AN ECONOMIC ANALYSIS OF FORESTATION IN PAKISTAN

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CERTIFICATE

This is to certify that this thesis entitled: **"An Economic Analysis of Forestation in Pakistan"** submitted by **Ms. Sara Rehman** is accepted in its present form by the PIDE School of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Philosophy in Economics**.

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Dedication

I dedicate this Research to my beloved parents that have been a great source of inspiration and support; their love encouraged me at every step in life and particularly during my studies at PIDE. I dedicate my little effort to my brothers and sister whose love, trust, and prayers are unforgettable for me.

(Sara Rahman)

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Abstract

Kuznets curve hypothesis holds a non-linear relationship between growth and the environment that is a country in the initial stages of growth deteriorates the environmental assets but after reaching a maximum threshold level economies divert resources to environmental protection and improves their relationship with the environment such as in Pakistan an attempt was made to preserve the environment by initializing a billion tree plantation drive that is Billion Tree Afforestation project. This thesis is an attempt to reconnoitre the Kuznets curve hypothesis whether the situation which it stipulates holds in a less developing country like Pakistan and does the initiative of the billion tree project has any impact on the environmental condition of the country? In this regard, this study used the Autoregressive Distributed Lag (ARDL) cointegration technique to check for the existence of the Kuznets curve and the effect of the Billion Tree plantation drive on the environmental quality and therefore used two models with deforestation and forest cover as two response variables. Using 29 years of data from 1990 to 2019 obtained from the World Development Index WDI, The Food and Agriculture Organization Corporate Statistical Database FAOSTAT, and the billion trees afforestation BTAP as a dummy variable, the results indicate that the Kuznets curve is not applicable in Pakistan in the case of deforestation as a response variable and in the case of forest cover, it is applicable in the short run only. Whereas The Billion Trees Afforestation Project BTAP is shown to have no effect in both models, and this is because all of these trees are in the growth stage, and secondly, all these plantations are carried out on a negligible portion of the country, hence has no significant impact on the overall level of the country's environmental condition. The policy's implication thus implies taking appropriate measures for the mass plantations like BTAP throughout the country for the sustainability of forests to recover and protect the environment.

KEYWORDS
Kuznets curve, environmental assets, afforestation, world development indicators, sustainability

Contents

ACRONYMS

BTAP	The Billion Trees Afforestation Project
WDI	World Development Index
FAOSTAT	The Food and Agriculture Organization Corporate Statistical Database
ARDL	Autoregressive Distributive Lag
ECM	Error Correction Model
IPCC	Intergovernmental Panel on Climate Change
GNP	Gross National Product
GDP	Gross Domestic Product
NTFP	Non-timber Forest Products
WWF	World Wildlife
MEAs	Multilateral Environmental Agreements
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	UN Framework Convention on Climate Change
CITES	Convention on International Trade in Endangered Species
CMS	Conservation of Migratory Species
NBSAP	National Biodiversity Strategies and Action Plans
KPBSAP	Khyber Pakhtunkhwa Biodiversity Strategies and Action Plans
INDCs	Pakistan's Intended Nationally Determined Contributions
EKC	The Environmental Kuznets Curve
FCPF	Forest Carbon Partnership Facility
REDD+	Reducing Emissions from Deforestation and forest Degradation
DFO	Divisional Forest Officer
GPS	Global Positioning System
FP&M	The Forestry Planning and Monitoring Circle
CDE&GAD	Community Development, Extension & Gender & Development
I&HRD&M	Institutional & Human Resource Development & Management
R&D	Research and Development
VDCs	Village Development Communities
M&E	The Monitoring & Evaluation
GIS/RS	Geographic Information Systems & Remote Sensing
IUCN	The International Union for Conservation of Nature
POP	Population density
API	Agriculture price Index
AGRL	Agricultural Land
FDI	Foreign Direct Investment
DEF	Deforestation
FC	Forest Cover
ADF	Augmented Dickey-Fuller

CHAPTER1

INTRODUCTION

1.1.1. The case of the world

Forest is the backbone of the green economy and is unfortunately undervalued and not properly taken care of in many countries. One of the prime reasons is probably because of underestimating its economic value and the environmental benefits are not comprehended in sense of market values. Timberland is of vital importance for any economy, whether it is regional or global, in terms of providing raw materials for energy and business purposes. Planted forests have provided a well-sustainable structural basis for many developing economies in the enhancement of wood-based manufacturing and hence their contribution to the country's exports (Jürgensen et al, 2014). The multifunctionality of woods can be expected from various jobs that it serves to nature and climate using an administrative device for hydrologic cycles, giving shelters to biodiversity, contributing crude material for therapeutic and woodland items, forestalling soil obliteration, and fulfilling sporting, otherworldly, and tasteful worth necessities. (Tsiantikoudis, Zafeiriou, Kyriakopoulos&Arabatzis 2019). Forest is the main source of livelihood for many households throughout the globe as provided green jobs. According to the Food and Agriculture Organization of the United Nations (FAO) 2020, about 880 million[1] individuals depend on forests to fulfil their domestic energy requirements in the shape of floods or deliver charcoal, a major portion consists of females. It is estimated that around 1 billion people of the world rely to some extent on wild food in the shape of meeting their much-needed nutritional requirements for wild meat, edible flora, comestible bugs, and vegetation food like mushrooms, and fish from freshwater that flows through it (Burlingame, 2000).

Since the beginning of the Industrial Revolution, the overall globe has turned into the functional centre of money-related headways. The advancement from a traditional cultivation-based society to a modern machine-based society generally brings along some negative impacts on the environment. Industrialization's negative impacts on the environment can be comprehended from the drastic shift from a green economy to a carbon emission based economy; Environment and environmental limits have been found to happen even more truly following the rising of overall temperature by 0.5 ◦ C which as shown by the 2018

[1]See Food and Agriculture Organization of the United Nations (FAO) 2020 annual Report, executive summary, page XVII

report of the Intergovernmental Panel on Climate Change (IPCC), has been delivered due to the overall ordinary surface temperature upswing of about 0.87 ◦ C from the late nineteenth-century level. These issues are the aftereffect of anthropogenic exercises, which declares sufficient measure of nursery gases. More vagarious climate, more prominent seriousness of cataclysmic events, outrageous dry spell in numerous districts, rising ocean levels because of liquefying of polar ice covers, transformation and elimination of some living species, and weakened human wellbeing are hence shadowed as a result of biological and ecological effects of theories anthropogenic exercises.

Within the last couple of centuries, deforestation has become a necessary tool, which permanently converts forest land into other land uses, to uphold societal modernization and urbanization. The rate forests are degrading and deforestation takes place is quite alarming, which indicates a significant loss of biodiversity, since 1990 it is estimated that about 420[2] million hectares of forest land have been put into other practices. Although for the last three decades, the rate of deforestation has diminished from 16 million hectares in 1990 to 10 million hectares during 2015-2020 on an annual basis, the total occupancy of land from the forest has diminished by 80 million hectares throughout the globe. More than 100 million hectares of woodlands are antagonistically influenced by backwoods fires, bugs, sicknesses, obtrusive species dry season, and unfriendly climate occasions (Food and Agriculture Organization of the United Nations Report, 2020).

Deforestation means fewer trees absorbing fewer greenhouse gases and increased quantities of carbon emissions, so economic growth and environmental degradation have a nonlinear relationship which is being characterized by the "Environmental Kuznets Curve" which states that at the initial level of Economic Development environment deteriorates, but when economic development reaches a certain level societies begin to improve their relationship with environment and level of environmental degradation improves (Kuznets, 1955). In the transition stages of economic development economies, open rely on heavy infrastructure projects leading to more environmental degradation in the form of emissions like carbon dioxide sulphur, and nitrogen dioxide (Dasgupta et al., 2002). However, after a threshold level, the reclamation of quality of life and decline in various pollutants is being accommodated by high sustained economic growth. Hence, over time, the effluence absorption intensity will turn down.

[2] See Food and Agriculture Organization of the United Nations (FAO) 2020 annual Report, executive summary, page XVI

1.2. The Case for Pakistan

Pakistan is fundamentally a mountainous country; its elevation varies from sea level to 8611 meters and has almost 65 percent of its area under mountains with an area of 88.430 million hectares and a population of 207,774 million[3]. The area distributions accord such that approximately 49 percent of the area is arid receiving less than 250 mm of rainfall annually, while 35 percent of the area is semi-arid with an annual rainfall of about 250-500 mm[4]. The remaining 16 percent area occurs in the sub-humid zone in the northern mountainous tract and contains productive coniferous forests. Thus, an important role in sustainable agriculture is being played by the forestry sector in Pakistan, as the bulk of irrigation water originates in these forest lands Pakistan is a federation of four provinces; Baluchistan, Khyber Pakhtunkhwa (KP), Punjab, and Sindh. The country has three special areas i.e. Gilgit Baltistan (GB) and Islamabad Capital Territory (ICT). Pakistan has glaciers, water bodies, and settlements over 6.8 percent of the total landmass of the country; agriculture extends over 29.2 percent of the area, while another 8.7 percent area is reported as barren; the remaining 55.3 percent area is under the management of the forestry sector; of which 5.1 percent is under forests, 1.7 percent is postures, and 45.1 percent is under rangelands[5]. Pakistan is a forest poor country with a small area of 4.478 million ha (5.1 percent) under forests. This amounts to 0.021 ha per person, compared to the world average of 1 ha/person. The contribution of the forestry sector to the GNP and GDP as per official estimates seems quite insignificant, primarily because a multitude of non-timber forest products (NTFP) and non-tangible environmental and ecological benefits of the forests are not taken into account (Forestry Sector Review: Pakistan 2019).

Higher energy demand is being anticipated by Pakistan's economy during the last few decades, due to enormous growth and, and continuous globalization with the opening of trade. Some challenges in the form of negative environmental impacts are being anticipated due to economic progress. The issue that relates to the alarming rate of environmental degradation in the country is that Pakistan's economy relies heavily on agriculture, increasing urbanization, the increasing need for agricultural land, and a higher population rate and for this reason, Pakistan has a high rate of deforestation. Currently, about 2.5% of the land area in Pakistan is natural forest, with a 2.1% annual rate of deforestation (WWF, 2010).

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[3] See, Pakistan Bureau of statistics, census of Pakistan 2017.
[4] See, National action programme to combat desertification in Pakistan, Ministry of Climate change (2017), International Union for Conservation Nature (IUCN), Pg. 22/103.
[5] See Food and Agriculture Organization of the United Nations, Forestry sector review: Pakistan, 2019. Executive summary, Pg. xiii.

The FAO's Global Forest Resource Assessment (2010:230) indicates that the deforestation trend in Pakistan is a constant rise. In about 10 years between 1990-2000, Pakistan lost 41,000-hectare forest areas annually corresponding to 1.76% of the annual change in vegetation cover. Then between 2000-2005 (5 years), the country lost 43,000-hectare area/year at the rate of 2.11% per annum. The rate of deforestation further increased to 2.37% per annum between 2005-2010, thereby amounting to the tune of a 43,000-hectare area on average per annum. In this way, Pakistan has lost about 33.2% of its forest cover in 2 decades from 1990 to 2010 which accumulates to about 840,000 hectares[6]. The statistics on trends in the extent of forest cover change in Pakistan between 1990-2010 have been reproduced in the table below:

Table: 1 Trends in the Extent of Forest Change in Pakistan between 1990-2010

Annual Change Rate					
1990-2000		**2000-2005**		**2005-2010**	
000 ha/yr	%	000 ha/yr	%	000 ha/yr	%
-41	-1.76	-43	-2.11	-43	-2.37

Source: FAO's Global Forest Resource Assessment 2010

The "Billion Trees Afforestation Project" (BTAP) that commenced in November 2014 is the game changer and the flagship project of the green sector in Khyber Pakhtunkhwa. It was initially planned for completion in 5 years with the cost of Rs.28 Billion[7]. Later on, it was redesigned at a reduced cost of Rs.22 Billion. The PC-I for Phase-I was designed with a total cost of Rs.1.91 billion for one year and the actual expenditure was incurred up to Rs.1.82 billion. The PC-I for Phase-II was formulated at a total cost of Rs.9.83 billion for another year (Jan 1st, 2016 to Dec 31, 2017) and an amount of Rs. 8.29 billion was utilized including Forest Development Fund and Loan from Energy and Power Development Fund. The Phase was then cost neutrally extended till June 30, 2017. Thus, a total of Rs. 10.1 billion has been utilized under Phase-I & Phase-II of the Project with saving to the exchequer. For achieving the balance targets and maintenance of assets, Phase-III was launched for three years up to June 2020 with a total cost of Rs.7.71 billion on special directives of the Hon'ble Chief Minister KP. Thus, under the Project 116% target of One Billion seedlings has been achieved

[6] See, Pakistan Forest information and Data, https://rainforests.mongabay.com/deforestation/2000/Pakistan.htm
[7] See, Times of Islamabad, https://timesofislamabad.com/10-Mar-2019/kp-government-launches-unprecedented-afforestation-plan-in-the-history-of-pakistan

at a total cost of Rs.12.42 billion against the initially planned amount of Rs. 22 billion (Times of Islamabad, 2019).

It has been seen that the total forest area space of the country has extended by 0.979 million ha during the period from 1992 to 2011. The execution of the one Billion Tree Afforestation Project (from 2014 to 2019) in KP alone carried 6.3 percent additional areas to the forest area cover, in this way the forest front of KP extended from 20.3 percent to 26.6 percent. The total area planted or recuperated under this endeavour is the tune of 593,292 ha. To paint the economy Green, the then normal organization of Khyber Pakhtunkhwa had set up a Task Force and dispatched the "Green Growth Initiative". The Task Force on Green Growth had perceived six community districts based on these environmental themes; I) Forestry, II) Protected Areas, III) Clean Energy, IV) Climate Resilience, V) Water/Sanitation and VI) Waste Management for Khyber Pakhtunkhwa. In this manner after ace contemplations, officer-administration was centred on nearby two distinct regions and the goals were accounted for during the dispatching capacity of Green Growth Initiatives on February 9, 2014, at the Pakistan Forest Institute, Peshawar.

The government of Khyber Pakhtunkhwa initiated the idea of launching a gigantic afforestation and conservation project, namely the “Billion Trees Afforestation Project” in 2014, to tackle the upsurging dilemma of global warming. Such projects are also being implemented by other countries like China, India, Ethiopia, etc., with numerous implementing partners and sufficient financial resources. However, Khyber Pakhtunkhwa being a small and financially constrained province has accomplished the commitment of growing and raising one Billion seedlings in the shortest possible time in three years with an overall survival rate of 84.79 percent[8]. The project has paved way for the smooth transformation of the current economic growth model to that of the Green Economy.

BTAP is a venture of incredible importance and will add to meeting Pakistan's commitments under different Multilateral Environmental Agreements (MEAs) /global shows United Nation Convention on Biological Diversity (UNCBD), United Nation Convention to Combat Desertification (UNCCD), UN Framework Convention on Climate Change (UNFCCC), Ramsar Convention, Convention on International Trade in Endangered Species (CITES), Convention on the Conservation of Migratory Species (CMS), their conventions and Aichi Biodiversity Targets (Strategic goal A), and accomplished the goals of different public and commonplace approaches, techniques and activity plans like National Biodiversity Strategies

[8] See, World Wide Fund for Nature Pakistan (WWF-Pakistan) July 2017, Third Party Monitoring of billion trees afforestation project in Khyber Pakhtunkhwa phase-II, Pg. 20/187.

and Action Plans (NBSAP), Khyber Pakhtunkhwa Biodiversity Strategies and Action Plans (KPBSAP), environmental change strategy and activity plan, public wetlands strategy, public ecological arrangement, public and common woodland strategies, rangeland strategies, Bonn Challenge Targets and Commitments, Pakistan's Intended Nationally Determined Contributions (INDCs) and SDGs. It will assume a major part in carbon sequestration in the area and hence help in environmental change relief and transformation as well as has the potential for carbon credits deal under deliberate just as consistence showcases through REDD+ and Clean Development Mechanism past June 2018.

Pakistan has joined REDD+ as an accomplice in 2011. In 2013 Pakistan turned into an individual from the Forest Carbon Partnership Facility (FCPF) of the World Bank. As 21% of the fossil fuel by-product happen because of deforestation consequently BTAP will be useful to restore and foster new backwoods assets through farms.

1.3. Problem Statement

As societies innovate so as the needs and necessities of humans and these technological and behavioural changes in humans' wants and necessities add to the continuous environmental degradation, particularly carbon emission. Environmental debasement, produced mostly by financial development and the extreme utilization of regular assets, has driven economies throughout the planet to take measures to deal with matters of environmental externalities. Accordingly, nations in the wake of accomplishing higher development rates, select all the more harmless ecosystem assets to safeguard and secure climate and this non-straight connection between monetary development and natural debasement is being given the name "Ecological Kuznets curve" which is fundamentally U formed. Along these lines, the essential point of this investigation was to assess the BTAP (Billion Tree Afforestation Project) drive utilizing the idea of the Kuznets curve is to find out the impact of afforestation on the natural quality in a sense whether it has been improved or not, utilizing woodland cover as a pointer for development in ecological quality.

1.4 Objective

The main incentive behind this research is to answer the question that whether the Environmental Kuznets curve tends to exist in a developing country like Pakistan? Kuznets curve tends to explain the relationship between environment and growth and expounds that countries after reaching a threshold level of growth try to improve their relationship with the environment. Pakistan a developing country so far and with enormous growth potential has

endeavoured to improve its relationship with the Environment by initiating a massive plantation drive that is BTAP (Billion Tree Afforestation Project) to counter the ill effects of climate change, and therefore, this study aims to answer this question that whether this plantation drive brought some positive impacts on Environment or not?

So, the main aim of this study is

1. To validate the existence of the Kuznets curve
2. To analyse the impact of BTAP (Billion tree Afforestation Project) on the Environment.

1.5 Significance of the Study

This research scrutinized whether the Environmental Kuznets curve is applicable in the case of Pakistan. Therefore, this paper sees a need to investigate further both whether the EKC hypothesis exists and the role of Afforestation in the improvement of environmental conditions in Pakistan. In addition to exploring the nature of the relation between growth and forest cover, we examined the effect of recent policy initiatives that have been taken in the form of BTAP (Billion Tree Afforestation Project) on Forest Cover and assessed whether such initiatives are effective in the improvement of environmental quality. The BTAP is expected to reduce deforestation (one of the major causes of Carbon emissions) as one aspect of the project was to create a forest-protected area. The study explored the reasons for the success/failure of this initiative through qualitative measures such as using different reports and Key Informant Interviews (Forestry Environmental and Wild Life department Khyber Pakhtunkhwa). At the policy level, this will be helpful for better policy design, especially for the 10 billion trees project across Pakistan.

1.6 Organization of Study

The study will embody five chapters. Chapter 1 illuminate the introduction and case of forestation in Pakistan Chapter 2 presents the literature review. Chapter 3 demonstrates qualitative assessment. Chapter 4 will show the methodology Chapter 5 shows the empirical results and Chapter 6 will manifest a summary, and result in discussions along with the conclusion and recommendation.

CHAPTER 2

LITERATURE REVIEW

Global warming or environmental pollution has remained the focal point of discussion since the nineteenth century, researchers from across the globe have carried out investigative studies to find out the factors that adversely affect our environment. Researchers from different regions and economies studied factors like the emission of Co_2, deforestation, and many more variables that could be the possible reasons for causing this dilemma, using different analysis tools like country-wise case studies and Panel investigations. A brief discussion of research work conducted in different times or regions of the globe is presented here to fathom the association between environmental degradation, its factors, and the economy to come up with better implementation policies.

Rahman &Nasir (2012) researched the presence of the Environmental Kuznets curve (EKC) in South Asian nations explicitly, Pakistan, India, Bangladesh, and Sri Lanka the period 1984–2008. Besides, they imagined producing into account the results of debasement on ecological corruption their outcome affirmed the presence of territorial EKC in these locales the defilement factor was likewise assessed to have an impact on natural debasement in a way that it defers the defining moment in EKC.

While investigating the connection between fossil fuel by-products, pay, energy utilization, and unfamiliar exchange rate in Pakistan, Rahman, and Nasir (2011) used 36 years of data for the period 1972-2008 for the analysis. The Johansen strategy for co-integration was utilized in the investigation and discovered that there is a quadratic since quite a while ago run connection between fossil fuel by-products and pay, affirming the presence of the Environmental Kuznets Curve in Pakistan. Furthermore, constructive outcomes on discharges have been articulated if there should arise an occurrence of energy utilization and unfamiliar exchange. The short-run results have, nonetheless, prevented the presence from getting the Environmental Kuznets Curve.

Ghosh, (2010) inspected the EKC speculation in India by utilizing the autoregressive distributed lag (ARDL) approach among the factors (development, energy use, and contamination). He discovered no help for the EKC speculation in long haul connections and causalities, yet some short-run, bidirectional causality between fossil fuel by-products and monetary development. In the meanwhile, (Rahman et.al, 2019) attempted to inspect the Environmental Kuznets curve (EKC) theory for the BCIM-EC (Bangladesh–China–India–Myanmar economic corridor) participant nations added to the repertoire of the Belt and Road

Initiative (BRI) of China. Both time series and board information were covered, regarding carbon dioxide (CO2) emanations, GDP per capita, energy use, and exchange receptiveness. They thought about first and second-age board unit root tests and the cross-sectional increased board unit root (CIPS) test and applied cross-sectional reliance tests by utilizing the board information model. For quite a while ago run board information examinations, the short-run impacts don't stay substantial, with the exception of energy use. Subsequently, on account of board information investigations, the EKC theory is just a short-run marvel. Other than analysing the board information framework, the ARDL limits testing approach within the sight of primary breaks was likewise applied. Given that ARDL limits tests with and without primary breaks, the EKC theory is substantial in India and China. Interestingly, the EKC theory was demonstrated to be material in Bangladesh and Myanmar on account of dismissing breaks inside the present moment. The drawn-out consequences of the ARDL approach with and without primary breaks do uphold the EKC theory for the part nations of the BCIM-EC (Bangladesh–China–India–Myanmar economic corridor), aside from Myanmar, and the outcomes are exceptionally measurably critical, which demonstrates a long haul upset U-moulded for the EKC for India, China, and Bangladesh.

Furthermore, Shahbaz et al (2017) examined the impact of trade transparency on CO2 emissions from 105 countries between 1980 and 2014. In the time series examinations, they found that exchange transparency decidedly contributes to the CO2 emanations of most of the explored nations. Notwithstanding, exchange receptiveness insignificantly affects CO2 discharges account in Tunisia. Further, the beneficial outcomes of exchange receptiveness and pay on CO2 discharges are found for the entire board.

Whereas, Al-Mulali and Ozturk (2016) intended to research the EKC speculation for 27 created nations by utilizing board information strategies. The inferred that the relationship between the economic growth of these countries and the emission of CO_2 is inverted U-shaped in nature, which verifies the existence of the EKC hypothesis. On the other hand, Kang and Zhao (2016) investigated the EKC speculation in China utilizing a spatial board information method. They witnessed an inverted-N curved shape environmental Kuznets curve relationship between economic growth and the emission of CO_2. It has been also observed that urbanization is one of the factors along with the increased level of coal utilization of rising CO_2 emissions.

Whereas an empirical study was conducted by Ertugrul, and Cetin (2016) to examine the nexus between CO_2 emission, an open market economy, real income, and the intake of energy in the top ten CO_2 developing countries like China, South Korea, India, Brazil,

Mexico, South Africa, Indonesia, Malaysia, Mexico, and Thailand using a 40 years data over the period of 1971-2011. The observational discoveries demonstrated that in the long run there exists a connection between CO_2 emission and real income, energy utilization, and trade openness. The outcomes support the EKC speculation for India, China, Korea, and Turkey.

In the meanwhile, a study was conducted by integrating the CO_2 emission function with globalization and energy intensity by Shahbaz and Solarin (2016) investigated the existence of the Environmental Kuznets Curve (EKC) using over a period of 41 years from 1971-2012 in 19 African countries. ARDL bound test technique was implied for the existence of any long-run relationship. The results indicated the existence of co-integration in certain African countries like (Africa, Algeria, Angola, Cameroon, Congo Republic, Ghana, Kenya, Libya, Morocco, Nigeria, South Africa, Sudan, Tanzania, Togo, Tunisia, Zambia, and Zimbabwe). It was found that in countries like Africa, Algeria, Angola, Cameroon, Congo Republic, Ghana, Kenya, Libya, Morocco, Nigeria, South Africa, Sudan, Togo, and Tunisia energy consumption positively affects CO_2 whereas in the case of Zambia and Zimbabwe the CO_2 emission diminishes as energy utilization increases. In the same way, Globalization drops the level of CO_2 emission in eight out of the 19 African countries whereas in four African countries it increases the level of CO_2 emission. The study observed that economic growth and CO_2 emission showed an inverted U-shaped EKC relationship for Sudan and Tanzania

Similarly, Mahmood et al (2019) worked on the relationship between trade openness and Carbon dioxide emission and the environmental Kuznets curve hypothesis in Tunisia using 43 years of data from 1971-2014. The results showed the presence of mix nature of integration, whereas long-run and short-run relationship was observed through co-integration analysis. The investigative study confirmed the existence of the EKC hypothesis with a turning point gross domestic product (GDP) of $ 292.335 billion (Constant U.S dollars) and Tunisia at the initial stage of EKC.

Whereas, the Autoregressive distributed lag (ARDL) technique was used by Tsiantikoudis et al (2019). to study the environmental Kuznets Curve hypothesis (EKC) by utilizing deforestation as CO_2 emission as an indicator of environmental degradation in Bulgaria. The study represented income with the Gross domestic product (GDP) per capita as an autonomous variable. Although the study did not find any traces of the Inverted U-shaped EKC hypothesis, on the contrary, an inverted N-shaped pattern was affirmed. On the other hand, the impact of property rights, forest area, the agricultural price index, population timber price, and income on deforestation in Iran was analysed by Esmaeili and Nasrnia (2014) using the environmental Kuznets curve (EKC) hypothesis using an autoregressive distributed

lag ARDL) methodology of empirical investigation. The study confirmed the existence of an inverted U-shaped Environmental Kuznets Curve hypothesis for deforestation in Iran.

On the other hand, Allen and Barnes (1985) examined the relationship between deforestation and its likely causes as well as the most recent and contested deforestation estimates in developing nations. The study compared three recent estimates of the pace of deforestation in developing countries between 1968 and 1978 using rank-order correlation. It was found that during this time frame in mentioned 39 countries in Latin America, Africa, and Asia deforestation is particularly linked with population growth, wood fuels production, and wood export. The study also suggests that agriculture expansion was an indirect cause of deforestation. It concludes that in the short term agriculture expansion and population growth can be the leading causes of deforestation while it can also be exacerbated by fuelwood harvesting and its export in the long run.

Similarly, Van Lantz (2002) studied the macroeconomic factors that drive forest clearcutting across Canada. It was found to be influenced by three factors including per capita GDP, technology, and population density. Between 1975 and 1999 a pooled regression analysis of the Atlantic, Quebec, Ontario, Prairie, and British Columbia using a more flexible quadratic model and it was reflected that although technological change has an inverted U-shaped relation with forest area clear-cutting, GDP and population density have the opposite effect thus strongly rejecting the environment Kuznets curve hypothesis of inverted u shape relation between forest area clear-cutting, GDP and population density.

López and Galinato (2005) investigated the effects of changes in land use influenced by economic growth, macroeconomic policies, and governance on forest policies. Linked a significant portion of the variation in two primary factors of deforestation i.e., Road construction and agriculture expansion to economic growth, trade policies, and democracy. It was found that governance and trade openness influenced the environmental Kuznets curve. The article concluded that countries with a disadvantage of crop encroaching the forest area would have trade shift the forest income curve up furthermore, it also states that a more democratic country was likely to have a longer turning point than a less democratic one

Stern (2004) studied the long and illustrious history of the environmental Kuznets curve. They stated that according to EKC when income per capita rises, markers of environmental deterioration first rise and then plummet but recent evidence, on the other hand, indicated that developing nations sometimes outperform developed countries in tackling environmental issues by adopting developed countries standards with a short time lag. It further states that the EKC results are based on a very shaky statistical foundation and that it may be replaced

by a new generation of decomposition and efficient frontier model that can assist to clarify the true relationship between development and the environment.

Apergis & Ozturk (2015) enunciated to test for 14 Asian countries the EKC hypothesis spanning the period 1990-2011. Panel data in alliance with GMM methodology were employed in a multivariate framework to test EKC. The variables that were considered in the multivariate framework include Co2 emission, GDP per capita, population density, land, industry share in GDP, and four indicators attributing to the quality of institutions. The result supported an inverted U-shaped relationship.

Whereas, Shahzadi et al (2019) Retained the data from 1996-2015 for low-income countries the impact of globalization and macroeconomic variables on environmental degradation has been nabbed along with challenging the Kuznets curve. The results after applying the Padroni panel co-integration test and FMOLS (fully modified ordinary least square) the result verified the existence of the Kuznets Curve in case of globalization and environmental quality.

Fodha and Zaghdoud (2010) Intervening the concept of Kuznets curve for a small open developing economy Tunisia casing the period 1961-2004 the relation between Economic growth and pollution emission has been studied. Environmental indicators apprehend carbon dioxide and Sulphur dioxide emissions and economic indicators incorporate GDP. Long-run co-integration between per capita emissions of two pollutants and per capita GDP was being anticipated and in the case of Sulphur dioxide So2, an inverted U-shaped relationship has been evaluated with an income turning point equal to $1200 or $3700. Whereas a monotonically increasing relationship between GDP and Co2 emission was shown appropriately. The policy implications suggest that emission reduction policies and pollution abatement expenses will not be indignant to economic growth.

Zulfikar et al (2021) Used secondary data from the Department of Environment, the Department of Energy and Mineral Resources, and the Central Bureau of Statistics of South Kalimantan Province incorporating water quality index, air quality index, land cover quality index, poverty, unemployment, and HDI for years 2006-2020 in order to check for the impact of economic development on environmental quality using Kuznets curve approach. The results thus so obtained by descriptive statistics and nonlinear regression were aligned with the Kuznets curve hypothesis except for unemployment which was not identified as non-linear due to adjusted $R^2 < 0$ and significance of > 0.05.

Zambrano et al (2018) By daubing ARDL bound testing for the period 1971-2011 on variables GDP per capita, energy consumption, population density, financial development, and trade openness for Singapore using the basis of environmental Kuznets curve hypothesis

that was supported by the results. The results accord that financial development led to CO^2 reduction.

Conclusion

Early investigative research work conducted is related to the impact of economic growth on environmental degradation, by taking into account different factors like CO_2 emission, deforestation, energy utilization, forest area, and timber price as proxies to testify to the existence of the Environmental Kuznets Curve (EKC) hypothesis. Some of these studies concluded with the existence of an inverted U-shape Environmental Kuznets Curve (EKC) (Rahman &Nasir 2011,2012, Gosh 2010, Al-Mulali and Ozturk 2016, Ertugral and Cetin 2016, Shahbaz and Solerin 2016, Esmaeili and Nasrnia 2014, Apergis & Ozturk 2015, Shahzadi et al 2019) some with N-Shaped pattern of Environmental Kuznets Curve (EKC) (Kang and Zhao, 2016), whereas, in some cases, no such behaviour was observed (Tsiantikoudis et al 2019, Van Lantz 2002). This study is different from the previous studies, as deforestation and forest cover have been used as dependent variables as a proxy for environmental degradation in the context of Pakistan, whereas earlier studies used CO_2 emission as an index for environmental degradation in Pakistan. The increase in CO_2 emission or its environmental increase is due to deforestation, hence this study investigates the direct source of data on deforestation and forest for more accurate results. This study intends to validate the existence of the Kuznets curve and to analyse the impact of BTAP (Billion tree Afforestation Project) a project limited to the Khyber Pakhtunkhwa province on the Environment of Pakistan

CHAPTER 3

QUALITATIVE ASSESSMENT OF BTAP

This section is based on key informant interviews regarding the process, success and issues of the billion trees afforestation project. We have interviewed five key informants from the forest departments in Khyber Pakhtunkhwa who were involved and have significant knowledge of the BTAP project. In the following lines, we summarize our questions and their responses.

1. What was the process being adopted for the implementation of BTAP?

A multi-stakeholder approach was adopted for the implementation of the mega afforestation project throughout the province of Khyber Pakhtunkhwa. The key modalities encompass the following:

- Establishing enclosures over depleted natural forests through Village Development Committees and effective payment through local communities.
- Carrying out plantation departmentally over-extended private and community-owned lands.
- Free distribution of plants grown in nurseries and planting by the community themselves in homes and on arable lands.
- Planting through owners over their private lands and effective payment based on successful plants under woodlots.
- Organizing Hashers (Volunteer community gatherings) and getting mass planting through motivating local communities
- Raising plants through private entrepreneurs. According to PC-1, 10% were raised by women, 10% by senior citizens, 40% each by youths and 40% by progressive farmers.[9]
- Department raised only that indigenous stock which requires more skill and care.

[9] WWF 107, Third Party monitoring of billion trees afforestation project in Khyber Pakhtunkhwa Phase-II. Pg. 59/178.

All through the entire execution measure, the local area was effectively occupied with all phases of the undertaking i.e., arranging, executing, observing and assessing the task mediations.

Monitoring and transparency

Observing is indispensable for fruitful dispatching and meeting the goals of the Billion Trees Afforestation Program. Observing the undertaking exercises has been helped out through three-phased monitoring for example at division, undertaking, and outsider levels (external). The following levels were engaged with checking of venture exercises:

1. **Departmental Monitoring:**

a. **Monitoring by supervisory staff**

The essentials of monitoring of executive and supervisory staff of the Forest Department for the correctness of the activities are summarized as under:

-

a. Being executing staff the Sub Divisional Forest Officer/Range Forest Officer, Forester, and Forest guard were 100% responsible for the correctness of quality and quantity of the work
b. Being a drawing and disbursing officer, the DFO was required to satisfy himself by verifying the correctness of activities before any disbursements.
c. The Divisional Forest Officer (DFO) concerned was additionally answerable for support of compartment history document having a guide of the manor, pre, during and post work photos of the space, quality and amount of work done, Global Positioning System (GPS) organizes record of the space and updating of history records.
d. The Conservator of Forests of the concerned Forest Circles was capable of genuinely checking 30% of the exercises arbitrarily chosen by him in his ward to fulfil himself that the Divisional Forest Officers (DFOs) were performing appropriately in the execution of the task.
e. The Chief Conservator of Forests of the Region was dependable to guarantee strategy intelligibility in regards to project ideas and guide the field staff on course amendments. For this reason, he was capable of haphazardly checking

10% of the exercises arbitrarily chosen by him for assessing the quality and amount of work to develop rules for essential restorative measures.

b. Monitoring by FP&MC

The Forestry Planning and Monitoring Circle (FP&M) to deliver the following activities:

I. Set up a benchmark in backwoods and non-woodland regions for the venture utilizing satellite symbolism.

II. Data set the foundation in the MS-ACCESS program including the subtleties of Plantation Journals and Nursery Journals (History records) everything being equal, to be observed. Subtleties like regular recovery, pit size, thickness, and region shrouded through the estate in support zone, badlands, and farmlands.

III. For the achievement of the above errands, the Forest Planning & Monitoring (FP&MC) staff may genuinely confirm the field exercises.

However, for enclosures the FP&M were assigned the following responsibilities;

- To coordinate with all important stakeholders including respective territorial, forest, Wildlife, Community Development, Extension & Gender & Development. (CDE&GAD), Institutional & Human Resource Development & Management (I&HRD&M), and Research & Development (R&D) staff and Village Development Communities (VDCs), to compile and collate their observations, learning and reports, and carry out studies to generate and update knowledge about silviculture system/ conditions required to boost the regeneration of desired species in all ecological zones of the province.
- To compile information regarding good seed years, seed ripening, collection, and its cost-effective dispersal and regeneration.
- To determine the appropriate time and mechanism for the establishment of the enclosure concerning desired species, in each ecological zone;
- To carry out field studies to determine the optimum level of regeneration of each species in all ecological zones in all quality sites and establish data/ record of all established closures with particular focus on its area, species wise number of regenerated and established seedlings;

- To identify major reasons for depletion of regeneration and forests and develop guidelines to render this system a regular feature of forest management;
- To determine the seasonal change in regeneration and species status after the regular interval;
- To identify gaps in the regeneration system proposed in the PC-I and maintenance system of proper regeneration and silviculture system applied in respective compartments and suggest remedial measures for improvement.
- To assist in the development of training modules and impart relevant training to the respective staff and relevant extension material for the guidance of staff and communities;
- To Carryout regular monitoring of enclosures and ensure full implementation of the provisions of PC-I and recommendations of Directorate of FP&M and guide raising and protection of enclosures, its appropriate composition/ratio, suitability, and success assessments;
- To provide regular feedback to respective officers and furnish progress reports on to project regularly;
- Any other technical responsibility assigned by the Project Steering Committee or PMU of Billion Trees Afforestation Project and the Administrative Department.
- The project will also monitor activities through its own four monitoring officers who have been drawn from existing staff of the Forest Department (BPS-18) or hired retired forest officers from the open market having prescribed qualifications and experience.

i. The Monitoring & Evaluation (M&E) Officers will carry out monitoring regularly in their regions, keep PD abreast of activities and suggest improvement measures for keeping the project in the right direction.

ii. Give contributions to PMU on ToR's advancement for outer checking and assessment, outlining capacities for outside validators and MOU marking.

iii. Checking through Geographic Information Systems & Remote Sensing GIS/RS, fixed-point photography (Pre, ongoing, and post-movement), and actual confirmation through overviews utilizing Global Positioning System GPS.

iv. Construct limit of the field staff in observing.

v. Advancement of Maps for regions observed appearance subtleties of exercises.

vi. Accumulation of observing reports containing ideas on progress adjustment for region administrators just as sending medicinal measures to guiding panel.

vii. Liaise with outer valuators, working with them in giving information and data sharing on formative exercises done under the venture.

The Planning Officer (Head Quarter) will give a total quarterly observing report from the information and data gathered from the Regional Monitoring Officers and Forestry Planning and Monitoring Circle.

The Director of Community Development, Extension & Gender & Development. (CD, E&GAD), and Director Institutional & Human Resource Development & Management (IHRD&M) will do the monitoring of fenced-in areas and foster data set of regions covered, seedlings recovered, and species arrangement.

2. External Monitoring & Evaluation:

Outside checking has been brought out through a free association chosen through a serious offering measure. The Senior Planning and M&E official under the direction of the Project Director will diagram the ToRs and proper strategies and instruments for outside observation.

(i) The External Monitoring Team will take 30% of new treated regions

(ii) These regions have been arbitrarily chosen in each natural zone/woodland type.

(iii) Physical checking has been done toward the finish of the estate season.

(iv) Verification/approval of the spaces and autonomous report accommodation to PMU on the estate done under the venture, planting program in assigned woodlands, waste, and farmlands.

(v) Validation of record records like ranch diary, nursery diary, contextual analyses, photographs, and guides.

2. What were the key achievements of the BTAP?

Salient Targets/ Achievements under various interventions

- Established 4509 Identified protected areas in depleted designated Forests to produce 732 million seedlings through natural regeneration with the active support of adjoining communities.
- Planted 476 million indigenous and multi-purpose fast-growing tree species over community-owned, private, and public owned lands.
- Planning and rehabilitation of 13 degraded Watersheds have been carried out.
- Established 13260 Nos of private forest nurseries cover Youth (40%), Women (10%), senior citizens (10%), and progressive farmers/nursery growers (40%).

Physical Progress

The project is being implemented in phases. The overall physical progress is as under:

Physical Achievement				
Activity	**Target (No. of plants in million)**	**Achievement (No. of plants in million)**	**Area treated (ha)**	**%age of Area Added to Forest Area**
Enclosures	600	732	253000	1.30
Plantation	200	316	209008	3.1
Sowing			23096	
Additionality			-	
Farm forestry	200	160	142818	1.9
Total	**1000**	**1208**	**627922**	**6.3**

Success stories:

- Overall, 6.3% of Forest cover of KP increased
- Enclosures produce 62% regeneration of indigenous species and contributed to the Biodiversity
- 1500 ha wasteland stabilized and 19000 ha saline & waterlogged area reclaimed
- Out of 74%, of barren land, 23% area has been reclaimed.
- Provided jobs to more than 500,000 individuals

- A major watershed Marbella & Mangla Dams treated
- Contributions towards Reducing emissions from deforestation and forest degradation (REDD+) and acting as a filter against Smog & air pollution
- Around 141, 00 Kanal Land was recovered from encroachers and treated with Plantation.
- Enterprise development and skills transferred
- People become tree lovers, by participating in the afforestation voluntarily.
- 84% [10]survival rate which is the highest in the world
- KP- as the first Province to meet the One Billion target

National and International Recognitions:

- Globally recognized in the fight against Climate Change
    - Asian Protected Area Partnership membership by IUCN
    - World Economic Forum appreciated the Project's achievements[11]
    - BONN Challenge issued a letter of recognition of commitment achieved under BTAP[12]
- One of the Fastest Afforestation programs globally
- It is the 4th biggest initiative of its type in the world (China, India, Ethiopia & Pakistan)[13]
- It is the biggest initiative in Pakistan's History

[10] WWF 2017, Third-party monitoring of billion trees afforestation project in Khyber Pakhtunkhwa Phase-II, Pg. 21/178
[11] World Economic Forum, Conference on Climate change 25-Nov-2020.
[12] International Union for Conservation of Nature (ICUN) Bonn Challenge 2020 Certificate ceremony held at Islamabad, 23 Aug 2017.
[13] Times of Islamabad, KP government launches unprecedented afforestation plan in the history of Pakistan, 10 March 2019.

The outcome of the Project:

- In Khyber Pakhtunkhwa, about 6,27,922 ha area ha has been treated/rehabilitated and 6.3 % added to the province's forest resources and contributed about 1 % to the country forest area.
- In the private sector of the province, about 13000 nursery units were established through senior citizens, progressive farmers, youth and women and up to 9000 community individuals were trained in nursery raising, forest firefighters and grazing control.
- Provided job opportunities to more than 5,00,000 individuals from the local community
- Provided Job opportunities to 4500 Negehban (caretaker and watchers) even in remote hilly areas to protect the existing natural degraded forests to improve the fauna density as well the biodiversity
- Provided job opportunities to about 2000 families at their doorsteps in the shape of chowkidars (watch & ward) for guarding the plantations
- The plantation under BTAP was raised in the buffer zone between natural forest and habitation to reduce pressure on existing natural meagre forest resources for fuelwood, fodder and timber for the construction industry.
- Awareness-raising programmes among the community regarding the importance of forest and forest resources
- The project is adding productive assets and significantly contributing to the GDP of the Province and the country
- The project has been succeeded to change the mindset of the general masses to become tree growers rather than tree reapers.
- According to the World Bank estimate, Pakistan's economy suffers a loss of Rs. 365 billion a year because of the neglect and degradation of the environment. According to the International Union for the Conservation of Nature (IUCN), the BTAP approaching goal to hit the 150-million mark "will create approximately $84 billion per year in net benefits that could bring direct additional income opportunities for rural communities". Achieving the 350-million-hectare goal will generate about $170 billion per year in net benefits from watershed protection, improved crop yield and

forest products, and could sequester up to 1.7 gigatons of carbon dioxide equivalent annually (Kamal et al, 2019).

- The billion-tree tsunami project will contribute to sequestering a considerable amount of carbon dioxide. If a billion trees mature successfully, it could sequester 0.04 Gigatons of carbon dioxide as a climate change benefit by 2020 and economic benefit worth 120 million USD (Kamal et al, 2019)
- The government of KP is also in the course of two sets of laws for REDD+, a ground-breaking international monetary mechanism that aims to repeal deforestation by providing cashable carbon value for forests depletion position. . In Khyber Pukhtoonkhwa, the natural Forests and the Afforestation under Billion trees tsunami afforestation project has the carbon sequestration potential of 6 million yonns and 3 million tonns annually meaning thereby it can fetch $45 million annually considering $5 per unit of Green Climate Fund. (PFI,2017). A total ban on forest cutting and felling in the reserved forest of KP is already obligatory but the community forest is subject to scientific supervision which is based on working plans.[14]
- Endangered species of both plants and animals have been rehabilitated and in plantations as well as in enclosures e.g., deer, black partridges, grey partridges and wild honey bees hives are distinctly visible and reported. Similarly, medicinal and aromatic plants are flourishing in the enclosures (any fenced structure created to prevent or impede movement across the reserved forest land) and plantation areas.
- The project has been successful in the context of awareness-raising, sensitization and capacity building as the focus of institutions and community had been diverted from 'mud and mortar' to 'greenery'. Urban Forestry had been in focus. In Punjab, 51 sites have been set aside for the establishment of "Miyawaki" [a concept of raising dense plantations in urban areas comprising indigenous species]. The Défense forces particularly Pakistan Army has been actively participating in the mass planting, and in District Nowshera, Miyawaki has been established on 10 Kanal and 11 Marlas and in AmanGarh, block plantation over an area of 5,000 ha is underway. The authorities of Tarbela Dam have also requested the KP Forest Department for its technical expertise in raising Miyawaki. Similarly, the educational institutions, schools, colleges, universities and Government Institutions are also taking a keen interest in planting activities on their respective lands.

[14] Director Forestry Environmental and Wild Life department Khyber Pakhtunkhwa.

- The project pushed on mindfulness raising through the utilization of print, electronic and web-based media, the inclusion of public agents, strict pioneers, instructive instincts, legal executive, military, and common society. Likewise, house to house crusades was dispatched with the ranger service augmentation staff.
- The Chief Minister, Khyber Pakhtunkhwa has directed relevant authorities to take necessary steps for including plantation as a compulsory component in the PC-Is of all new projects of the Provincial Government.

3. What were the <u>issues</u> confronted within the execution of BTAP?

The following issues were faced during the implementation of the project:

1. **Land availability**

   The difficult task was land accessibility and seedlings creation for a particularly gigantic area drive. One of the challenges was the perception among the people that Government will take hold of their private properties. The Forest Department prepared the current assets and included the neighbourhood local area in raising nurseries for seedlings, furthermore persuaded them to let a portion of their land for purpose of ranches.

2. **Disproportionate allocation /Releases against PC-I demand**

   In forestry, the interventions are dependent upon planting season, monsoon and spring, and for this purpose, constant, adequate and regular funding is a prerequisite. The disproportionate allocation of funds, as well as the untimely release of funds, was one of the bottlenecks that hindered the proper execution of the project.

3. **Staff deficiency**

   One of the main issues was staffing deficiency. Forest Department is mandated to protect, conserve and develop forest resources. Forest Department implemented BTAP activities with the same human resources in addition to their duties.

4. **Fire incidents in forests and enclosures**

   Due to protection provided to afforestation sites through the appointment of Chowkidars (watch & ward) and assisted natural regeneration through Negehbans (Caretaker and watcher), the local biodiversity improvement and the growth of natural flora including grasses and shrubs increased. Amid dense grass growth, the incidence of fire occurrence

was rampant, however, the Forest Department in collaboration with the community as well as District Administration carried out tireless efforts to combat fire incidences.

5. Tree and land tenure/ absentee ownership

Certain conflicts over tree ownership and land erupted while the project was in the execution stage; however, these conflicts were resolved by mobilizing the local community.

4. What are the lessons learnt while implementing BTAP?

a. Block Plantations

During the course of implementation, vital new experiences were gained according to different climatic, atrophic[15] and topographic [16]conditions which were implemented in the field for the better success of the plantation and to minimize the cost of its raising.

Some of these experiences are highlighted as under: -

(i) The plantations were planned to be raised in pits of 1x1x1.5 size at 10x10 spacing for the whole of the province but in dry areas i.e., mostly southern Districts the plantations were raised in continuous ditches through tractors. This practice not only catered for the rainwater runoff but also broke the hard surface crust of the lands for maximum infiltration of rainwater. This practice not only helps in better growth of the plants but also minimizes the cost of watering in very dry areas of the southern districts.

(ii) Inside the plantation areas, rainwater storage interventions have been introduced according to the sites where main nullahs were abstracted by check dams and mini dams interventions and rainwater ponds were constructed. This practice not only provided water for the plants but also positively affected the growth of plants in the plantations process through seepage.

(iii) Along with the plant sowing of indigenous species, seeds sowing was experienced in both the pit and on the berms of roads/fields but in dry areas, the result inside the pit was more encouraging instead of the berms due to water available for the plants. However, in sandy areas, the result of seed broadcasting was found more effective than the sowing of seed.

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[15] Atrophy or hypoplasia involves the slowing down or retardation of normal plant Processes resulting in stunting of the entire plant or plant parts.

[16] Topography is a key driver of tropical forest structure and composition, as it constrains local Nutrient and hydraulic conditions within which trees grow.

(iv) During the early stage of Plantation, special care was given to the regenerated plants in the area by taking into account proper landscaping for pits and water management. This process has helped in the regeneration of the barren land in the middle with the dimensions of 10x10 into green land covered with trees.

(v) In sandy areas, plants in silt up pits[17] give better results due to moisture retention.

(vi) Termite attack is quite severe in sandy areas, to avoid such situations plantation was done in trenches so that water flows directly into it. Due to this technique, the Termite attack was avoided and hence significant growth in the green area was observed.

(vii) For the control of pig damage, the traditional method of hanging plastic bags and cassette rills on the plantation with ropes/wires is more effective.

(viii) In eucalyptus plantations, it was made sure that its indigenous species should be preferred and planted at specific locations contained only to waterlogged areas, riverbanks and canals.

b. Linear plantations

(i) To regenerate the barren space between the distantly scattered Shisham trees along the road and canal side. The most effective technique known as "the root sucker (a shoot springing from the roots of a plant)" was used, where the roots of shisham trees were damaged with a tractor ditcher to increase the green pasture of the land.

c. Woodlot plantations

However, outsourcing plantation (where a third party is involved or hired, such as private nurseries and local communities for plantation) as planned above has not borne fruitful results due to certain shortcomings as: -

(i) As forestry is a long-term enterprise and locals were having no experience, therefore, they hesitated to take interest in this intervention.

(ii) The private sector was unable to assess the cost-benefit ratio, as such felt a high risk of losses.

(iii) The private interested bidders couldn't accomplish the task in an area of different communities.

[17] The function of a silt pit is to control the runoff, trap and settle down the sediments, increase soil moisture or improve the groundwater, reduce the slope length and further reduce soil erosion and fertiliser losses.

Based on the above-mentioned faced problems and experiences gained the outsource plantation (where a third party is involved or hired, such as private nurseries and local communities for plantation) was re-planned as private wood lots under the following criteria

To ensure the interest of small land holding(1 ha to 20 ha) woodlots/owner's plantationas has been introduced (MOCC,2021). In this case in areas requiring watering Rs, 44 per plant and in areas not requiring watering for planting Rs 17 per plant has been paid to owners besides free provision of plants. In case of Rs 44/- per plant, plants have been given after excavation of pits, Rs 14 on completion of plantation and Rs 10 per plant after one completion, while the remaining amount of Rs 20 per plant has been paid after completion one and half year in case of surviving plants only. On all payments actual counting of successful plants was mandatory and payment has been made on the actual no of surviving plants. In the case of non-watered areas, the first instalment was Rs 5 after completion of the plantation, after the one-year second instalment of Rs 5 while the final payment of Rs 7 has been made after one and half years.

Protection responsibility has solely lies on the owners' shoulders, but the department through regular coaching and phased payment has ensured that plants planted are protected.

Under this activity 20042 ha area has been planted successfully.

d. Sowing/dibbling

The traditional method of sowing in 10X10 spacing trenches has been adopted but during the course of implementation, the following experiences have been gained and successfully implemented, especially in dry zones of southern districts.

1. In extremely dry conditions, the sowing of the height gaining grasses (long leaves) like Cymbopogon (lemongrass) shows better results due to moisture retention and fertility of the soil.
2. Sowing of seeds on the shady sides of boulders and rocks results in better germination and subsequent survival due to better moisture retention.

e. Reclamation of waterlogged and saline areas

1. Where the effect of salinity is severe, mixing gypsum with the soil inside the pit minimizes the effect of salinity and increases the survival percentage of plants.
2. The results of Tamarix (Tamarix aphylla Tree) cutting planting in the north-south direction by placing cow dung on the exposed top of the cutting showed better results of success.
3. In severe waterlogging conditions, the plants without pits give better results and preparation of ditches are also not advisable however in slit water logging condition the results of ditches with planting on the berms showed better results.

f. Departmental and private nurseries

1. In bare-rooted nurseries normally Bakain is sown in flatbeds but the results on the raised beds with two-line sowing give better results.
2. The cutting of poplar in the bare-rooted nursery in the offseason after sprouting can be raised in nurseries if kept irrigated like rice crop till re-sprouting.
3. The application of growth regulators instead of fertilizers initially helps in better germination and growth but badly affects the production in terms of the number of plants in bare-rooted nurseries.

CHAPTER 4

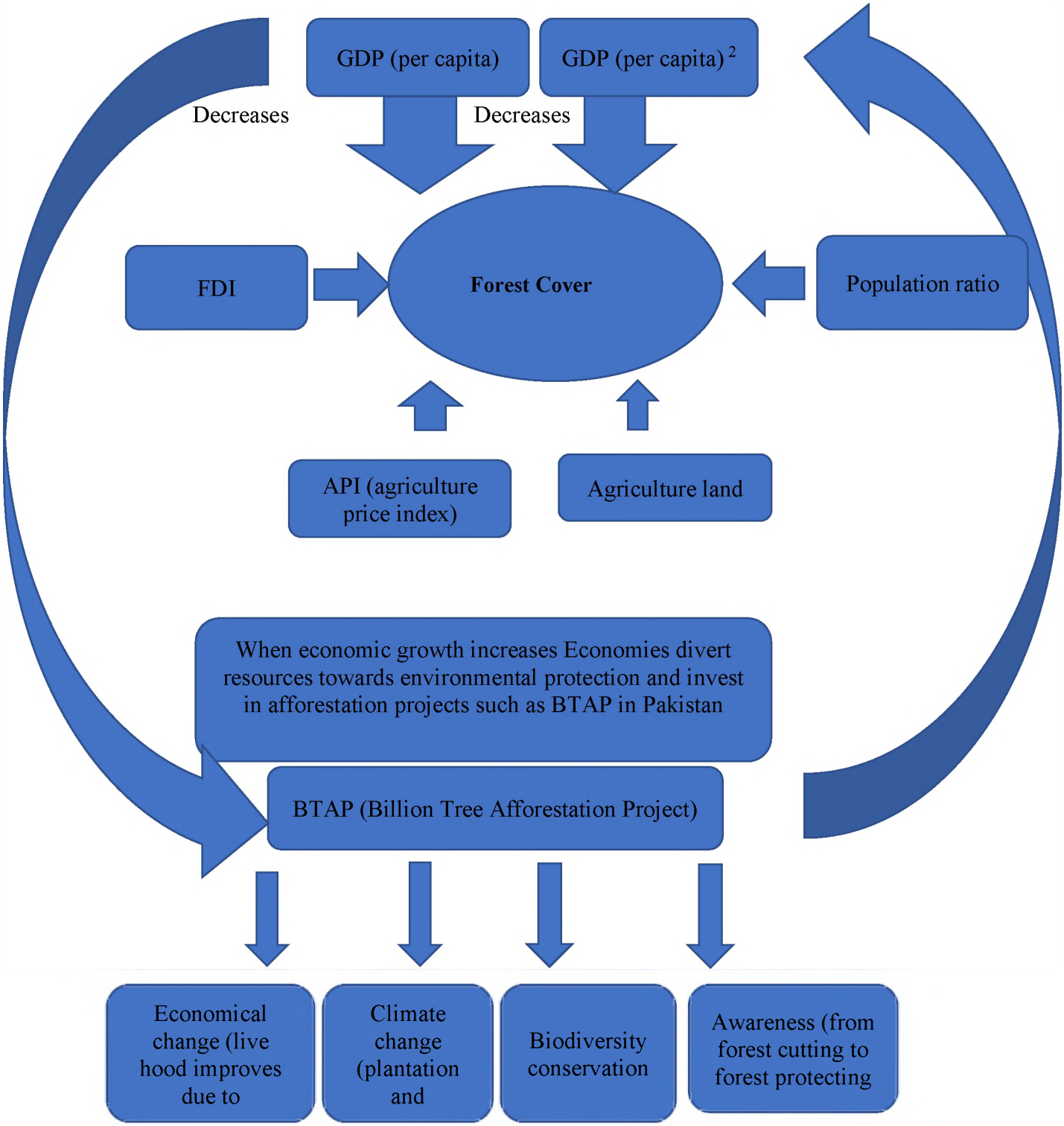
METHODOLOGY

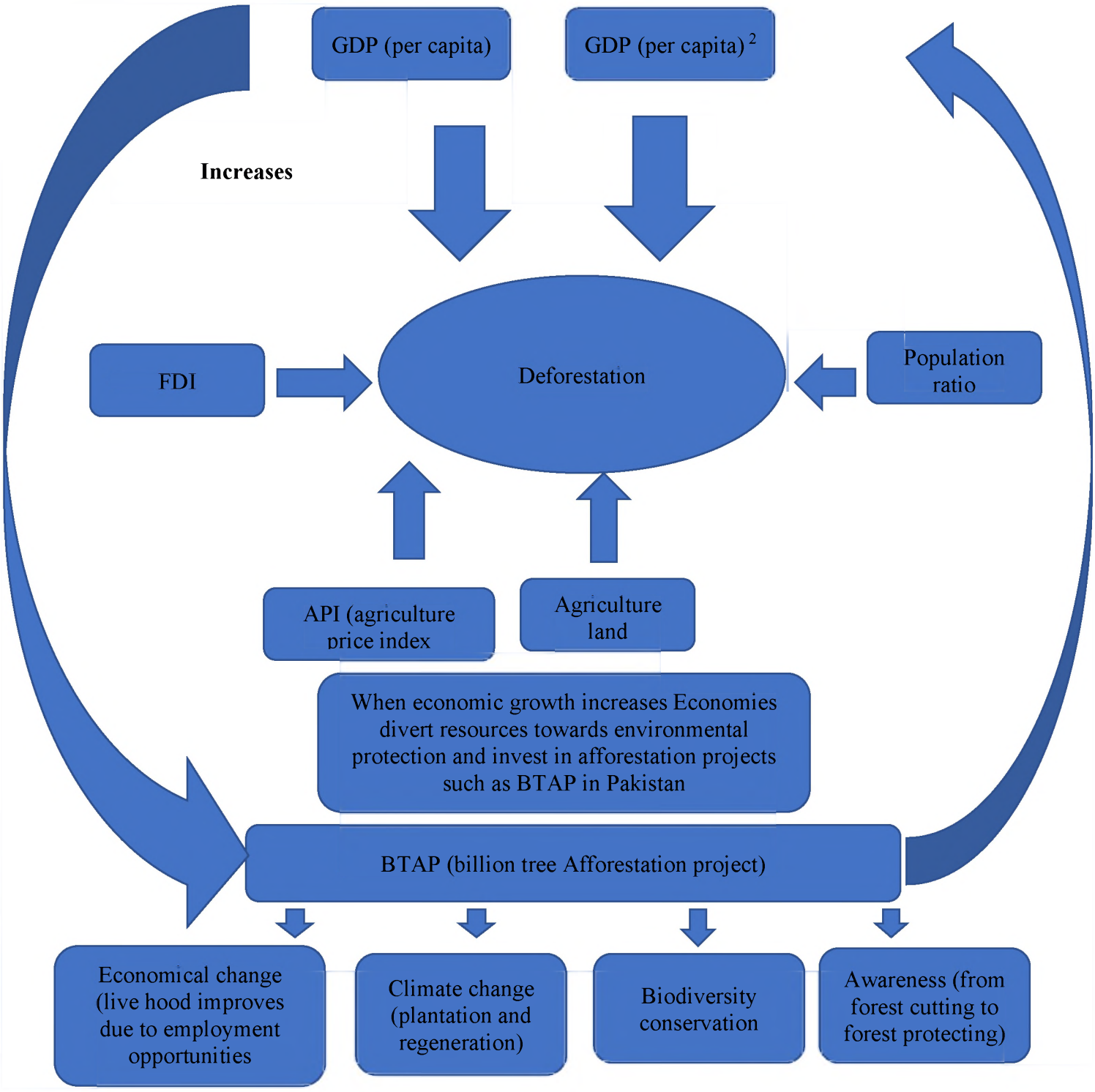
4.1 Analytical Framework

The relationship between development and inequality has been recognised for at least 60 years. Simon Kuznets studied this relationship and produced the Kuznets economic hypothesis. Kuznets (1955) argued that, at the initial stage of economic growth, income inequality increases until it reaches a maximum point, and then income variation reduces with economic development. In the early 1990s, the concept of the environmental Kuznets curve (EKC) hypothesis emerged from the work of Grossman and Krueger (1991) using the concept of Kuznets as a benchmark. Even though Grossman and Krueger initially examined the impact of the North American Free Trade Agreement (NAFTA) on the environment, the starting point for the concept of the EKC was a background study by Shafik and Bandyopadhyay (1992) for the World Development Report in 1992. Similarly, another factor that contributes to deforestation is more roads, an increase in the price of agricultural goods, and population density, Angelesen and Kaimowitz (1999) also concluded that higher agricultural and timber prices, result from an improvement in terms of trade, which would increase the rate of deforestation. Maestad (2001) concluded that agricultural products price changes can increase or decrease the rate of deforestation. Increasing agricultural product prices might expand agricultural land use and increase deforestation. The expansion of agricultural production onto forest land is considered an important strategy for increasing agricultural production and income Culas (2007). The relationship between deforestation and population is particularly worrisome because wood is used as a fuel and for house construction in most rural areas. There is also a need for sufficient plantations with wood cutting for domestic use Ahmed et al (2015).

According to the Kuznets curve, Economic development after reaching a certain threshold level minimizes its negative effect on the environment and Environmental quality improves, as countries tend to invest in environmental conservation such as afforestation projects which in turn again enhances economic growth by improving the ecological, economical condition of the country along with the living hood of the community.

4.2 Conceptual Framework




GDP (per capita)
GDP (per capita) 2
Increases
FDI
Deforestation
Population ratio
API (agriculture price index
Agriculture land
When economic growth increases Economies divert resources towards environmental protection and invest in afforestation projects such as BTAP in Pakistan
BTAP (billion tree Afforestation project)
Economical change (live hood improves due to employment opportunities
Climate change (plantation and regeneration)
Biodiversity conservation
Awareness (from forest cutting to forest protecting)

4.3Data and Its Description

The proposed study used Forest Cover and deforestation as dependent variables, GDP per capita, FDI, agriculture price index, population ratio (urban/rural) and agricultural land as independent variables from the period 1990 to 2019 for Pakistan. Whereas BTAP (Billion Tree Afforestation Project) was used as a dummy variable. We use the ARDL approach to test the validity of the Kuznets curve. The data for variables were taken from WDI except for Forest cover and API which were taken from FAOSTAT. The econometric models used for this study have been derived from the studies by Koop & Tole (1999) and Culas (2007). The models used by them have been altered for this study.

4.4 Econometric Model for Forest Cover

The econometric model that we will use to test EKC and the effect of afforestation on Forest cover in Pakistan is as follows

$$\mathbf{FC}_t = f(GDP_t, GDP^2_t, POP_t, API_t, FDI_t, AGRL_t, BTAP_t, T) \qquad (1)$$

Where GDP, GDP^2, POP, API, FDI, AGRL, BTAP and T stands for per capita real GDP, Square of per capita GDP, Population, Agriculture price index, Foreign direct investment, Agricultural land, billion tree afforestation program, and Terms of trade respectively. The econometrics model can be presented in equation (2) as follows:

$$\mathbf{FC}_t=\alpha+\beta_1 GDP_t+\beta_2 GDP^2_t+\beta_3 POP_t+\beta_4 API_t+\beta_5 tFDI_t+\beta_6 tAGRL_t+\beta_7 BTAP_t+\beta_8 T+\varepsilon_t \ldots (2)$$

Where FC_t is Forest cover in year t, ε is an error term and GDP is per capita real GDP, GDP^2 is square of per capita real GDP, POP is population growth, API is an agriculture price index, TOT is a term of trade, and BTAP is a Billion Trees Afforestation Project which is a dummy. GDP per capita is used to represent growth and its square represents the development in growth and the data will be taken from WDI. The data for the Population ratio will be taken from WDI and its effect on forest cover and deforestation is assessed. The agricultural price index is used to represent deforestation through the conversion of forest to agricultural land and the data was taken from FAOSTAT.FDI represent foreign direct investment net inflow its data was taken from WDI. Whereas, as BTAP is taken as a dummy variable it will take the value 1 in the years when it was initiated and 0 otherwise. As it is a project with both tangible

and non-tangible benefits both so we are taking it as a categorical variable and dummy variable. The main purpose is to explore the relationship, whether forest cover increases or decreases with any change in the rest of any independent variables (GDP, GDP^2, POP, API, FDI, AGRL, T, and BTAP), according to Maestad (2001) with the increase in per capita real GDP and its square GDP^2 the forest cover decrease, similarly with increase in Agricultural prices (API) people reallocate forest land into agriculture which causes a decline in forest cover and hence deforestation occurs. Population growth is also negatively associated with forest cover and positively with deforestation (Ahmed et al, 2005). All these possibilities are tested in the environmental sphere of Pakistan using a time series data of 30 years from 1990 to 2020 and also the existence of the Environmental Kuznets curve (EKC) and the impact of BTAP on the environment as denoted by forest cover.

According to the forestry department, the forest cover has been increased to 6.3%[18] with a survival rate of 84%. So here assessed its effect on forest cover.

4.5 Econometric Model for Deforestation

Following is the econometric equation that we estimate:

$$\mathbf{DEF_t} = f(GDP_t, GDP^2_t, POP_t, API_t, FDI_t, AGRL_t, BTAP_t, T) \qquad (3)$$

Where GDP, GDP^2, POP, API, FDI, AGRL, BTAP and T stands for per capita real GDP, Square of per capita GDP, Population, Agriculture price index, Foreign direct investment, Agricultural land, billion tree afforestation program, and Terms of trade respectively. The econometrics model can be presented in equation (4) as follows:

$$\mathbf{DEF_t} = \alpha + \beta_1 GDP_t + \beta_2 GDP^2_t + \beta_3 POP_t + \beta_4 API_t + \beta_5 tFDI_t + \beta_6 tAGRLt + \beta_7 BTAP_t + \beta_8 T + \varepsilon_t$$

Where DEF_t is Deforestation in year t, ε is an error term and GDP is per capita real GDP, GDP^2 is square of per capita real GDP, POP is population growth, API is an agriculture price index, TOT is a term of trade, and BTAP is billion tree Afforestation Project which is a dummy.

GDP per capita is used to represent growth and its square represents the development in the growth and the data will be taken from WDI. The data for the Population ratio will be taken

[18] The Dawn, Published on March 7, 2021.

from WDI and its effect on forest cover and deforestation is assessed. The agricultural price index is used to represent deforestation through the conversion of forest to agricultural land and the data was taken from FAOSTAT. FDI represents a foreign direct investment, net inflow data were taken from WDI. Whereas, as BTAP is taken as a dummy variable it will take the value 1 in the years when it was initiated and 0 otherwise. As it is a project with both tangible and non-tangible benefits both so we are taking it as a categorical variable and dummy variable. The relation we are to explore is any increase or decrease in foreign direct investment (FDI), agricultural price index (API) and Population on deforestation, according to Angelesen and Kaimowitz 1999 increase in FDI, API leads to an increase in deforestation, also improvement in terms of trade increase the rate of deforestation. Similarly, Maestad (2001) also point out that an increase in API contributes to the increasing rate of deforestation. Ahmed et al. (2015) found that population growth is also accelerating the rate of deforestation, as people use timber as fuel and for building purposes. All these possibilities are tested in the environmental sphere of Pakistan using a time series data of 29 years from 1990 to 2019 and also the existence of the Environmental Kuznets curve (EKC) and the impact of BTAP on the environment as denoted by deforestation. According to the forestry department, the forest cover has been increased to 6.3% with a survival rate of 84%, so here assessed its effect on Deforestation.

4.6 Estimation Strategy

We are intending to use time series data which helps us understand and predict or forecast the future based on previously observed values. It aids in identifying the changes in a variable over time. The first and foremost strategy will be to check the data for stationary. Are the data stationary or not? Why is this necessary, it is because if in case the data was non-stationary, a shock will remain in the system for infinity and all the coefficient estimation will be spurious in nature, whereas in the case of stationary data its influences will be powerful on the characteristic of the series. Non-stationary data can only be viewed as viable if its analysis is restricted to the period, which is under investigation, as a different picture will be portrayed. Hence making it difficult for any researcher to generalize the finding of non-stationary data series for some other time period. Hence it is impossible to forecast based on non-stationary data. Another negative attribute attached to non-stationary data is the failure of the value of the variable to converge back to its mean value. A time-series data is termed as non-stationary if it violates any of these conditions, (1) constant mean, (2) variance is constant. There are many reasons which cause the non-stationarity of data, but the one that is of immense importance is a

unit root. To check the stationary of any time series data, the unit root test technique is quite a in use for several years now, it is vital for estimation as it tells us whether the shock will be permanent or an ephemeral one.

4.7 Unit Root Test

To avoid the problem of spurious regression, we enunciated the use of the Unit Root test to check for the stationarity of data and we would use the Augmented Dickey-Fuller test (ADF). Dickey and Fuller (Dickey and Fuller, 1979) were the founders who conducted the unit root test on time series data, the method was termed as tau statistic or famously known as Dicky-Fuller (DF) test. The acceptance and denial of the null hypothesis are based on Dickey-Fuller's critical values of tau statistics. DF test is performed under the condition when the error term of the series is interrelated, but in reality, the error term is correlated that's serially correlated. Thus, Dickey and Fuller come up with another test which they termed as Augmented Dicky-Fuller (ADF) test.

Here, we test the null hypothesis of "the series has the unit root" against the alternative hypothesis "the series has no unit root".

The rejection and acceptance of the null hypothesis are being made based on Dickey-Fuller's critical values of (tau) statistic.

4.8 Lag Structure

Once we are done with the unit root test, and the stationarity of the data series is confirmed along with the order of integration, the second process of estimation strategy is identifying the lag structure of the model. The lag structure is dependent on the explanatory variables, but also its past values. The main purpose of lagged variables is to make use of variation that is spread over time. There are many criteria based on which lag structure is selected, among them some are named as, LR= Sequential modified LR test statistic (each at 5% level), AIC=Akaike information criterion, SC=Schwarz information criterion, FPE=Final prediction error, HQ= Hannan-Quinn information criterion.

4.9 Estimation technique

The basic assumption of the classical statistical method of constructing a model and thereby testing a hypothesis, such as Ordinary Least Square (OLS) is the stationary of data on variables. The dilemma arises, statistical inference related to stationary data is not valid on non-stationary data, if such a mistake has been made, then regression results will be spurious in nature. By the spurious regression, even though all the variety shows significant relations between the variables, the actual results are interrelated. To counter this problem, the Co-integration technique is implied, which makes a non-

stationary model in such a way that estimated results will be both economically and statistically meaningful.

4.9.1 Before Going on the Estimation

As the first step of the model estimation unit root test is ADF will be applied for checking the stationarity of variables. The ADF test will show the order of integration if the results thus obtained confirms integration of order 1 i.e. I (1) then this implies the use of the Johanson Cointegration technique, and if integration is of mixed order that is, some are I(1) while others are integrated of order zero such like situation favours Autoregressive Distributive Lag Model (ARDL) promoted by Pesaran and Shin (1995, 1996), Pesaran et al (1996) and Pesaran (1997). Lastly, regarding the existence of any cointegration, the ARDL test of cointegration will be used and the long-run relationship between the dependent and independent variable is confirmed if the hypothesis of the presence of cointegration has been accepted. That's a possible condition for ARDL, if there is no sign of co-integration hence ARDL is not applicable.

4.10 Diagnostic Tests

As we are quite acquainted with the fact that the Autoregressive distribute lag model technique is too sensitive when it comes to the use of the number of lag and time duration. Thus, many diagnostic tests can be carried out to check the health of estimations. A test like serial correlation, normality and Heteroscedasticity is performed, to check the model for testing the hypothesis of the non-existence of serial correlation of error terms, the absence of Heteroscedasticity and that all the error term is distributed normally and stability test.

The serial correlation will be tested based on the hypothesis that there exists serial correlation in the residual of the series, and the rejection of the null hypothesis will state the exact opposite that there is no serial correlation. Any serial correlation in residuals will imply that the standard errors are unbiased and hence all the statistical conclusions will be incorrect.

Heteroscedasticity is applied to check whether the variance of the residual is constant or not. The null hypothesis will be there is heteroscedasticity, against the alternative hypothesis of no heteroscedasticity in the series.

For checking out the model specification, the Ramsey test will be used. The null hypothesis of no miss specification in the model will be checked against the alternative hypothesis of miss specification in the model.

4.11 Limitation of the study

The study used 29 years of data on forest cover and deforestation in Pakistan from 1990 -2019 to analyze the impact of different external factors of Pakistan's economy on the environmental factors like forest cover and Deforestation and also to test the validation of the Environmental Kuznets Curve. The study used data from one of the ambitious projects from Pakistan known as the Billion Tree Afforestation program BTAP, as the project is restricted to only one Province Khyber Pakhtunkhwa which limits our analysis as we can't extrapolate based on afforestation in one province and generalize it about Pakistan. Additionally, the BTAP project was carried out in a time span of 4 years from 2014 to 2018, whereas the study used 29 years of data from 1990 to 2019. To counter this, we used a dummy variable for BTAP it will take the value 1 in the years when it was initiated and 0 otherwise. As it is a project with both tangible and non-tangible benefits both so we are taking it as a categorical variable and dummy variable.

CHAPTER 5

EMPIRICAL RESULTS

This chapter covenants with testing the properties of time series. The steps mentioned in the previous chapter Data and Methodology have been followed in this chapter. The estimated results are reported in the following Tables.

5.1 Testing Stationarity

Before testing the co-integration and error correction mechanism we tested the unit root to find out whether the data is stationary or non-stationary. Augmented dicky fuller test (ADF) is applied for each variable like deforestation, forest Cover, GDP per capita, foreign direct investment, population density and agricultural land. The estimated results are shown in the following table5.1

Table 5.1: Estimated statistics of unit root test for Stationarity

Variables	ADF	Probability Values	Trend	Integrated
Log_deforestation	-1.5977	0.4709	NO	I(1)
ΔLog_deforestation	-5.1236**	0.0003	NO	I(0)
GDP_per Capita	-1.9228	0.6170	YES	I(1)
ΔGDP_per Capita	-3.6543**	0.0109	NO	I(0)
LogFDI	-2.9363***	0.0538	NO	I(0)
logPopulation	-4.4757	0.0014	NO	I(0)
log Agricultural Land	-2.0047	0.2833	NO	I(1)
Δ(log Agricultural Land)	-4.8587***	0.0005	NO	I(0)
forest Cover	1.2803	0.9999	YES	I(1)
Δ(forest Cover)	-342.73***	0.0001	NO	I(0)
API	-0.8769	0.7810	NO	I(0)
Δ(API)	-4.5322***	0.0001	NO	I(1)

*Implies that the series is stationary at 1% ,** denotes 5%, and *** denotes 10%. Δ denotes the first difference. Deforestation, Population density GDP_per_Capita, and Agricultural land denote the logarithmic deforestation, GDP_per_Capita, Population density, and Agricultural land respectively.

The above Table 5.1 shows the estimated results of a unit root. The null hypothesis H_0 for all variables like deforestation, forest cover and agricultural land, API and GDP per capita is not

rejected in their original series, so we can say that the series are non-stationary. However, by taking the first difference of all variables, it is found that H is rejected indicating that all variables are integrated of order one, I(1) i.e. X_t = (Deforestation, Forest Cover, Agricultural land, API and GDP per Capita)~I(1). While the variables i-e API, foreign direct investment and Population ratio are stationary at the original series because we reject the null hypothesis that series are not stationary.

5.2 Co-Integration Analysis

To investigate the long-run relationship between dependent variables like Deforestation and forest cover with explanatory variables, the Johansen test of co-integration (1988) is applied. Our analysis is based on the following steps.

5.2.1 Optimal Lag Length

After examining the after-effects of the unit root test following stage is to pick the ideal lag length. We decide on the ideal lag length because the Johansen test of co-integration requires lag length. As we are utilizing yearly information in our investigation, along these lines inclination will be given to the Schwartz data rule (SIC). The following table shows the chosen lag length of SIC.

Table 5.2: Estimated Statistics of Lag Order Selection Criteria for Deforestation (DV)

Lag	LogL	LR	AIC	SIC	HQ
0	73.61524	NA	-4.829660	-4.544187	-4.742388
1	296.0909	333.7135	-18.14935	-16.15104	-17.53845
2	**369.2812**	**78.41810***	**-20.80580***	**-17.09466***	**-19.67126***

Note: *indicate lag length chosen by different criteria.

Table 5.3: Estimated Statistics of Lag Order Selection Criteria for Forest Cover (DV)

Lag	LogL	LR	AIC	SIC	HQ
0	-278.5505	NA	20.46789	20.84852	20.58425
1	34.80592	425.2694	2.656720	6.082389	3.703981
2	**171.6392**	**107.5119***	**-2.545657***	**3.925050***	**-0.567497***

Note: *indicate lag length chosen by different criteria

The abovetable5.3 provides results of different criteria for lag order selection. However optimal lag length is two**, lag (2).** The Criterion with the least/lowest value will be the best optimal lag to choose for the model. As suggested by these criteria the lowest value is lag 2 among the different lag structures which suggested that the optimal lag structure is lag 2 when we have forest cover as the dependent variable.

5.2.2 Co-integration Test

The results which we obtained from the Augmented Dickey-Fuller test as presented in table 5.1, indicate that all variables like deforestation, forest cover and agricultural land are stationary at the first difference, while FDI, GDP per capita, population density are stationary at a level and to determine the lag length, the necessary step is to determine the number of co-integrating equations in our VAR model. We apply trace test values and max eigenvalues to investigate the co-integration relationship between variables. The estimated results of the co-integration test are given in the following table 5.4 and table 5.5

Table 5.4: Estimated Summary of Johansen Co-integration test for deforestation (DV)

Data Trend Test Type	None No Intercept No Trend	None Intercept No Trend	Linear Intercept No Trend	Linear Intercept Trend	Quadratic Intercept Trend
TraceTest	6	6	6	6	4
Max.Eigen	6	6	6	6	4

The above table 5.4 provides estimated results of the co-integration test. The trace test statistics and max eigenvalue are used to check the co-integration relationship between the dependent (deforestation) and the independent variables. The upper panel of the table provides the trace test statistics and the max eigenvalue is given in the lower panel of the table. Both tests indicate that there is six co-integrating vector or co-integrating equation in the model.

Table 5.5: Estimated Summary of Johansen Co-integration test for forest cover (DV)

Data Trend Test Type	None No Intercept No Trend	None Intercept No Trend	Linear Intercept No Trend	Linear Intercept Trend	Quadratic Intercept Trend
TraceTest	6	6	5	6	6
Max.Eigen	6	6	5	6	6

The above table 5.5 gives assessed after-effects of the co-coordination test. Both the following test measurements and max eigenvalues are utilized to look at the co-integration connection between subordinate variables (forest cover) with the autonomous factors. The upper board of the table gives the following test measurements and the max eigenvalue is

given on the lower board of the table. The two tests plainly show that there is six co-coordinating vector or co-incorporating condition in the model.

5.2.3 ARDL Model Along with ECM Term Equations for Deforestation

The test of co-integration indicates six co-integrating equations in the analysis for dependent variables i-e deforestation with the independent variables. To analyze the long-run relationship among dependent variables i.e., deforestation and forest cover with the independent variables, we normalize the co-integrating equation between deforestation and forest cover. The ARDL model for the long run and ECM term for the ARDL model are estimated for capturing the long run as well as the short-run relationship between dependent variables i.e., deforestation along with the independent variables are given as in Table 5.6 and Table 5.7

Table 5.6: Long run ARDL relationship (Deforestation as dependent variable)

Indp. Variable	Coefficient	Standard Error	t-statistics
LAGRL	0.1813	0.1378	1.3152
LFDI	0.1222	0.0616	1.9837*
GDP Per Capita	-0.003045	0.001020	-2.9864*
GDP Per Capita_square	0.0000012	0.0000000345	2.894493*
Population (POP)	1.671035	2.572051	0.649690
Agriculture price Index (API)	-0.021958	0.027877	-0.7876
BTAP	0.012638	0.147273	0.0858

Note: *, **, *** show the significant at 10%, shows 5% and 1% level.

Table 5.7: Estimates of the Error Correction model coefficient (Short-run relationship) based on selected ARDL model Dependent variable (Deforestation)

Indp. Variable	Coefficient	Standard Error	t-statistics
D(LAGRL)	0.086166	0.078603	1.096218
D(LFDI)	0.058094	0.029530	1.967283*
D(GDP)	-0.001447	0.000529	-2.732971*
D(GDP$^{2)}$	0.0000016	0.0000000253	2.423256*
D(Population)	0.793995	1.179768	0.673009
D(API)	-0.010433	0.012075	-0.864057
D(BTAP)	0.006005	0.068474	0.087697
Ecm term	-0.475151	0.188834	-2.516238*

Note: *, **, *** show the significant at 10%, shows 5% and 1% level.

The reported result of the ARDL long-run estimates is presented in table 5.6 and the short-run estimates are shown in table 5.7 for the dependent variable deforestation. In the long-run estimates, agricultural land has no relationship with deforestation because it is statistically insignificant as the t-value is 1.3152 which is less than 2. There is a positive and significant relationship between foreign direct investment and deforestation. It means that a one percent increase in foreign direct investment brings a 12% increase in deforestation. The variable GDP and GDP^2 are both statistically significant but the sign of the GDP is negative and the sign of the GDP^2 is positive which means that in the case of deforestation the Kuznets curve hypothesis is not validated and hence the inverted U shape is not accomplished. The result of the Kuznets curve is in line with studies of (Soytas et al (2007), Naradda Gamage et al (2017), DH Linh and Lin SM (2014), Ozturk and Acaravci(2014)). The variable API and Population ratio are insignificant which means they have no statistically significant relationship with deforestation. The dummy BTAP is also statistically insignificant and does not affect deforestation. Since the Billion Trees Afforestation project was launched in selected districts of Khyber Pakhtunkhwa province of Pakistan and it took 4 years from 2014 to 2018 to achieve the required target of 1 billion plantations with a survival rate of 84.79%[19], all of these trees are in the growth stage, and secondly, all these plantations are carried out on a negligible portion of the country, hence has no significant impact on the overall level of the country's environmental conditions

The Short-run estimates from ARDL ECM as shown in table 5.7 where deforestation is taken as the dependent variable, agricultural land has no relationship with deforestation because it is statistically not significant as the t-value is 1.09 which is less than 2. There is a positive and significant relationship between foreign direct investment and deforestation. It means that a one percent increase in foreign direct investment brings a 0.05 0r 5% increase in deforestation in the short run. The variable GDP and GDP^2 are both statistically significant but the sign of the GDP is negative and the sign of the GDP^2 is positive which means that the environmental Kuznets curve is not corroborated in the short-run as well. The result of the Kuznets curve is in line with the study of (Soytas et al (2007), NaraddaGamage et al (2017), DH Linh and Lin SM (2014), Ozturk and Acaravci (2015)). The variable API and Population ratio are insignificant meaning that they have no statistically significant relationship with deforestation. The dummy BTAP is also statistically insignificant and does not affect deforestation. The project of BTAP was launched in 2014 and all of these trees are in the

[19] See, World Wide Fund for Nature Pakistan (WWF-Pakistan) July 2017, Third Party Monitoring of billion trees afforestation project in Khyber Pakhtunkhwa phase-II, Pg. 20/187.

growth stage, and secondly, these trees are planted in a small area of the country that has no significant impact on the whole of the country's environmental conditions. The Error correction coefficient is negative and statistically significant, showing the speed of adjustment it would take to converge to the long-runß equilibrium. The error correction term (ECT) shows a 4.75 percent speed of adjustment.

Table 5.8: Diagnostic test for Deforestation Model

Test	P-value
Autocorrelation test	0.2113
Hetroscedascity test	0.3895
Ramsey reset test	0.1785

* Significance at 5%level

All the results from the diagnostic tests are presented in Table 5.6. it can be inferred that there is no autocorrelation in residuals as the probability value of 0.2113 is higher than a 5% level of significance can be accepted, which means that the residuals have no serial correlation in them indicating that our estimations are unbiased. Serial correlation is of vital significance, if residuals were serially correlated with each other then all the estimations will be based on a biased stand error, hence spurious interpretation will be derived about the coefficients of the model. Similarly, from the Heteroskedasticity test, we can see that there is no heteroscedasticity issue attached to the residuals as the p-value is 0.3895 which is higher than the 5% significance level which means we do not reject the null hypothesis that there is no problem of heteroscedasticity in the model. The Ramsey test is used to check the misspecification in the model. We can see that the p-value is 0.1785, greater than the 5% significance level, which means that we do not reject the null hypothesis that there is no misspecification problem in the model.

5.2.4 ARDL Model Along with ECM Term Equations for Forest Cover

The test of co-integration indicates six co-integrating equations in the analysis for dependent variables Forest cover (FC) with independent variables. To analyse the long-run relationship among dependent variables i.e. deforestation and forest cover with the independent variables, we normalize the co-integrating equation on deforestation and forest cover. The ARDL model for the long run and ECM term for the ARDL model are estimated for capturing the long run as well as the short-run relationship between dependent variables i.e. forest cover (FC) along with the independent variables are given as in Table 5.9 and Table 5.10

Table 5.9: Estimates of the long-term coefficient based on selected ARDL model Dependent variable (forest cover)

Indp. Variable	Coefficient	Standard Error	t-statistics
LAGRL	0.790296	0.038145	20.717969*
LFDI	-0.032312	0.028988	-1.114675
GDP Per Capita	0.001001	0.000727	1.376720
$GDPPerCapita^2$	0.0000000247	0.0000000328	-1.287061
Population (POP)	-3.803708	1.026271	-3.706338*
API	0.000390	0.005227	0.074687
BTAP	0.034965	0.040921	0.854464

Note: *, **, *** show the significant at 10%, shows 5% and 1% level.

Table 5.10: Estimates of the Error Correction model coefficient based on selected ARDL model Dependent variable (forest cover)

Indp. Variable	Coefficient	Standard Error	t-statistics
D(LAGRL)	0.019439	0.014719	1.320640
D(LFDI)	-0.000795	0.000282	-2.819518*
D(GDP)	0.0000246	0.00000480	5.126766*
$D(GDP^{2)}$	-0.00000000010	0.000000000206	-5.027378*
D(Population)	-0.093559	0.053273	-1.756212
D(API)	0.000010	0.000127	0.075707
D(BTAP)	0.000860	0.000580	1.483219
Ecm term	-0.024597	0.019435	-1.265561

Note: *, **, *** show the significant at 10%, shows 5% and 1% level.

The reported result of the ARDL long estimated is shown in table 5.9 and the short-run estimates are shown in table 5.10 for the dependent variable forest cover. In the long-run estimates, the agricultural land has a positive relationship with the forest cover as it is statistically significant because the t-value is 20.17 which is greater than 2. It means that a one percent increase in the agricultural land brings a 0.79 or 79% increase in the forest cover. There is no relationship between foreign direct investment and forest cover because it is not statistically significant. The variable GDP and GDP^2 are both statistically insignificant but the sign of the GDP is positive and the sign of the GDP^2 is positive as well which means that for forest cover (FC) in the long run The Environmental Kuznets Curve hypothesis (EKC) is not applicable. The result of the Kuznets curve is in line with studies of (Soytas et al (2007), Naradda Gamage et al (2017), DH Linh and Lin SM (2014), Ozturk and Acaravci(2014)).

The variable Population (POP) is statistically significant with a negative coefficient which means that it has a negative relationship with forest cover. The coefficient of the population ratio is -3.80 which means a one percent increase in population brings about a 380 percent decrease in forest cover. The dummy BTAP has also statistically insignificant and does not affect the forest cover. Since the Billion Trees Afforestation project was launched in selected districts of Khyber Pakhtunkhwa province of Pakistan and it took 4 years from 2014 to 2018 to achieve the required target of 1 billion plantations with a survival rate of 84.79%[20], all of these trees are in the growth stage, and secondly, all these plantations are carried out on a negligible portion of the country, hence has no significant impact on the overall level of the country's environmental conditions.

The reported result of the ARDL Ecm of the short-run estimates is shown in table 5.10 for the dependent variable forest cover. In the short-run estimates, the agricultural land has no relationship to the forest cover as it is statistically insignificant because the t-value is 1.32 which is less than 2. There is a negative and significant relationship between foreign direct investment and Forest cover. It means that a one percent increase in foreign direct investment brings a 0.07% decrease in the forest cover in the short run. The variable GDP and GDP^2 are both statistically significant but the sign of the GDP is Positive and the sign of the GDP^2 is negative which means that in the short-run environmental Kuznets curve subsists in Pakistan. The result of the Kuznets curve is in line with the studies of (Nasir and Rehman (2011), Ertugrul et al (2016), Tang and Tan (2015), Tan et al (2014), Shahbaz et al (2012), Pao and Tsai (2011), Kivyiro and Arminen (2014)). The variable API and Population ratio are insignificant, meaning they have no statistically significant relationship with the forest cover. The dummy BTAP is also statistically insignificant and does not affect the forest cover. Since the Billion Trees Afforestation project was launched in selected districts of Khyber Pakhtunkhwa province of Pakistan and it took 4 years from 2014 to 2018 to achieve the required target of 1 billion plantations with a survival rate of 84.79%[21], all of these trees are in the growth stage, and secondly, all these plantations are carried out on a negligible portion of the country, hence has no significant impact on the overall level of the country's environmental conditions. The Error correction coefficient is positive and statistically insignificant.

[20] See, World Wide Fund for Nature Pakistan (WWF-Pakistan) July 2017, Third Party Monitoring of billion trees afforestation project in Khyber Pakhtunkhwa phase-II, Pg. 20/187.

[21] See, World Wide Fund for Nature Pakistan (WWF-Pakistan) July 2017, Third Party Monitoring of billion trees afforestation project in Khyber Pakhtunkhwa phase-II, Pg. 20/187.

Table 5.11: Diagnostic test for forest cover model

Test	P-value
Autocorrelation test	0.1943
Hetroscedascity test	0.4431
Ramsey test	0.2242

* Significance at 5%level

The above table of the diagnostic test for the forest cover model shows that there is no problem with the autocorrelation in the model as the p-value is 0.19 which is greater than the 5% significance level which means we do not reject the null hypothesis that there is no problem of the autocorrelation. The test of the heteroscedasticity shows that there is no problem with heteroskedasticity in the model as the p-value is 0.4431 which is greater than the 5% significance level which means we do not reject the null hypothesis that there is no problem with heteroskedasticity in the model. The Ramsey test is used to check the misspecification in the model. We can see that the p-value is 0.2242, greater than the 5% significance level, which means that we do not reject the null hypothesis that there is no misspecification problem in the model.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATION

6.1 Conclusion

The primary purpose of this empirical investigation study is to explore the impact of externals factors like GDP, GDP^2, Foreign direct investments (FDI), Agriculture land (AGL), Population (POP), Agricultural price Index (API), Billion trees afforestation Project (BTAP), and Terms of Trade (T) on the environment of Pakistan, using two different proxies like Forest Cover FC (see equation 2) and Deforestation DEF (see equation 4) in two different equations, and ultimately to check the existence of The environmental Kuznets Curve hypothesis. Additionally, to explore the impact of The Billion Trees Afforestation Project (BTAP) initiated in the Khyber Pakhtunkhwa province on the environmental spectrum of Pakistan, by utilizing an updated data set of 29 years from 1990 to 2019 collected World Development Indicator (WDI), Food and Agriculture Organization Corporate Statistical Database (FAOSTAT).

The unit root test suggested that variables, Foreign direct investment (FDI), and Population density (POP) are co-integrated of order zero, that's they are stationary at the level with the order I(0). Whereas Forest cover (FC), Deforestation (DEF), GDP per capita (GDP), Agricultural land (AGL) and Agricultural Price Index (API) variables are non-stationary at the level, these variables were made stationary by taking the first difference, that's I(1). Then the lag length of 2 was selected by Schwarz Bayesian criterion. The Johansen test of co-integration analysis identified the existence of co-integration.

The long-run ARDL estimate of model 2 (where deforestation DEF is a dependent variable) showed that Foreign direct investment (FDI), and GDP per capita square (GDP^2) have a statistically positive and significant relation with Deforestation (DEF), whereas GDP per capita has a statistically negative relation with the dependent variable deforestation. Furthermore, Agricultural land AGL, Population density POP, Agricultural Price Index API, and the billion trees afforestation project BTAP have a positive insignificant statistical relationship with the dependent variable deforestation DEF. The variable GDP and GDP^2 are both statistically significant but the sign of the GDP is negative and the sign of the GDP^2 is positive which means that the environmental Kuznets curve is not corroborated in the short-run as well. The result of the Kuznets curve is in line with the study of (Soytas et al (2007),

NaraddaGamage et al (2017), DH Linh and Lin SM (2014), Ozturk and Acaravci (2015)). Hence, we could not find any traces of The Environmental Kuznets Curve (EKC) hypothesis in the case of model 2, thus we cannot validate the existence of The Environmental Kuznets Curve (EKC). Whereas, the short-run ECM estimates showed that Foreign Direct Investment FDI and GDP per capita square (GDP^2) have a statistically positive significant relation with Deforestation DEF and GDP per capita square (GDP) has a negatively significant relation with Deforestation DEF. Additionally, Agricultural Land AGL, Agricultural Price Index API, and the billion tree afforestation project BTAP have a statistically insignificant relationship with the dependent variable Deforestation DEF in the short run. The short-run ECM value of Model 2 (with deforestation as a dependent variable) indicates a negative coefficient value (-0.47) which is statistically significant means that a long-run causal relationship exists and the speed of convergence to equilibrium in the long run. The variable GDP and GDP^2 are both statistically significant but the sign of the GDP is negative and the sign of the GDP^2 is positive which means that the environmental Kuznets curve is not corroborated both in the long run as well in the short-run. The result of the Kuznets curve is in line with the study of (Soytas et al (2007), NaraddaGamage et al (2017), DH Linh and Lin SM (2014), Ozturk and Acaravci (2015)). Hence, we could not find any traces of The Environmental Kuznets Curve (EKC) hypothesis in the case of model 2, thus we cannot validate the existence of The Environmental Kuznets Curve (EKC).

The Long-run ARDL estimates of model 4 (with Forest Cover FC as a dependent variable) showed that Agricultural Land AGL has a statistically positive significant relationship and Population density (POP) has a statistically negative significant relationship with the dependent variable Forest Cover (FC), whereas Foreign direct investment FDI, GDP per capita, GDP per capita square GDP^2, Agriculture Price Index API, The billion trees afforestation project BTAP has a statistically insignificant relationship with Forest Cover (FC). The variable GDP and GDP^2 are both statistically insignificant with positive signs which means that for forest cover (FC) as a dependent variable in equation 4 The Environmental Kuznets Curve hypothesis (EKC) cannot be validated in the long run. The short-run ECM results revealed that both Agricultural Land AGL and Population density POP, have a statistically negative significant relationship with Forest Cover FC, whereas Foreign Direct Investment FDI, GDP per capita GDP, GDP per capita square GDP^2, Agricultural Price Index API, and the billion trees afforestation project BTAP relationship with Forest cover FC, are statistically insignificant. The short-run ECM estimates for equation 4 (with Forest cover as a dependent variable) revealed that both Foreign Direct

Investment FDI and GDP per capita square GDP^2 have a statistically negative significance, whereas GDP per capita has a positive significant relationship with Forest cover FC. Agricultural land AGL, Population density POP, Agricultural Price Index, and the billion trees afforestation are statistically insignificant in the short run. The coefficient of ECM showed a negative value but is statistically insignificant. The variable GDP and GDP^2 are both statistically significant but the sign of the GDP is Positive and the sign of the GDP^2 is negative which means that in the short-run environmental Kuznets curve subsists in Pakistan. The result of the Kuznets curve is in line with the studies of (Nasir and Rehman (2011), Ertugrul et al (2016), Tang and Tan (2015), Tan et al (2014), Shahbaz et al (2012), Pao and Tsai (2011), Kivyiro and Arminen (2014)). Thus, the case of equation 4 (with Forest cover as a dependent variable) validates the existence of the environmental Kuznets curve hypothesis in the short run.

The diagnostic test of both models showed that there is no problem with the autocorrelation, heteroscedasticity and no misspecification problem which is a good sign that no assumption of the time series model is violated.

The result of the study does not meet the objective of the effect of the BTAP on environmental quality because the coefficient of the BTAP in both models is statistically insignificant which means that there is no effect of the BTAP in the case of Pakistan and the reason is that the Project was initiated 6 years ago from 2014 to 2018 and more of the trees are in the growth process and secondly it started yet in the small area that's why the effect maybe not captured. The second objective of the study of the Kuznets curve in Pakistan is also not met for the deforestation model for both long-run and short-run estimates but for the forest cover model, the Kuznets curve is validated in the short run.

6.2 Policy Recommendation

The results from the analysis of the long-run as well the short-run relationship between forest cover, deforestation, and other variables like GDP per capita, API, FDI, Agricultural land, FDI and population ratio suggest that the government should move toward making strong policies against the deforestation and for the motivation of the people to improve the forest cover to recuperate the environmental situation which helps in the climate change mitigation. The government should make a restrictive law for those people who used forest land or agriculture for some other infrastructures. The policies maker should implement such effective policies that are useful to increase the sustainability of forests by appropriate property rights, and facilities of higher per capita income, so that not only the already established forest be protected but also the new plantation carried out privately owned land

should be appreciated. Pakistan is a forest poor country with approximately less than 6 % area covered by forest, much efforts must be made to not only sustain the existing forest but also to increase the forest coverage area, as it is important for many vital reasons, some of these and policies suggestions are given as:

1. The major source of water for Pakistan is the glaciers in the Northern region of the country. In recent years Pakistan is experiencing frequent occurrences of heatwaves, droughts, riverine, landslides, and cyclones due to the issue of global warming. Climate change directly affects and exacerbates people's socio-economics vulnerabilities and health issues. To tackle this dilemma, policies related to plantations should be seriously implemented, Forestry is a long term enterprise requiring both space as well as time to establish. To have more pragmatic results, the afforestation shall be managed as a long term programme preferably 10-15 years instead of short term projects. So as not to only protect the biodiversity but also the water requirement of the country both glaciers and underground water.
2. Time scheduled of each activity i.e. Nursery rising& Plantation of all categories, should be appropriate so that healthy and vigorous planting stock is obtained.
3. The flow of funds should be timely and regular before initiation of project works as forestry activities are time bound and require proper care/maintenance.
4. Before start of Plantation, delineate the area, erect/ construct loose-stone boundary pillars, jointly in consultation with the community.
5. Farm Forestry component is although very important & complicated to create awareness among the masses. However, the record, distribution, maintenance and monitoring require proper and sound mechanism. A code of proper distribution in consultation with local community is highly recommended.
6. VDC constitution through Community Development, Extension and Gender Development (CDE & GAD) identify their role and bound them to protect the plantation site by providing a clause in the agreement for sustainability of the Project.
7. Resolve land tenure, tree tenure and absentee ownership issues before initiation of project activities/ work. Director CDE & GAD should be involved at all stages of this activity.
8. To control porcupine, rodents, termites& wild boar attacks in plantations, Pakistan Forest Institute (PFI), Research &Development (R&D)and other allied departments should be involved to devise a research based and permanent remedy for prevention of these attacks.

9. Involvement of different stakeholder i.e wildlife department, CDE & GAD, I&HRD, FP & M Circle, R&D their activities should be identified prior to execution of project to avoid any complication in the field e,g Wildlife Department has constituted enclosures on site outside designated Forests, which now Forest Division could not takeover.
10. The achievement of pay upgrade programs worked on recipients' wages and reinforced getting sorted out limits of VDCs. This thusly prompted a pattern towards legitimate backwoods activity and upkeep exercises. It is trusted that pay upgrade segments will be brought into such like ventures. To carry out a decent pay upgrade project, it is powerful to utilize I/NGOs that have business ability and have contacts with privately owned businesses, and utilize specialists to help making an arrangement and to work with and survey it.
11. Other policies related to climate change should be insured: To minimize pollution through tree plantations like billion trees afforestation projects, the establishment of green windbreaks on arid lands, enforcement of green areas in all cities, recreational spaces like green parks and green belts; designing and implementing anti-pollution measure to counter the problem of emissions that adversely affect the wildlife areas and wetlands and hence have both economic and health impacts.
12. Plantation should be carried out of the indigenous species to evade the risk of diseases and pests and to further ameliorate its environmental and biodiversity values.
13. Preference should be given to fast-growing indigenous species which have both commercial and local usefulness.
14. The plantation is carried out on privately owned land and should be properly organized and managed according to the commercial requirement of producing high-quality timber for construction, furniture and sporting goods industries.
15. policies should be devised to promote forestry as an industry and special provisions should be made for development programmes and investment opportunities for the private sector to establish nursery schemes and afforestation drives on their lands for a wood-based industry.

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