultural characteristics of growing stock were recorded from the compartment's history files. Tree growths were recorded by various techniques as followed earlier by the (Nath *et al.*, 2010; Vesa *et al.*, 2010; Arif *et al.*, 2017). Total 332 circular plots (1 ha, 56.4 m radius) were established in different compartments of the plantations. Diameter at Breast

Height (DBH) was measured from diameter tape and calipers, while tree height was calculated from Abney's level and Haga altimeter. Tree volume was determined by following formula:

$$\text{Tree volume } (m^3) = (\pi/4) \times d^2 \times h \times f) \quad (1)$$

Where, $\pi = 3.1416$, d = at DBH (1.3m), h = tree height, f = form factor.

Interpolative growth of all trees was constructed by regression analysis. Costs of raising and maintenance of tree species were documented from the forest department running developmental working schemes. Prices of timber and fuelwood for different tree species were taken from the open markets held in Multan and Bahawalpur civil divisions.

3.4. The financial model

The financial analysis of conceivable investment has carried out by ensuing the all-encompassing information. Comprehensive detail of such information has already been elucidated in the printed books on the forest economics by Pearse (1990), Klemperer (1995) and Alavalapati and Mercer (2006). Moreover, the common possible deficiencies exist in the financial analysis have studied and overwhelmed in this paper, as discussed earlier by Steve Harrison and John Herbohn (2016) to have valid results. A simple private-investment analysis is carried out to see whether investment is financially viable or else. As proposed SPFC sites are blank, so financial model was prepared on one-ha land units, and data was collected from adjacent plantations for said tree species (i.e. *D. sissoo, E. camaldulensis* and *A. nilotica*).

Sites of plantations are almost plains and highly suitable. SPFC has also recommended these tree species for the cultivation. Economic viability of different rotation ages was predicted, but focus was made on the 15-years rotation age, as it is the maximum period which is going to be offered for investment. In the available circumstances, constant price analysis is adopted. The main incremental cost's categories for raising three species are discussed in the Table III. A few assumptions have made for the current financial analysis: (I) The sites are completely blank, and there is no opportunity cost for other projects; (II) Present immature vegetation, partially available, is mostly invasive in nature (i.e. mesquite), which has no timber and fuelwood value; (III) An interest rate of 11.33% per annum (i.e. from 1992 until 2017 in Pakistan) is used for agriculture credits; (IV) Inflation rate of 7.80 % per annum (i.e. from 1947 until 2017 in Pakistan) is used; (V) Discount rate of same 11.33% per annum is used to get the equal values of currency level (i.e. costs and revenues); (VI) Fisher equation is used to get the real annual interest rate with the help of nominal interest rate and expected annual inflation rate; (VII) Personal income tax of 20 % is used (i.e. from 2006 until 2017 in Pakistan) (Economics, 2018); (VIII) The same rate of forestry operations (in coolly) is used as opted by the Punjab forest department; (IX) The factor of fertilization has ignored as it is not practiced in study areas; (X) Same rate of timber and firewood as used by the local market is selected; (XI) The risk level for current forest investment is counted as zero as SPFC is assuring 100% safe capital investment (SPFC, 2018); (XII) The input and output factors of investment can be changed over time due to variation in technology and management practices, and hence this financial model is applicable to current scenario and conditions. Final evaluation is conducted by the formula below:

$$\text{Net Present Value (NPV)} = \sum_{t=0}^{T} \frac{R_t}{(1+r)^t} - \sum_{t=0}^{T} \frac{C_t}{(1+r)^t} \qquad (2)$$

Where,

R_t = revenue at time t; C_t = cost at time t; r = annual discounting rate; t = length of rotation in years.

4. Results and Discussions

Results are showing a clear depiction of the Pakistan's forest-based sector investment opportunities within the context of globalization. Agriculture based-sector has accounted for 19.5 percent of the gross domestic product in Pakistan during the fiscal year 2016-17. Forestry based-sector, a sub-sector category of agriculture, has contributed 2.33 percent, with a net growth of 14.49 percent during the same time (Pakistan, 2017). Although, forest sector in general, is showing a positive-growth sign due to higher timber production from the hill (natural) forests, yet forest covered-area and forest goods have been decreasing from the irrigated plantations in last few decades (Bukhari *et al.,* 2012; Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; FAO, 2016; Arif, 2018). Eventually, people of Pakistan are suffering from shortages of goods and services from these planted forests. In due course, government of the Punjab modified forest policy to address changing needs over time. The need and scope of forest-based sector investment have become critical with the passage of time, and it turns out to be mandatory to respond to the changing needs of the globe (FAO, 2016).

Table 1 shows detail of forest areas available for forest-based sector investment under SPFC in Pakistan. All sites exist in the civil divisions of South Punjab (FWF, 2016, SPFC, 2018) and are nearby to CPEC routes. Table 2 illustrates the features of tree species raised in most of the plantations in Pakistan (Ashraf *et al.*, 1991; Sheikh, 1993; Rahim, 2010; Bukhari *et al.*, 2012; Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; Arif *et al.*, 2017; Arif, 2018).

Table 1: Detail of areas available for investment under South Punjab Forest Company in Pakistan

Sr. No.	District name	No. of plantations	Total area (ha)	Available area for investment (ha)
1.	Bahawalpur forest district	1	1206	483
2.	Dera Ghazi Khan forest district	2	2286	1899
3.	Muzaffargarh forest district	22	32618	28063
4.	Rahim Yar Khan forest district	5	12447	4773
5.	Rajanpur forest district	9	6305	4877
	Total	39	54861	40095

Source: SPFC (2018), FWF (2016)

Table 2:Major three tree species in plantations at southern-zone Punjab, Pakistan involved in this study

Plantations	Species	Common name	Family	Natural distribution
1. Chichawatni plantation 2. Khaniwal plantation 3. Machu plantation	*Dalbergia sissoo* Roxb.	Shisham, Tahli, Rose wood	Fabaceae	The Indian Subcontinent and Southern Iran
4. Inayat plantation 5. Rajan Shah plantation 6. Bahawalpur plantation	*Eucalyptus camaldulensis* Dehnh.	Sufeda, Lachi, Red river gum	Myrtaceae	Australia, the Indian Subcontinent
7. Chak Katora plantation	*Acacia nilotica* (Linn.) Delile	Kikar, Babul	Fabaceae	Africa, the Middle East and the Indian Subcontinent

Source: Arif (2018), Arif *et al.* (2017), Ahmed (2015), Babar (2015), Khaggah (2015), Shahzad (2015), Bukhari *et al.* (2012), Rahim (2010), Sheikh (1993), Ashraf *et al.* (1991)

4.1. Expenditure break-up for raising tree species in irrigated plantation

Table 3 displays categories-wise break-up of expenditures (US\$ ha^{-1}) for establishment/raising forest crops in irrigated plantations in Punjab, Pakistan (FWF, 2016). Results showed that mean amount of \$535 (ha^{-1}) for 1st year is required to raise plants in these forests. In further categorization of field operations, the maximum amount of \$178 (ha^{-1}) for earth work (main, branch, trenches and passels, etc.), while a minimum amount of \$8 (ha^{-1}) is required for slots making. Jungle clearance, mesquite stubbing, etc., are the first category of field operations. Irrigation is the most frequent operation, and it is essential for the forest crops in prevailing harsh climatic conditions (Khaggah, 2015). Detailed break-up of maintenance expenditures for the 2nd, 3rd and so on to 15th years forest crops are also provided in the same Table 3.

Table 3: Break-up of expenditures (\$ ha^{-1}) for raising plants in the irrigated plantations in Pakistan

Sr. NO.	Operations	Quantity (No.)	Unit (coolly)	Amount (\$)
1st year raising plants				
1.	Jungle clearance, mesquite stubbing, etc.	1 ha	25	50
2.	Debris collection and its burning	1 ha	7	14
3.	Plough and leveling by machinery/labor	1 ha	Mean	77
4.	Layout and points bailing	1 ha	5	10
5.	Earth work (main, branch, trenches and passels, etc) 420 m^3	1 ha	89	178
6.	Slots making 1794 number		4	8
7.	Cost of stumps/plants 1794+449=2243 number (restocking 25%)	1 ha	0.05/ each	112
8.	Planting cost including restocking (25%)	1 ha	5	10
9.	Irrigation 18 times	1 ha	21	42
10.	Weeding	1 ha	12	24
11.	Managerial cost	1 ha	-	5
12.	Miscellaneous	1 ha	5	5
Total	-	-	-	535
2nd year maintenance				
1.	Weeding	1 ha	25	50
2.	Cost of stumps/plants (359 No.)	1 ha	0.05/ each	18
3.	Restocking 20% (359 No.)	1 ha	1	2
4.	Reopening of irrigation channels	1 ha	13	26
5.	Irrigation 22 times	1 ha	26	52
6.	Managerial cost	1 ha	-	5
7.	Miscellaneous	1 ha	5	5
Total	-	-	-	158
3rd year and so on maintenance				
1.	Reopening of irrigation channels	1 ha	13	26
2.	Irrigation 12 times	1 ha	14	28
3.	Managerial cost	1 ha	-	5
4.	Miscellaneous	1 ha	5	5
Total	-	-	-	64
15th year Felling				
1.	Cutting, conversion and carriage from site to the sale depot	1 m^3	-	35

Note: 1 coolly = \$2, plants spacing = 3m × 1.8m, interest rate on agriculture sector loan = 11.33%, the personal income tax rate = 20%
Source: FWF (2016)

Irrigation and weeding are the most expensive operations for raising in the 2nd year of forest crop. Other operations (including stumps/plants, restocking, reopening of irrigation channels) are also required in the first year of maintenance of plants. Irrigation operation remains the continuous composite process from 1st year and so on until main-felling. Weeding is a vital operation and required at the early stage of the plants. It improves the survival and development of forest crop. That is the reason it is prescribed for every plantation. Intensive care is required for plants during initial 2-3 years, and weeding charges start declining from 2nd year onward.

Forest's crop starts competing and defeating all types of weeds during the establishment phase. This result is supported by the findings of (Padmaja *et al.*, 2003), but is in contradiction with the findings of (Pitigala and Gunatilake, 2002). Pitigala and Gunatilake reported the weeding cost pattern for Jatropha plantation in 2002, and they claimed to increasing cost design from 1st to 6th year of maintenance of crop. Reason behind the story can be dissimilar site conditions and different tree species. It has noticed that some tree species are more sensitive to weeds, and such species need intensive care for a long time. Similarly, silt clearance operation is another significant operation in the irrigation plantation. It ensures the reopening of tranches and confirms the continuous supply of abundant water to plants (Nissen *et al.,* 2001). Cutting, conversion and carriage are the last operations in break-up of expenditures. Costs of all operations are accounted in Coolly units, and it is an officially recognized parameter used in forest departments in Pakistan. Rate of coolly may vary with time and different site conditions. It is further noticed that some operations can be conducted from the mechanical machinery/tools, but their charges must be counted into same unit of coolly. However, this condition is applicable for departmental works only, and investors are not bound to such restrictions.

4.2. Growing stock

At present, *D. sissoo*, *E. camaldulensis* and *A. nilotica* are the leading tree species in all irrigated plantations in Pakistan. Table 4 displays the age-wise and site-quality wise mean volume (m^3 ha^{-1}) of studied three tree species from seven research sites. The results show that *D. sissoo*, age-classes 0-5 to 20-25 years, has the mean volume at site qualities-I, II and III as 136.7 ± 36.8 (m^3 ha^{-1}), 104.9 ± 23.4 (m^3 ha^{-1}) and 77.8 ± 14.4 (m^3 ha^{-1}). The results illustrate that *E. camaldulensis*, age-classes 0-5 to 10-15, has the mean volume at site quality-I as 152.8 ± 96.2 (m^3 ha^{-1}), site quality-II as 114.4 ± 71.3 (m^3 ha^{-1}) and site quality-III as 89.7 ± 33.8 (m^3

ha^{-1}). *A. nilotica*, age classes 0-5 to 16-20 years, has the mean volume at site quality-I as 185.6 ± 94.1 (m^3 ha^{-1}), site quality-II as 157.8 ± 53.8 (m^3 ha^{-1}) and site quality-III as 117.9 ± 43.8 (m^3 ha^{-1}). It is observed during the study that tree diameter and volume have positive relationship, and tree volume rises with the increase in diameter and stem density. The endorsement of this relationship has already reported earlier by Arif *et al.* (2017). These findings are in accordance with conclusions from Montagnini *et al.* (1995), Montagnini and Porras (1998) and Piotto *et al.* (2003a, b) and Petit B (2004), that the growth of same species is almost similar in other plantations of the comparable regions. Whereas, tree diameter and stem density have negative relationship, and their relationship is observed as inversely proportional. Figures 3-5 are displaying a relationship between time (year) and tree volume (m^3/ha) for *D. sissoo*, *E. camaldulensis* and *A. nilotica*. Results shown that tree volume (m^3 ha^{-1}) rises with an increase of time (year), and it is established that volume is the function of time (Arif et al., 2017). Moreover, CAI (m^3) and MAI (m^3) start getting decreased with the passage of time. It is also confirming the findings from Fry and Poole (1980), Lamprecht (1986) and McDade *et al.* (1994) that tree species could be harvested when their growth starts to decrease. Generally, at that stage, tree species attain their optimum merchantable size (Butterfield, 1993).

Table 4. Age-classes wise and site-qualities wise mean volume (m^3 ha^{-1}), CAI (m^3) and MAI (m^3) of major three tree species

Age (years)	Site quality I			Site quality II			Site quality III		
	Volume (m^3)	CAI (m^3)	MAI (m^3)	Volume (m^3)	CAI (m^3)	MAI (m^3)	Volume (m^3)	CAI (m^3)	MAI (m^3)
Dalbergia sissoo									
5	36.8	14.5	7.4	23.4	8.7	4.7	14.4	6.3	2.9
10	77.1	6.3	7.7	57.3	6.1	5.7	39.4	4.1	3.9
15	104.2	4.5	6.9	84.2	4.4	5.6	57.8	2.9	3.9
20	124.9	3.3	6.2	97.3	1.7	4.9	69.8	2.2	3.5
25	136.7	1.2	5.5	104.9	1.2	4.2	77.8	1.4	3.1
Eucalyptus camaldulensis									
5	96.2	13.4	19.2	71.3	10.5	14.3	33.8	4.4	6.8
10	137.4	2.2	13.7	97.3	7.1	9.7	65.2	5.3	6.5
15	152.8	5.6	10.2	114.4	1.8	7.6	89.7	3.1	6.0
Acacia nilotica									
5	94.1	21.2	18.8	53.8	18.7	10.8	43.8		8.8
10	149.6	7.7	15.0	119.4	9.6	11.9	71.0	5.2	7.1
15	173.8	3.6	11.6	145.7	3.5	9.7	95.8	4.8	6.4
20	185.6	1.4	9.3	157.8	1.8	7.9	117.9	4.2	5.9

Note: CAI (m^3): Current annual increment; MAI (m^3): Mean annual increment

It is noted that tree productivity, their uses and market values are the significant factors in decision making for raising preferences in plantations. Therefore, *D. sissoo*, *E.*

camaldulensis and *A. nilotica* are the most preferred species for reforestation in blank areas of irrigated plantations. Tree economic value is most important for planting purpose (Montagnini *et al.*, 2003). Generally, *D. sissoo* is perhaps the most regularly planted specie in the areas with good soils and adequate water availability. *E. camaldulensis* is preferred for the areas with moderate soils with lesser irrigation supply. Whereas, *A. nilotica* is an ideal tree species for poor sites receiving a limited supply of irrigation (Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; FWF, 2016; Arif *et al.*, 2017). It is evident from the previous studies that tree species preference depends on several other aspects such as genetic characteristics, vegetative propagation, climatic and edaphic conditions, etc., (Montagnini *et al.*, 2002, Petit and Montagnini, 2004). In contrast, tree species with good timber quality are preferred over higher growth for planting under commercial purpose.

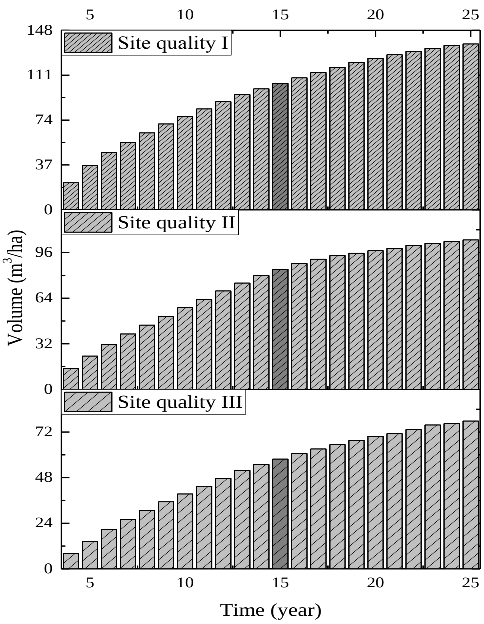

Figure 3: Relationship between time (year) and tree volume (m^3/ha) for *Dalbergia sissoo*

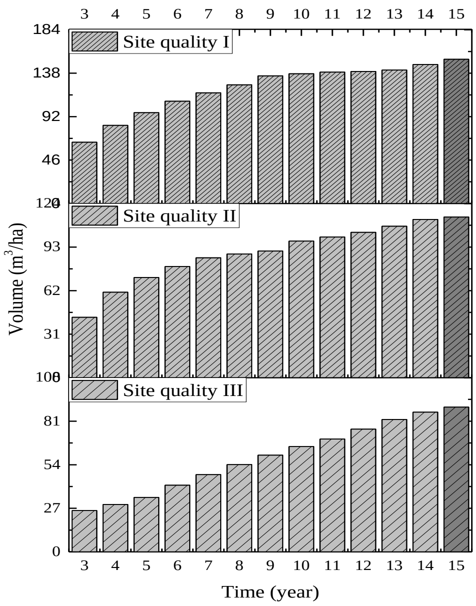

Figure 4: Relationship between time (year) and tree volume (m^3/ha) for *Eucalyptus camaldulensis*

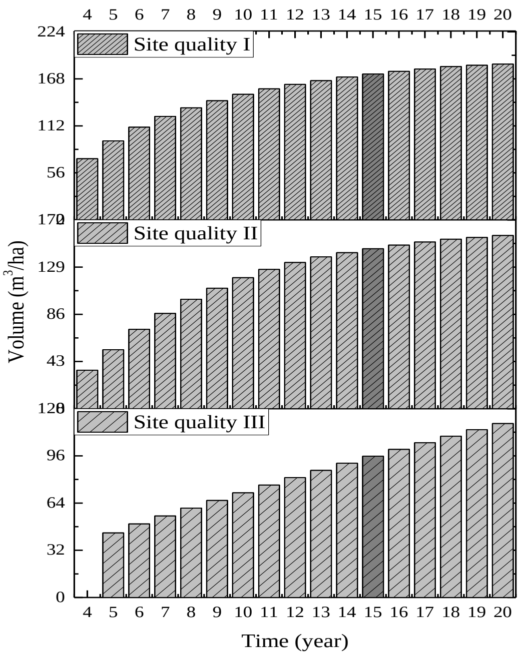

Figure 5: Relationship between time (year) and tree volume (m^3/ha) for *Acacia nilotica*

Under the available conditions, *D. sissoo*, *E. camaldulensis* and *A. nilotica* are best tree species to be established/raised at different sites under SPFC. Although, originally, these tree species are not indigenous, but have been well-adapted to the environmental and edaphic conditions and have started growing naturally in the plantations. Thinning and pruning practices are important and needed for maintaining good tree form. For *D. sissoo* crop, thinning is carried out in the 6th and 12/13th years when crop rotation age is fixed as 20 years. *E. camaldulensis* is usually prescribed with 10-years of rotation age without thinning practices. *A. nilotica* is a preferred species mostly for the poor soils and is recommended for environmental protection purposes (Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; FWF, 2016; Arif *et al.*, 2017).

Timber and fuelwood market prices for *D. sissoo*, *E. camaldulensis* and *A. nilotica* are given in Table 5. It is obvious that each tree species has different market prices for similar log-classes, and price is mainly contingent on its length, girth sizes and quality-class. Same nomenclature of timber and firewood is opted as recommended by the Punjab forest department in 2013 (Ahmed, 2015; Babar, 2015; Khaggah, 2015; Shahzad, 2015; FWF, 2016).

Table 5: Timber price (\$/m^3) of tree species in the open market of Pakistan

Sr. No.	Log classes	Log measurement (length/girth over bark)	Timber price (\$/m^3)		
			Dalbergia sissoo	*Eucalyptus camaldulensis*	*Acacia nilotica*
1.	I A	≥2.44m to ≤4.88m/≥160cm	1003-1340	590-788	314-419
2.	I B	〃	737-907	433-534	230-284
3.	I C	〃	534-673	314-396	167-210
4.	II A	≥2.44m to ≤4.88m/≥135cm to ≤159cm	939-1073	553-631	294-335
5.	II B	〃	603-806	355-474	189-252
6.	II C	〃	470-571	276-336	147-178
7.	IIIA	≥2.44m to ≤4.88m/≥97cm to ≤134cm	838-1003	493-590	262-314
8.	IIIB	〃	704-737	414-433	220-230
9.	IIIC	〃	304-368	179-217	95-115
	Mean		681-831	401-489	213-260

Note: Firewood (dry) mix for all species and classes= \$18/m^3

4.3. Economic comparison

Average cost of raising tree species for 15-years crop was counted as \$1,525 (ha^{-1}) for all species. Mean timber prices for *D. sissoo, E. camaldulensis* and *A. nilotica* were calculated as \$756 per (m^3), \$445 per (m^3) and \$236 per (m^3) in the local market. Table VI illustrates the economic comparison of cost and returns for the discussed tree species for different age-classes and site-qualities. Table 6 shows that *D. sissoo,* age classes 0-5 to 11-15 years, has the NPV at site quality-I ranging as \$40,941 ± (-) 223 (ha^{-1}), site quality-II as \$25,821 ± (-) 464

(ha^{-1}), and site quality-III as \$8,371 ± (-) 626 (ha^{-1}). The results display that *E. camaldulensis*, age classes 0-5 to 11-15 years, has the NPV at site quality-I ranging as \$25,564 ± 2,555 (ha^{-1}), site quality-II as \$16,760 ± 1,252 (ha^{-1}), and site quality-III as \$10,338 ± (-) 277 (ha^{-1}). Similarly, *A. nilotica*, age classes 0-5 to 11-15 years, has the NPV at site quality-I ranging as \$16,209 ± 1,354 (ha^{-1}), site quality-II as \$11,562 ± 83 (ha^{-1}), and site quality-III as \$4,341 ± (-) 97 (ha^{-1}). Tree volume of *D. sissoo* remains lower from *E. camaldulensis* and *A. nilotica* at site qualities-I, II and III, but it provides higher net-returns at site qualities-I and II. Similarly, *E. camaldulensis* delivers more earnings at site-quality-III. It is obvious from the results that NPV significantly remains positive for the 6-10 and 11-15-year age-classes period. However, investment is looking inappropriate for 0-5 years period in the forest-based sector in Pakistan. These results are in line with the finding from Azhar *et al.* (2011) and Mutanal *et al.* (2009). NPV will differ for each site and depend upon tree species, practices and site conditions. NPV for irrigated plantations and other sites will be different due to the previously discussed factors.

Table 6: Age-classes wise and site-qualities wise financial comparison (\$ ha^{-1}) of planting major three tree species in the irrigated plantations in Pakistan

Age (years)	Net Present Value (\$ ha^{-1})		
	Site quality I	Site quality II	Site quality III
Dalbergia sissoo			
5	-223	-464	-626
10	12,729	5,730	242
15	40,941	25,821	8,371
20	59,443	44,186	21,551
25	71,882	56,549	33,921
Eucalyptus camaldulensis			
5	2,555	1,252	-277
10	11,089	7,378	3,812
15	25,564	16,760	10,338
Acacia nilotica			
5	1,354	83	-97
10	9,118	4,868	2,253
15	16,209	11,562	4,341
20	21,116	15,819	10,305

The findings from this study are obvious and would be followed until decrease in growth rates is detected for *D. sissoo*, *E. camaldulensis* and *A. nilotica*. In such case, it can affect the yield and as well as their net returns. Furthermore, current information regarding uses of tree species is required after this research. Information relating to investor interests and objectives can be more important than tree productivity. This research is a pioneer in its kind and has provided a solid foundation for the investors and researchers working on forest-based sector under OBOR and CPEC. It is providing an opportunity to expand research and can deliver relevant and important information to invest in the forest-based sector in Pakistan within context of globalization. This study can be followed up with other ensuing and well fitted studies.

All these conditions and situations are principally subjected to change in foreign trade policy and development in forest-based sector investment and within the context of globalization as discussed earlier by Merkova and Drabek (2010), Merkova *et al.* (2012), and Merkova *et al.* (2015). It has observed that globalization brings progress in forest-based sector investment, and it also boost the wood industry as confirmed from results of Merková, Drábek and Jelačić (2011) and Sujova *et al*. (2015).

5. Conclusions

This study assessing the tree growth potential of existing forest crops and providing the cost and returns information for raising/establishing plants from study areas, which is a necessary information for the investors to decide for investment in SPFC under globalization context. Research pointed out that SPFC is holding forest lands, presently laying blank, and is the perfect platform for Chinese's enterprises to invest their capital to generate both sustainable returns and long-term capital appreciation. SPFC is offering the investors to have access to forest sites and is ensuring the availability of all basic required factors needed for raising forest crops. Forest company is also offering technical support and facilitation regarding law and order situations. NPV results are confirming the potential areas for significant investment. SPFC is assuring the investors for safe 100% capital investment + profit takes the back guarantees, which is admissible by the federal government to Chinese's enterprises under OBOR and CPEC agreements. Pakistan and China, through cooperation and investment, have the potential to be meaningful partners in promoting growth and stability in all sectors, mainly agriculture sector under OBOR and CPEC initiatives.

6. References

AHMED, M. *Draft working plan of Multan forest division*. Forestry, Wildlife and Fisheries Department, Government of Punjab, Lahore, Pakistan, 2015.

AHMED, R.; MUSTAFA, U. *Impact of CPEC projects on agriculture sector of Pakistan: Infrastructure and agricultural output linkages*. Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan, 2014.

ALAVALAPATI, J. R. R.; MERCER, D. E. *Valuing agroforestry systems: Methods and applications*. Springer Science & Business Media, New York, USA, 2006.

ALI, L.; MI, J.; SHAH, M.; SHAH, S. J.; BIBI, K. The potential socio-economic impact of China Pakistan Economic Corridor. *Asian Development Policy Review,* v. 5, n. 4, p. 191-198, 2017a.

ALI, Y.; RASHEED, Z.; MUHAMMAD, N.; YOUSAF, S. Energy optimization in the wake of China Pakistan Economic Corridor (CPEC). *Journal of Control and Decision*, v. 5, n. 2, p. 129-147, 2017b.

ANJUM, K.; QADIR, I.; FAROOQ, M. A.; HAFEEZ, S. Economic evaluation of irrigated plantation in Kamalia, Punjab, Pakistan. *Journal of Agricultural Research,* v. 51, 2013.

ANTLE, J. M. Human capital, infrastructure, and the productivity of Indian rice farmers. *Journal of Development Economics,* v. 14, n. 1, p. 163-181, 1984.

ANWAR, M. I.; QURESHI, M. A. A. Economic analysis of irrigated plantations: a case study of Kamalia plantation. *Pakistan Journal of Agricultural Sciences,* v. 31, p. 294-297, 1994.

ARIF, M. *Resources assessment and sustainable management of Chichawatni irrigated plantation in Pakistan*. PhD thesis, Department of Forestry Economics and Management, Northeast Forestry University, Harbin, P. R. China, 2018.

ARIF, M.; SHAHZAD, M. K.; ELZAKI, E. E. A.; HUSSAIN, A.; ZHANG, B.; YUKUN, C. Biomass and carbon stocks estimation in Chichawatni irrigated plantation in Pakistan. *International Journal of Agriculture and Biology,* v. 19, n. 6, p. 1339-1349, 2017.

ASHRAF, M. M.; CHAUDHRY, I.; GROSENICK, G. *Irrigated plantations in Pakistan: Forestry sector master plan Pakistan*. Government of Pakistan, Islamabad, Pakistan, 1991.

ASIF, M.; SIDDIQUI, M. T.; NAWAZ, M. F.; KASHIF, M. Economic appraisal of Changa Manga irrigated forest plantation. *Pakistan Journal of Agricultural Sciences*, v. 51, p. 545-548, 2014.

AZHAR, M.; ISHAQUE, M.; HUSSAIN, M.; SIDDIQUI, M. T. Economic evaluation of Daphar irrigated plantation in Punjab. *Pakistan Journal of Science*, v. 63, n. 1, 2011.

BABAR, K. *Draft working plan of Layyah forest division*. Forestry, Wildlife and Fisheries Department, Government of Punjab, Lahore, Pakistan, 2015.

BHAGWATI, J. *In defense of globalization: With a new afterword*. Oxford University Press, Dehli, India, 2004.

BIRDSEY, R.; PAN, Y. Trends in management of the world's forests and impacts on carbon stocks. *Forest Ecology and Management*, v. 355, p. 83-90, 2015.

BOND, C.; J. O'BYRNE, D. Challenges and conceptions of globalization: An investigation into models of global change and their relationship with business practice. *Cross Cultural Management*, v. 21, n. 1, pp. 23-38, 2014.

BUKHARI, S. S. B.; HAIDER, A. M.; LEEQ, M. T. *Land cover atlas of Pakistan*. Pakistan Forest Institute Publishers, Peshawar, Pakistan, 2012.

BUTTERFIELD, R. P. *Tropical timber species growth in the Atlantic lowlands of Costa Rica and wood variation of two native species*. North Carolina State University, Raleigh, NC, 1993.

CHANG, C.-P.; LEE, C.-C.; HSIEH, M.-C. Does globalization promote real output? Evidence from quantile cointegration regression. *Economic Modelling*, v. 44, p. 25-36, 2015.

CHENG, L. K. Three questions on China's "Belt and Road Initiative". *China Economic Review*, v. 40, p. 309-313, 2016.

CHOI, Y. K.; SCHELLHASE, R. Exploring globalization and marketing performance at the 2012 global marketing conference at Seoul. *Journal of Business Research*, v. 67, n. 10, p. 2053-2055, 2015.

DREHER, A. Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, v. 38, n.10, p. 1091-1110, 2006.

ECONOMICS, T. *Trading economics for the Pakistan*. Available at https://tradingeconomics.com/pakistan. 2018. (accessed 18 January 2018).

FOOD AND AGRICULTURE ORGANIZATION (FAO). *Global forest resources assessment 2015: How are the world's forests changing?* Food and Agriculture Organization Press, Rome, 2016.

FOUNDATION, N. *Economic Benefits of Neem Production*. Available at http://www.neemfoundation.org. 2018. (accessed 19 January 2018).

FRIDAY, J. B.; CABAL, C.; YANAGIDA, J. *Financial analysis for tree farming in Hawaii*, 2000.

FRY, G.; POOLE, B. Evaluation of planting stock quality several years after planting. *New Zealand Journal of Forestry Science*, 1980.

FORESTRY, WILDLIFE & FISHERIES (FWF) DEPARTMENT. *Forestry, Wildlife & Fisheries Department Data*. Government of Punjab, Lahore, Pakistan, 2016.

GLOCK, D. *China's one belt, one road initiative and its potential impact on Central Asia*. Available at https://www.researchgate.net/. 2017. (accessed 18 December 2017).

HAJDÚCHOVÁ, I.; SEDLIAČIKOVÁ, M.; HALAJ, D.; KRIŠTOFÍK, P.; MUSA, H.; VISZLAI, I. The Slovakian forest-based sector in the context of globalization. *BioResources*, v. 11, n. 2, p. 4808-4820, 2016.

HARRISON, S. R.; VENN, T. J.; SALES, R.; MANGAOANG, E. O.; HERBOHN. J. L. Estimated financial performance of exotic and indigenous tree species in smallholder plantations in Leyte Province. *Annals of Tropical Research*, v. 27, p. 67-80, 2005.

HARRISON, S.; HERBOHN, J. Financial evaluation of forestry investments: Common pitfalls and guidelines for better analyses. *Small-Scale Forestry*, v. 15, n. 4, p. 463-479, 2016.

HUSSAIN, I.; HANJRA, M. A. Irrigation and poverty alleviation: review of the empirical evidence. *Irrigation and Drainage*, v. 53, n. 1, p. 1-15, 2004.

IORIS, A. A. R. *The political ecology of the state: the basis and the evolution of environmental statehood*. Routledge, Oxford, UK, 2014.

KHAGGAH, N. H. *Draft working plan of Chichawatni forest division*. Forestry, Wildlife and Fisheries Department, Government of Punjab, Lahore, Pakistan, 2015.

KLEMPERER, W. D. *Forest resource economics*. McGraw-Hill, New York, 1995.

KLIESTIK, T.; CUG, J. Comparison of selected models of credit risk. *Procedia Economics and Finance*, v. 23, p. 356-361, 2015.

LAMPRECHT, H. *Silviculture in the Tropics*. GHZ, Eschborn, p. 296, 1986.

MAHAPATRA, A. K.; TEWARI, D. D. Importance of non-timber forest products in the economic valuation of dry deciduous forests of India. *Forest Policy and Economics*, v. 7, p. 455-467, 2005.

MAJID, T. *Economics of Eucalyptus camaldulensis in District Faisalabad*. Department of Forestry, M.Sc. Thesis: University of Agriculture, Faisalabad, Pakistan, 1995.

MAYER-FOULKES, D. The challenge of market power under globalization. *Review of Development Economics*, v. 19, n. 2, p. 244-264, 2015.

MCDADE, L. A. *La Selva: ecology and natural history of a neotropical rain forest*. University of Chicago Press, Chicago, USA, 1994.

MCMILLAN, M.; RODRIK, D.; VERDUZCO-GALLO, I. Globalization, structural change, and productivity growth, with an update on Africa. *World Development*, v. 63, p. 11-32, 2014.

MELLER, B. The two-sided effect of financial globalization on output volatility. *Review of World Economics*, v. 149, n.3, p. 477-504, 2013.

MERKOVÁ, M.; JOSEF, D.; JELAČIĆ, D. Determinants of effects of foreign direct investment in terms of Slovak Republic and wood-processing industry of Slovakia. *Drvna industrija*, v. 63, n. 2, p. 129-142, 2012.

MERKOVA, M.; DRABEK, J. *Wood processing and furniture manufacturing: present conditions, opportunities and new challenges.* Vyhne, Slovak Republic., 2010.

MERKOVA, M.; DRABEK, J.; JELACIC, J. Evaluation of Investment Management and Business Performance in Wood Processing Industry in Slovakia. *Wood Industry/Drvna Industrija*, v. 66, n. 3, 2015.

MERKOVÁ, M.; DRÁBEK, J.; JELAČIĆ. *Impact of investment on labour productivity growth in wood processing industry in Slovak Republic*. Available at http://publikace.k.utb.cz/. 2011. (accessed 10 December 2016).

MONTAGNINI, F.; CAMPOS, J. J. N.; CORNELIUS, J.; FINEGAN, B.; GUARIGUATA, M.; MARMILLOD, F.; UGALDE, L. Environmentally-friendly forestry systems in Central America. *Bois et Forests des Tropiques*, v. 272, n. 2, p. 33-44, 2002.

MONTAGNINI, F.; GONZÃLEZ, E.; PORRAS, C.; RHEINGANS, R. Mixed and pure forest plantations in the humid neotropics: a comparison of early growth, pest damage and establishment costs. *The Commonwealth Forestry Review*, p. 306-314, 1995.

MONTAGNINI, F.; PORRAS, C. Evaluating the role of plantations as carbon sinks: an example of an integrative approach from the humid tropics. *Environmental management*, v. 22, n. 3, p. 459-470, 1998.

MONTAGNINI, F.; UGALDE, L; NAVARRO, C. Growth characteristics of some native tree species used in silvopastoral systems in the humid lowlands of Costa Rica. *Agroforestry systems*, v. 59, n. 2, p. 163-170, 2003.

MUTANAL, S. M.; PATIL, S. J.; PATIL, H. Y. Performance of Soybean-Sunflower under different tree species in black soils. *Karnataka Journal of Agricultural Sciences*, v. 22, n. 2, p. 377-381, 2009.

NATH, C. D.; PALISSIER, R.; GARCIA, C. Comparative efficiency and accuracy of variable area transects versus square plots for sampling tree diversity and density. *Agroforestry Systems*, v. 79, n. 2, p. 223-236, 2010.

NISSEN, T. M.; MIDMORE, D. J.; KEELER, A. G. Biophysical and economic tradeoffs of intercropping timber with food crops in the Philippine uplands. *Agricultural Systems*, v. 67, n. 1, p. 49-69, 2001.

NORBACK, P.-J.; PERSSON, L. Born to be global and the globalization process. *The World Economy*, v. 37, n. 5, p. 672-689, 2014.

PADMAJA, K. V.; WANI, S. P.; AGARWAL, L.; SAHRAWAT, K. L. *Economic assessment of desilted sediment in terms of plant nutrients equivalent: A case study in the Medak district of Andhra Pradesh*. Global Theme 3: Water, Soil and Agro diversity Management for Ecosystem Resilience, 2003. Report no. 4.

PAKISTAN. *Pakistan economic survey 2016-17*. Available at www.finance.gov.pk. 2017. (accessed 22 January 2018).

PAROBEK, J.; PALUS, H.; KAPUTA, V.; SUPIN, M. Analysis of wood flows in Slovakia. *BioResources*, v. 9, n. 4, p. 6453-6462, 2014.

PASCHALIS-JAKUBOWICZ, P. Analysis of selected factors in the processes of globalization and their impact on global trends in forestry. Role, place and importance of forests and forestry in a global perspective. *Sylwan*, v. 154, n. 3, p. 147-159, 2010.

PEARSE, P. H. *Introduction to forestry economics.* University of British Columbia Press, Vancouver, Canada, 1990.

PETIT, B.; MONTAGNINI, F. Growth equations and rotation ages of ten native tree species in mixed and pure plantations in the humid neotropics. *Forest Ecology and Management*, v. 199, n. 2-3, p. 243-257, 2004.

PIOTTO, D.; MONTAGNINI, F.; UGALDE, L.; KANNINEN, M. Growth and effects of thinning of mixed and pure plantations with native trees in humid tropical Costa Rica. *Forest Ecology and Management*, v. 177, n. 1-3, p. 427-439, 2003a.

PIOTTO, D.; MONTAGNINI, F.; UGALDE, L.; KANNINEN, M. Performance of forest plantations in small and medium-sized farms in the Atlantic lowlands of Costa Rica. *Forest Ecology and Management*, v. 175, n. 1-3, p. 195-204, 2003b.

PITIGALA AND GUNATILAKE. An assessment of economic and financial feasibility of selected forest plantation species. *Sri Lankan Journal of Agricultural Economics*, v. 4, p. 121-135, 2002.

POTRAFKE, N. The evidence on globalization. *The World Economy*, v. 38, n. 3, p. 509-552, 2015.

RAHIM, S. M. A. *Working plan of Changa Manga forest division*. Forestry, Wildlife and Fisheries Department, Government of Punjab, Lahore, Pakistan, 2010.

SHAH, T.; SINGH, O. P.; MUKHERJI, A. Some aspects of South Asia's groundwater irrigation economy: analyses from a survey in India, Pakistan, Nepal Terai and Bangladesh. *Hydrogeology Journal*, v. 14, n. 3, p. 286-309, 2006.

SHAHZAD, M. K. *Draft working plan of Bahawalpur forest division*. Forestry, Wildlife and Fisheries Department, Government of Punjab, Lahore, Pakistan, 2015.

SHARMA, V. P.; KUMAR, A. Effects and financial performance of poplar-based agroforestry systems in the north-western region of India. *Agricultural Economics Research Review,* v. 13, p. 123-137, 2000.

SHEIKH, M. I. *Trees of Pakistan*. Pictorial Printers (Pvt.) Ltd., Islamabad, Pakistan, 1993.

SIAL, S. The China-Pakistan Economic Corridor: an assessment of potential threats and constraints. *Conflict and Peace Studies,* v. 6, n. 2, p. 24, 2014.

SMITH, P.; BUSTAMANTE, M.; AHAMMAD, H.; CLARK, H.; DONG, H.; ELSIDDIG, E. A.; HABERL, H.; HARPER, R.; HOUSE, J.; JAFARI, M. *Climate change 2014: mitigation of climate change*. Cambridge University Press, Cambridge, England, 2014.

SOUTH PUNJAB FOREST COMPANY (SFPC). *SPFC official site*. Available at http://www.spfc.org.pk/. 2018. (accessed 10 January 2018).

STRATEGY, A. *A new EU forest strategy: For forests and the forest-based sector*. European Commission Press, Brussels, 2013.

SUJOVA, A.; HLAVACKOVA, P.; MARCINEKOVA, K. Measuring the impact of foreign trade on performance growth of the wood processing industry. *Wood Research,* v. 60, n. 3, p. 491-502, 2015.

VESA, L.; MALIMBWI, R. E.; TOMPPO, E.; ZAHABU, E.; MALIONDO, S.; CHAMUYA, N.; NSSOKO, E.; OTIENO, J.; MICELI, G.; KAAYA, A. K. *NAFORMA field manual: Biophysical survey*. Dar es Salaam, Tanzania, 2010.