NEAR EAST UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

DEPARTMENT OF ENVIRONMENTAL EDUCATION AND MANAGEMENT

EVALUATION OF FOREST KNOWLEDGE USING DETERMINISTIC ANALYSIS INTEGRATED WITH ARTIFICIAL INTELLIGENCE BASED MODELS: CASE STUDY NORTHERN CYPRUS

PhD Thesis

Abdelgader ALAMROUNI

Nicosia

February 2022

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Approval

We certify that we have read the thesis submitted by Abdelgader Alamrouni titled "Evaluation of Forest Knowledge Using Deterministic Analysis Integrated with Artificial Intelligence Based Models: Case Study Northern Cyprus**."** and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Doctor of Educational Sciences.

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Declaration

I hereby declare that all information, documents, analysis, and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of Graduate School of Educational Sciences, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

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Abdelgader Alamrouni

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Abstract

Evaluation Of Forest Knowledge Using Deterministic Analysis Integrated with Artificial Intelligence Based Models: Case Study Northern Cyprus

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This research considered critically the evaluation and estimation of the knowledge of forests among university students in North Cyprus using two different approaches namely, deterministic, and artificial intelligence (AI) based models. Following that, DL and RF models were used to forecast the effect of forest knowledge (FK) during the COVID-19 pandemic. For the first approach, the study broadly assessed university students' knowledge about the forest in general context, forest protection, the importance of forest, forest administration, the danger of deforestation, individual and the government has taken the responsibility of forest versus their nationalities. Primary data were collected with the aid of a structured questionnaire in line with the proposed five research questions; all the proposed research questions were adequately answered through Cross-tabulation analysis. The outcome of the result revealed that students' knowledge about forest, importance of forest, individual and government responsibility of taken care of forest has no significant effect on nationality; while on the contrarily, the result indicated that students' knowledge about forest protection, poor forest administration and danger of deforestation has significant effect on nationality. The results revealed a significant association between knowledge about forests and forest protection. Thus, having knowledge about forests will greatly help individuals in protecting forests, government responsibility to take care of forest has no effect on Nationality, feeling passion around forest has no effect on Nationality, danger of cutting forest has no effect on Nationality, responsibility of individual to protect forest has no effect on importance of forest to individual and the economy, forest knowledge has effect on educational background, forest protection has effect on educational background, and creating community awareness about forest destruction has no effect on educational

background. This means community awareness about forest those not required going to school.

Students at all levels of education should strive to have better understanding of forest – because it has impacted our world in every area financially, ecologically, medically, and socio-traditionally. The unique diverse functions of forest endowments are yet to be acknowledged by great number of nationalities across the globe. Several nations worldwide still place low priority on forest administration at local, state, and central levels; these have resulted into low passion for forest care and protection; this also makes forest segment to be short of improvement, efficiency, and public advocates. Most essentially, probably not every area of vegetation and ecosystem could possibly be known or exposed to all students at the tertiary institution level – because of their various courses of study which differs. Although, the tertiary institution students have a strong capability for personal learning or learning autonomy – provided the adequate facilities are provided. For the second approach employed the estimation of forest knowledge using three artificial intelligence (AI) models (ANN, SVM, and ANFIS) and a classical MLR model. The performance efficiency of the models was evaluated using four statistical measures. The results indicated that SVM-M1(R2=0.8893, MSE=0.0950, and R=0.9430) outperformance all the other models despite other AI based models proved reliable for the estimation of forest knowledge. LSTM-M1 emerged as the best and most accurate estimation model among the DL models studied, with both RF and LSTM achieving over 80% prediction accuracy. The DL's EML, on the other hand, proved to be accurate to the tune of 96%. The results of the two situations show that ARIMA time series and DL models are preferable in further decision-making for FK.

Keywords: Key Words: Environmental education, Forests, Knowledge, Artificial Intelligence, North Cyprus

Öz

Orman Bilgisinin Yapay Zeka Tabanlı Modellerle Bütünleşik Deterministik Analiz Kullanılarak Değerlendirilmesi: Örnek Olay Kuzey Kıbrıs

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Doktora Tezi, Çevre Eğitimi ve Yönetimi Bölümü

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Bu araştırma, deterministik ve yapay zeka (AI) tabanlı modeller olmak üzere iki farklı yaklaşım kullanarak Kuzey Kıbrıs'taki üniversite öğrencileri arasında orman bilgisinin değerlendirilmesini ve tahmin edilmesini eleştirel olarak ele almıştır. Bunu takiben, COVID-19 salgını sırasında orman bilgisinin (FK) etkisini tahmin etmek için DL ve RF modelleri kullanıldı. İlk yaklaşım için, çalışma, üniversite öğrencilerinin genel bağlamda orman, orman koruma, ormanın önemi, orman yönetimi, ormansızlaşma tehlikesi, birey ve devlet hakkındaki bilgilerini geniş bir şekilde değerlendirdi ve milliyetlerine karşı ormanın sorumluluğunu üstlendi. Birincil veriler, önerilen beş araştırma sorusu doğrultusunda yapılandırılmış bir anket yardımıyla toplanmıştır; önerilen tüm araştırma soruları Çapraz tablo analizi yoluyla yeterli şekilde yanıtlanmıştır. Sonuç sonucunda öğrencilerin orman, ormanın önemi, orman bakımının bireysel ve devlet sorumluluğu hakkındaki bilgilerinin milliyet üzerinde anlamlı bir etkisinin olmadığı; Buna karşılık, sonuç, öğrencilerin orman koruma, kötü orman yönetimi ve ormansızlaşma tehlikesi hakkındaki bilgilerinin milliyet üzerinde önemli bir etkiye sahip olduğunu göstermiştir. Sonuçlar, ormanlar hakkında bilgi ve orman koruma arasında önemli bir ilişki olduğunu ortaya koydu. Bu nedenle, ormanlar hakkında bilgi sahibi olmak, bireylerin ormanları korumada büyük ölçüde yardımcı olacaktır, ormanları koruma sorumluluğunun devlet üzerinde etkisi yoktur, orman tutkusunun Milliyet üzerinde hiçbir etkisi yoktur, ormanı kesme tehlikesinin Milliyet üzerinde hiçbir etkisi yoktur, bireyin sorumluluğu üzerinde hiçbir etkisi yoktur. ormanı korumanın ormanın birey ve ekonomi üzerindeki önemine, orman bilgisinin eğitim düzeyine, orman korumanın eğitim düzeyine, orman tahribatı konusunda toplum bilinci oluşturmanın eğitim durumuna etkisi yoktur. Bu, okula gitmesi gerekmeyenlerin orman hakkında toplum bilinci anlamına gelir.

Eğitimin her seviyesindeki öğrenciler ormanı daha iyi anlamak için çabalamalıdır - çünkü orman dünyamızı finansal, ekolojik, tıbbi ve sosyo-geleneksel olarak her alanda etkiledi. Orman bağışlarının benzersiz çeşitli işlevleri, dünya çapında çok sayıda millet tarafından henüz kabul edilmemiştir. Dünya çapında birçok ülke, yerel, eyalet ve merkezi düzeylerde orman yönetimine hala düşük öncelik vermektedir; bunlar orman bakımı ve koruması için düşük tutkuyla sonuçlandı; bu aynı zamanda orman kesimini iyileştirme, verimlilik ve kamu savunucularından yoksun hale getirir. En temel olarak, muhtemelen, bitki örtüsünün ve ekosistemin her alanı, farklı çalışma kursları nedeniyle, üçüncül kurum düzeyindeki tüm öğrencilere bilinemez veya maruz bırakılamaz. Bununla birlikte, yükseköğretim kurumu öğrencileri, yeterli olanaklar sağlandığı takdirde, kişisel öğrenme veya öğrenme özerkliği için güçlü bir yeteneğe sahiptir. İkinci yaklaşım için, üç yapay zeka (AI) modeli (ANN, SVM ve ANFIS) ve bir klasik MLR modeli kullanılarak orman bilgisi tahmini kullanıldı. Modellerin performans verimliliği, dört istatistiksel ölçü kullanılarak değerlendirildi. Sonuçlar, SVM-M1(R2=0.8893, MSE=0.0950 ve R=0.9430), diğer AI tabanlı modellerin orman bilgisi tahmini için güvenilir olduğunu kanıtlamasına rağmen diğer tüm modellerden daha iyi performans gösterdiğini gösterdi. LSTM-M1, hem RF hem de LSTM'nin %80'in üzerinde tahmin doğruluğu elde etmesiyle, çalışılan DL modelleri arasında en iyi ve en doğru tahmin modeli olarak ortaya çıktı. Öte yandan DL'nin EML'si %96 oranında doğru olduğunu kanıtladı. İki durumun sonuçları, FK için daha fazla karar vermede ARIMA zaman serileri ve DL modellerinin tercih edildiğini göstermektedir.

Anahtar Kelimeler: Anahtar Kelimeler: Çevre eğitimi, Ormanlar, Bilgi, Yapay Zeka, Kuzey Kıbrıs

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CHAPTER Ⅰ

Introduction

Statement of the Problem

In all ages of human existence, vegetation has never seized to play a vital role financially, commercially, traditionally, societally, and religiously across every nation globally. The importance of vegetation covers the supply of various varieties of logs, vegetation materials and other immaterial products as being acknowledged by so many academicians and students. Vegetation materials are widely utilized for medical, food, energy generation, building and household purposes across our counties and metropolitan cities (Ormsby & Kaplin, 2005; Mengistu, 2006; Appiah, 2009; Katerere et al., 2009). Vegetation is so vital like we often regard carbon emissions in climatic variation as it is most aware and believed across the world. The world vegetation covers were highly utilized above the natural capacity, and these have resulted in safeguarding and preservation of vegetation endowments in the areas facing severe deforestation (Heino, 2008; FAO, 2009).

In forest management, understanding several environmental uncertain concerns such as forest management is paramount for sustainable development. Forests constituted a lot to the coexistence and general fitness of both man and the natural environment. Forests are so essential with diverse values and roles it plays in the lives of the people and society. The ecological units of the environment are categorised into servicing, balancing, traditional and other secondary functions that rightly define the vast values of vegetation. These values could be commercial, societal, and ecological, which enhances the viability of the administrative system of the vegetation, evaluation of trees well- being and supervision. It is well known that the roles of vegetation may be confusing due to the latest vegetation administrative notions and workable activities initiated to find solutions to the illogical ideas (Berninger & Messier, 2010; Soe, & Yeo-Chang, 2019).

(Band, 1993; Houghton, 1998; Lal, 1995; Pandy, 2002 & Schimel, 1995) concurred forest cover changes, particularly group of anthropogenic origin, which have broad effects on critical environmental developments like the water cycle, earth's energy balance, water and biogeochemical processes. Therefore, judging such changes is vital for tackling many pressing problems that have to do with ecosystem

dynamics, global carbon budget, and sustainability, finally the vulnerability of natural and human systems. Furthermore (Skole et al., 1998; Townshend et al., 2012; CCIWG, 2018 & GCOS, 2010) conveyed that, there is need for setting a framework and design implementation that will assist globally for observing, understanding, and predicting any alteration causing global forest changes, natural or human as well as the global examining of forest land covering and its dynamics. (Korner, 2007) said apart from the land forest, there are forests mountain known as Tropical Mountain Forests (TMF), in a broad sense they are those forests located on mountains above 300m asl. Korner further added that TMF serves as vital ecosystems, which indeed the mountains cover a quarter of the land area, they are heterogeneous environments that support about a third of terrestrial plant diversity, and they supply half of humanity with drinking water. TMF ecosystems are gravely threatened; however, there is a critical need to understand their diversity and function to evaluate their potential response to global change drivers.

Forests are so essential with diverse values and roles it plays in the life of the people and the entire society that can never be underestimated. Forests constituted a lot to the coexistence and general fitness of both man and the natural environment. The ecological units of the environment are basically categorized into servicing, balancing, traditional and other secondary roles that rightly define the vast values of vegetation. These values could be commercial, societal, and ecological – which in turn enhance the viability of the administrative system of the vegetation, evaluation of trees well- being and supervision. Defining the roles of vegetation may be confusing due to the latest vegetation administrative notions and workable activities that are initiated to find solutions to the confusing notions. The environmental aesthetic values, plants, and animal multiplicity are fundamental that makes vegetation renewable or viable. More focus and management should be given to reinforcement of trees planting and replacement where it has been exploited for various human uses. The notion of forest study should be redefined to accommodate environmental forest resources, a collaboration of environmental benefits with commercial benefits regarding forest study. Thus, there is the need to collaborate environmental teaching with an environmental practice which could serve great value in the teaching of landscape beauty – to actualize the unification of the aims of environmental and landscape beauty for efficient forest administrative system. Many researchers contested with this ideology, especially on the possibility of actualizing

effective teaching, learning and practice on environmental beauty among concern people (Lim et al., 2015; Parsons & Daniel, 2002; Morton, 2007).

The absence of landscape beautification yardsticks is the reason why they need for environmental understanding is being stressed in the issue concerning renewable trees administration. Other research works deal with the understanding of the environmental and life-supporting multiplicity of vegetation and necessary values indicated in the renewable plant cover administration and policy formulation procedures due to the level of awareness of people and their societal notions regarding landscape beautification. The level of people understanding varies in respect of benefits of vegetation and landscape beautification assessment considering ethnic diversity and other demographical variables (Lim et al., 2015).

In addition, it is very important in this on-going research work to have full knowledge of students about tree-plant resources which will invariably reveal the determinant variables that gives meaning to the purpose of the study. It is an empirical fact that people demographic profiles determine their perceptions and views about forestry. Even people way of life or lifestyle based on occupation and nationality in relation to natural endowments could influence their views and perceptions concerning the administration of such nature gifts (Upton et al., 2015; Berninger & Messier, 2010).

The knowledge and behaviors of human regarding vegetation endowments were mostly controlled by the level, and pattern surrounding their activities in the trees cover environment; this call eventually calls for more protection and preservation of wood endowments (Ite, 1996; Mehta & Kellert, 1998; Marcus, 2001; Ormsby & Kaplin, 2005). It is so very pertinent to assess on a regular or periodic basis the knowledge and behavior of man toward vegetation endowments; in order to have improved outcome toward vegetation protection strategies and activities; all the activities should be targeted toward knowing how man relates with the vegetation endowments, decided activities of man and the mode of operation – which basically depend on the understanding, level of awareness, conception and other accessible options by native populace.

Fundamentally, the protection of vegetation endowments is very behavioral in nature that may demand reformation of human opinions, their pattern of reasoning and manner as they regularly utilized vegetation endowments. Thus, it is indispensable to enhance the native settlers to have constructive manners and views

in respect of vegetation endowment protection programs; the native settlers must be regarded alongside with vegetation covers; creating more awareness on matters concerning the environment can positively advance human understanding, manners, views, and abilities which could improve their responsibilities as ecological patriots (Mabogunje, 2007; Jonathan, 2008; Wangari, 2008).

The crucial role of tradition, society, and individual sociological factors such views, manners, beliefs, age, gender, nationality, education, social status, public engagement, and enlightenment program; all these are gaining more attention in theory and conceptual framework (Mohamed-Katerer, 2009; Lepetu & Oladele, 2009). So, there are small research works done to assess students' knowledge and attitudes toward forests across universities attended by various nationalities worldwide; few studies on how students understand and view vegetation resources and protection; very few studies or absence of in-depth analysis on the basis of comparative study among students of different nationalities in particular higher institutions of learning (Kohler & Schmithusen, 2004; Oskamp & Schultz, 2005; Poffenberger, 2006; Rasul & Karki, 2009). For this crucial reason, this current study is indeed intent to cover the area that is lagging comparatively on students' knowledge and attitudes toward forests from the perspective of nationality differences.

Furthermost research works relate natural factors and events with people's beliefs which could be limited with the method being used for evaluation beliefs, natural events and interrelationships that follow, such as interconnecting chemical airspace contamination with human displeasure. Based on the developed literature, various deterministic classical linear analysis has been widely established, which have generally been reported as being associated with low estimation accuracy. This necessitates the development of a robust, accurate and non-linear hydro-environmental method known as the artificial intelligence (AI) approach. In parallel with this, different types of AI-based models have been explored in different application related to forest sustainable management which pre-dominantly used artificial neural network (ANN) for example, sustainable forest management (Diamantopoulou, 2012), socio-ecological system (Frey & Rusch, 2013), forest change (Gopal &Woodcock 1996), forest resources management (Hanewinkel et al, 2011; Hanewinkel & Schill, 2004; Peng & Wen, 1999).

Research Background

The Mediterranean tree-plant is usually known for its unique and remarkable natural attributes that make the region center of fascination for tourists trooping from different parts of the world. It comprises of an extensive range of bio-multiplicity in varieties of plant and animal that depicted great significance rate of variation. This catchment is so much affluent with many natural endowments or forest resources that have positive impacts in reducing harshness among the people, and it enhances societal and commercial growth of the people across cities and local areas, higher agricultural output that meets the needs of the people and renders ecological supports to the people and the environment in terms of carbon reduction, conservation of water bodies, protection for a various living organism that include plants and animals, restoration of land from land destruction activities. Nevertheless, the bio-multiplicity of Mediterranean forest resources were consistently being challenged by various actions and advancements that are mostly carried out by the growing population – which also coupled with climate change menace that has serious, devastating effects on ecological units of the region. The critical forces behind this bio-multiplicity deterioration include the rapid advancement in agricultural production, high rate of urbanization, artificial pests and insects control technology, environmental pollution, deforestation, overuse of plant resources through animal rearing and wood fetching, low fertility of the soil, high rate of water shortage and poor management of environmental resources within a sustainable culture (Bengoumi, 2010).

In fact, many indigenous plant and animal communities in their diversities have been threatened and eventually terminated. The Mediterranean forest and the shrub areas are unevenly distributed among twenty-six nations (Albania, Algeria, Bulgaria, Cyprus, Croatia, Egypt, France, Greece, Italy, Jordan, Lebanon, Libya, Macedonia, Malta, Monaco, Montenegro, Morocco, Palestine, Portugal, Serbia, Slovenia, Spain, Syria, Tunisia and Turkey) with the overall landmass of Eight Million Seven Hundred Seventy-Nine Thousand Kilometer Square in the southern part of Europe, Northern part of Africa and the Middle East as shown by the map below (Figure 1). Primarily in the time past before the era of civilization, Mediterranean forests have been a center of food collection, sources of meat for human consumption, pastoral ground for the rearing of domestic animals, sources of wood materials for domestic

and industrial purposes that serve the cities and the growing local populace. These activities are a natural recycling system that with time restores back the ecosystem by remains of a man, animals, and plants that enrich the soil. While in the civilization era, it comes with massive advancement in cities, industries, transportation, and globalization trigger the need for economic growth; thus, the pattern of land utilization changes which demand the need for more efficient uses of forest resources (Winter & Marchetti, 2011; Mohren & Nabuurs, 2012; Cullotta & Maetzke, 2015).

Nations located in the north part of the Mediterranean region, their primitive and local ways of utilizing forest resources have reduced drastically due to advancement in farming activities that include animal products. These transformations have affected forest resources and services coupled with the farming administration, an outbreak of wildfires and a long period of water scarcity which threatened the whole ecosystems of that region. But the south and east Mediterranean regions experienced the extreme part of the situation due to the high growth numbers of people with high demand for agricultural land, high pressure on forest resources and high pressure on pastoral land due to increase in domestic animal production with estimated values of over two hundred per cent; while the local domestic animal production sector, particularly among the low-income earners in the countryside's, were estimated to about seventy per cent. Now on every part of the Mediterranean region, the rising populations are making a significant request on the virgin land covered by Mediterranean vegetation for aesthetic recreational centers, cities, and social amenities expansion. This issue has instigated land and property ownership problem (Martins & Fragoso, 2014; Martín-Alcón & González-Olabarría, 2015; Masiero & Secco, 2016).

Figure 1

Map showing forest concentration in the Mediterranean region

Source: State of the environment and development in the Mediterranean – 2009, Plan, Bleu based on FRA data.

According to the above statistical map illustration (Figure 1), the vegetation cover is increasing with stability growth toward the northern part of the Mediterranean region; but toward the southern and eastern region, the vegetation density is very mild of about ten per cent of the total land area due to the desert nature of the climate, badly depreciated ecological system, massive desert encroachment. Although, Libyan have a high concentration of vegetation cover towards the north of the coast side (which is less than ten per cent of the total landmass in Libyan) than North Cyprus except the South Cyprus (Cyprus) that have a bit concentration of forests. Thus, this is one of the main catalysts that prompt and as well adds value to this on-going research (Fady-Welterlen, 2005; Butchart & Carpenter, 2010). Basically, students that have moved from childhood, teenage to the youthful stage have different thinking perspective and knowledge than aged people with regards to forests; they are thinking maybe more of creating funs and leisure rather than the profound fascination aspect of the environment that enhances positive beliefs and practices toward forests. The students understanding and views about forests could be altered positively or negatively by where they reside either in the cities or countryside, educational background, the field of studies and other social

and societal factors. This study purposely focused on both Undergraduate and Post-graduate students to reveal the humanly induced challenges confronting forests and the need to rise to the tasks in protecting forests; in this wise, the study focused on Undergraduate and Post-graduate students in North Cyprus to ascertain the state and future of Mediterranean and global forest resources (Nummelin & Nordin, 2017).

Problem Formulation

There are bulk of literature and conceptual theories that provide relevant write up to the challenges of forests worldwide – most especially in third world nations of Africa, Asia, central and southern America where forest resources have been badly destroyed; because most people depend solely on forest resources for survival - it is severe agitation among environmental activists – particularly the gradual extinction of equatorial and Mediterranean forests and its ecological endowments. It is seriously panicking with the advent of global warming, climatic variation, degradation of ecosystem endowments, and severe reduction of ozone blanket and endanger of wildlife resources; this is posing severe risks to world environmental resources. Also, several millions of lands and aquatic resources in Africa, South America and Asia continents are drastically wearing away coupled with massive poverty rate, socio-economic problem, high illiteracy level and absence of environmental values among the people (Twine et al., 2003; Shackleton, 2004). All these are a significant concern to students, academicians and global environmental bodies that are environmental oriented – because the vegetation is habitation to many populace globally, significant sources of livelihood, enhancing various farming activities that sustain human both domestically and industrially, sources of foreign exchange earning both for the government and individuals, very supportive to tourism activities and hospitality industry, enriching the soil fertility, preservation of hydrological structure in terms of quantity and quality of natural water, global climatic regulation and preservation of natural wildlife and other natural endowments . As it is so glaring from the assertion, adequate assessment of student knowledge and attitudes are crucial factors that could trigger a better understanding of forest sustainability among people of various nationalities globally (Badola, 1998; Obiri & Lawes, 2002; Robertson & Lawes, 2005; Silori, 2007). To address these perennial challenges confronting our global forest resources, it would be relevant at this conjunction to reveal that evaluating

students' knowledge and attitudes are so vital in laying the basic structure for forthcoming years ahead of vegetation protection and awareness – which formed the fundamental aim and objective of this study from the perspective of students' nationality. Thus, these problems confronting global forest resources anticipated this current study.

Purpose of the Study

The main objective of this study is to assess the knowledge of students toward forests on the basis of nationality with regards to the importance of forests, problems associated with forest resources, practices of taking responsibility, forest education and general attitudes toward forests; this is evaluating the impact of various nationalities of students across three universities in North Cyprus on their knowledge and attitudes toward forest resources from comparative study perspective as initiated as follows:

- To critically ascertain whether there is any significant effect between student knowledge about forest and nationality.
- To assess whether there is any significant effect between students' knowledge about forest protection and nationality.
- To evaluate whether there is any significant effect between students' knowledge about the importance of forests and nationality.
- To analyze whether there is any significant effect between students' knowledge about poor forest administration, the danger of deforestation and nationality.
- To proof whether there is any significant effect between students' knowledge about individual and government taken responsibility for forest and nationality.
- To explain where there is any significant difference between ages of students among their perception of forest knowledge
- To demonstrate whether there is any significant difference between ages among those that believe forest responsibility can be manage by government.

The objective of the second approach is to propose three different AI-based models : Artificial neural network (ANN), adaptive neuro-fuzzy inference system (ANFIS), and support vector machine (SVM) and a conventional multilinear regression (MLR) models for the estimation of knowledge forest among university

students in North Cyprus. It is worth mentioning that since the pronouncement of AI-based techniques, to the best of the authors' knowledge, up to date no study has been conducted in technical literature indicating the knowledge forest application using these models. The motivation for work is presented in different aspects. First, investigation of the potential capability of AI-based mode (ANN, ANFIS, SVM and MLR) models for the estimation of knowledge forest.

Lastly, the present study makes the following contributions: This is the first research, to the best of the authors' knowledge, in which deep learning models random forest (RF) and long-short term memory (LSTM)) to estimate cumulative covid-19 cases (CCC) under environmental protection knowledge.

Research Questions

Understanding and views affect people manner of actions, and the two terms are very prevailing on one another to the extent that they encourage, caution and determined people belief ecologically; it also affects the views that regulate people believe. The ecological understanding, views, and beliefs of people and students varied from one nationality to another depending on culture, lifestyle, education, commercial settings, political ideology, and governmental decision organizations (Van Der Linden, 2015; Tang & Xue, 2013). Although, previous research works if not few or not at all have not been focused on comparative case works primarily on the basis students' nationality. Opportunity is widely opened now to evaluate the students based on their knowledge on the values, problems, education and taking responsibility and general attitudes about forests from the perspective of students' nationality across three universities (Near East University, Cyprus International University and East Mediterranean University) in North Cyprus. Thus, making an impact from the opinions of both university students of Turkey, Africa, Middle East and North Cyprus regarding their knowledge and attitude about forests formed the basic consideration behind the formulation of the following research questions:

1) Is there any significant effect between student knowledge about forest and nationality?
2) Is there any significant effect between students' knowledge about forest protection and nationality?

3) Is there any significant effect between students' knowledge about the importance of forests and nationality?
4) Is there any significant effect between students' knowledge about poor forest administration, the danger of deforestation and nationality?
5) Is there any significant effect between students' knowledge about individual and government taken responsibility for forest and nationality?
6) Can Artificial intelligence (AI) be the potential and novel estimation tools for knowledge forest?

Significance of Study

Vegetation resources are broadly utilized for various necessities across the globe, especially among native communities, city dwellers and governments. Although, human traditions in the form of views, manners, behavior, and beliefs vary significantly across the globe; marking and differentiating diverse races and nationalities and demographical backgrounds will significantly enhance forests knowledge and protection through the creation of sufficient awareness and public participating programs that awaken native and educated people which may be vital to triggering traditional and ecological values. Although, adequate research on people ecological views and understanding have been consistently carried in different nations of the world by differentiating views in the advanced world with views in third world nations, and the outcomes have been widely remarkable (Ashley, 2000; Batterbury, 2005). Considering the disparity in weather conditions, location, and societal, traditional, and commercial attributes associated with many nations of the world and the closely related ecological problems prevailing on the entire globe; it also revealed the absence of interconnection and knowledge sharing among students and academicians around forests or ecological protection, administration, and awareness. However, within a specific race, associating differences among people of the same nationality and merging of nationalities in a significant scope of the study. The stagnant of study, directionless aim, and lack of active environmental programs in the third world nations have created an increase crisis for a long period – in which this current research intended to solve by using this avenue to open doors for other scholars in this direction of study. It is vital to have deep knowledge about the connection that exists between man and ecosystem; this will give clear conception about man view regarding the forests and thus reinforce the protection programs

among the public in any given ecosystem (Ramsey & Hungerford, 1992; Ramsey et al., 1998). The great number of academicians and scholars has the general knowledge that stringent steps or strategies must be adopted to minimize the deforestation activities of man, but academicians from various fields of life as well as legislators are restricted in their strengths to provide a lasting reformation of human perceptions and principles toward vegetation endowments; it is crucial that academicians and scholars should be supported in various stages of creating awareness and programs that could possibly enhance people in all works of life toward sustainability of vegetation. Several nations from diverse nationalities across the world are so behind from behind in getting to this goal forests sustainability; thus, using adequate assessment tools to reveal the knowledge and attitudes of students regarding forests will effectively gear up many interest groups among politicians, individuals, pro-environmental activists, students and academicians across different nationalities toward forests sustainability – as accorded by various ecological awareness conferences worldwide (World Bank, 2002b; Laubner, 2002).

Limitations

It is comparative nationality study that addresses several assumptions and research questions that are vital to be able to comprehend the knowledge and attitudes of university students of North Cyprus toward forests based on the importance of forests, problems that are associated with forests, practices of taking responsibility, forest education or awareness and general attitudes toward forests.

- The study shall also assume that the nationality of students at the universities in North Cyprus will determine their knowledge significantly toward forest resources.
- The study shall be limited to a selection of theories and available conceptual frameworks to provide appropriate information relating to the context of the study.
- This study shall be restricted to three designated universities in North Cyprus (Near East University, Cyprus International University and East Mediterranean University – which involved students at undergraduate and post-graduate levels with sample size projection of 300 respondents in the study areas.
- This study shall also be constrained with finance to run all the activities that would be involved during study.

This research shall take more time and active labor to be accomplished.

Theoretical Frameworks

The general views of several theories and conceptual works shall reveal so many works of research across the globe that vividly applicable to this current study over the past thirty years which themes shall be focused on the following: ecological enlightenment, understanding, beliefs and values; assessment of learning institution ecological classroom working schemes; instructors or academicians and scholars perspectives to forests education, creation of programs and strategies that will champion the course of the ecosystem and forest resources, qualities that depicts conscious environmental scholars; governmental ecosystem, theories regarding forest views, manners and perceptions sociological and psychological perspectives (Ajzen, 2002), notion of thinking decision, the notion of managed manners, contention theories of managed manners and views (Scott, 2017), ecological principles and theories, forests protection and awareness (Cookson, 2000).

The overall Conceptual Frameworks

The Role of Informal Knowledge in Changing Students View about Forests

Informal and native understanding is basically the fact that human in given settlement depending on their anthropological encounter within a confined geographical location. This concept about their geographical settings has been parts of practice, belief, and culture for a long period of time – as it is transferred and advanced as ages pass by from one age group to another within the space of human existence. Native understandings are very crucial and unavoidable because of its relevance in food stability, the advancement of farm production and provision for health resources in every given society across the globe. Native understanding about forests are very essential parts of human endeavors in every nation because it serviced the wellbeing of human medically due to some financial constraints and people beliefs; most especially in third world nations, Latin American nations, and nations around Asia axis. Even in advanced societies, there are high market responses for forest products because of its relevance in the health sector. Other relevance parts of native understandings about forests are facts regarding different varieties of trees, animals, and bio-multiplicities, their habitations, physical settings,

mode of life, production, and environmental challenges. Examples are modern medicinal drugs that are sourced from forest resources. Fundamentally, the understandings of culture and native agriculturalists regarding the production of crops are major determinant forces in the improvement of diverse crop species and increment in agricultural produce across nations of the world (Hansen & Van Fleet, 2003; Ugulu, 2013; Ugulu & Dogan, 2009; Khan & Harper, 2013).

With the changing phases of the contemporary world, civilization is a major prevailing factor affecting the public and their academic backgrounds. Civilization in collaboration with internationalization has constructively and destructive changed human attitude and knowledge towards nature; with a serious emphasis on the younger generation in acknowledgement of cultural norms toward forests in all their livelihoods. The spread of household of values and union appeared to be depreciating in all every cultural endeavor. These societal reformations have affected day to day activities of human due to social mass media communications that in turn replaced cultural values of understanding that are being passed from one generation to another. Thus, most replicas for our young ones and students are productions from social media instead of cultural norms that protect nature and its diversities (Hezel, 2001; Balick, 2007).

Ecological Knowledge and Views of Students in Learning Institutions

Research studies have shown that if learners are subjected to the persistent teaching of environmental ethics; it will constructively influence the learners understanding at the end of the teaching program (McMillan & Beazley, 2004). Another work by Schmidt assessed the impacts of ecological teaching on the views and conducts of learners in tertiary institution; the outcomes showed a constructive relationship concerning learners view and conduct for offering academic program in ecological matters; non-registered learners on ecological program – depicted low level of ecological knowledge; learners in Hong Kong High schools indicated a high level of regards for nature and readiness to be involved in public nature advocacy, but their passion for modernization and advancement in technology have overturned the positive esteem for nature protection (Schmidt, 2007; Hunter, 2000). Learners in the United States of American acknowledged the connection regarding people concentration and ecological expected standard; learners confessed to being highly negative concerning the required environmental standard and the entire earth carriage

capability. Thus, the knowledge and view of learners regarding passion for nature have a serious link with their sex differences, time of life, academic backgrounds, racial differences, and societal status or class. All the demographic characteristics, particularly on sex disparities, indicated significantly how this factor could determine students' degree of conducts, understanding, and views regarding nature (Nisiforou & Charalambides, 2012).

Geographical distribution and multiplicity of vegetation could affect the development of knowledge and views in human life. The high concentration of vegetation may affect land topography; usage of land could be seen as high risks to farming activities and the surrounding settlements. Examples are Irish people that connect farming culture to agricultural activity. Agriculturalists were noted for wrong conceptions about vegetation in comparisons to non-agriculturalists (Upton & Bullock, 2015). The emergent of the ecological problem is determined remarkably by the degree of human conducts, views, and knowledge. Making more emphasis on the societal and financial gains from nature may indirectly affect the well-being of nature. Thus, there is the need to comprehend the correlation concerning human knowledge and views in the direction of nature; knowledge and views about nature could be well exhibited indeed or practice and communications amongst groups of humans in society. From a broad point of views, people readiness of being responsible to protect nature is notable force influencing ecological endowment, not ecological strategies put in place by government or any environmentally concerned organizations (Tikka & Tynys, 2000).

Thesis Structure

In this thesis, the chapter one section includes background of the introduction, problem formulation, aim of the research, assumption, research questions, significance of the study, scope and limitation of the study, theoretical framework, the overall Conceptual Frameworks and thesis structure, Chapter two comprises of; overview of the study, literature review related to deterministic analysis, literature review related to artificial intelligence analysis, while chapter three includes; background and overview, general analysis and concept using the deterministic approach, research paradigm, experimental research design, population and sample, data collection and instrument, administration of survey instrument, data analysis,

validity and reliability of the research instrument, estimation of knowledge using artificial intelligence, artificial intelligence-based models, artificial neural network, adaptive neuro-fuzzy inference system, support vector machine, multilinear regression analysis, model performance criteria. Chapter four also includes; background and overview, evaluation of knowledge using deterministic assessment, demographic characteristic of the respondent, Students' Knowledge About Forests Versus Nationality, Students' Knowledge About Forest Protection Versus Nationality, Students' Knowledge about the Importance of Forest Versus Nationality, Students' Knowledge About Poor Forest Administration and Danger of Deforestation Versus Nationality, Students' Knowledge of Individual and Government Responsibility Regarding Forest and Nationality, Comparison of the general outcomes from the deterministic approach, Results of AI-based models, and lastly chapter five which comprises of conclusion and recommendation.

CHAPTER Ⅱ

Literature Review

Overview

Human advantages are dependent on forest for directing and supporting social and temporary administrations in numerous cases. Be that as it may, the territories of forest assets are declining over the globe, somewhat, because of business logging and change of forested natural surroundings to crop lands. For instance, horticultural land development driven by the aimless leeway of forest is assessed to represent 43% of tropical woodland misfortunes. This proposes tropical woodlands are being pulverized at a disturbing rate everywhere throughout the world. For example, more than 5 million hectares of forest are being changed over into ineffectively oversaw auxiliary vegetation every year (Tadesse & Teketay, 2017; Woldie & Tadesse, 2019).

As an approach to lessen woodland corruption in various pieces of the world, joint effort between various partners has been created. For instance, a few nations in Latin America, Asia, and Africa are moving the obligations regarding overseeing regular assets to city governments (Tadesse & Teketay, 2017; Woldie & Tadesse, 2019).

The forest resources have been continuously declining over time. They have declined significantly and steadily both in size and quality, e.g., in species composition and structure. In the past, forests were managed by the government without the participation of local communities. Local communities are often rich in indigenous knowledge and appreciation of their natural and cultural heritages. Pressure for rapid economic development, however, can alienate people from their heritage and degrade the local environment. For example, lack of public awareness, negative attitudes, and absence of an economic benefit-sharing mechanism from the forest resources to the local people have contributed much to the loss of forests in Ethiopia (Tadesse & Teketay, 2017; Woldie & Tadesse, 2019).

Literature review related to the research based on deterministic analysis

(Macura et al. 2011) conducted a reteach based on the awareness, management, attitudes impacted by the community on the forest management. The assessment was based on forest controlled by the state government at Karnataka, India. The district in Kodagu Karnataka was the case study and the different community leaving in and near the forest (dwellers) were considered. The data were collected using various sets of questioners for 247 instances each instance indicated the number of villagers surviving under different land area including national parks, reserved forest, and private plantation. The results were evaluated using several multivariate analyses and the likely outcomes show more knowledge about forest right Act led to numbers of people to appreciate the forest reserved must with a positive attitude. The obtained results also indicated that the forest management is quite attributed to the negative attitudes directly on the reserved forest. The reteach concluded that for attaining sustainable forest management across India, the community as well as local people awareness and participation toward the forest right and their right and the relationship between with the forest education is paramount.

(McFarlane & Boxall, 2000) studied and evaluated the forest values and attitudes concerning vacationists and hunters in Albert Forest. The study was based on the concept of intellectual perspectives and cognitive reasoning which directed towards the knowledge and attitudes of the two important groups. The survey data were obtained by mail and the results displayed that the vacationists and hunters have the total faith in their forest understanding and orientations. The two groups confirmed that the sustainable forest is not quite management for different reasons such as socioeconomic factors, lack of adequate knowledge, values and attitudes. The research also indicated that there is a strong bond and relation between attitudes and knowledge with regards to forest sustainability.

(Harshaw et al., 2009) employed different ways to evaluate the nine forests in British Columbia communities. The major aim of this research is to appreciate and comprehend the levels of participation and awareness with regards to the sustainable forest management in such a way that the decision-makers can understand the overall concept, beliefs, and perception of forest management. In this way, the obtained analysis results demonstrated that there urgent need to introduce some approaches

that that would help in community participation and awareness with regards to sustainable forest management. The results also suggested that the public awareness of forest management would give way in terms of trust to different companies related to forestry.

(Obua et al., 1998) conducted a study to evaluate the attitudes of peoples towards forest management practices at Budongo, Uganda. For this purpose, 200 inhabitants were assessed with respect to social and economic features applied to the resources of forest management. The study also highlights different way of managing the forest in the case study. After that, the obtained analysis indicated that the community surrounding the case study can possibly have the advantage from the forest resources. The study also depicted that confident attitude of the local people concerning forest sustainably are very vital in forest management.

(Meijer et al., 2015) reviewed various article related to knowledge, attitudes, and forestry perception in Sub-Saharan Africa. The research focused on the developing the decision to implement a new system that aid the sustainability of agricultural and forestry management in term of technologies. The extrinsic and intrinsic variables parameters affecting the process of agroforestry management were identified due to its chaotic nature. After that several recommendations with regards to improvement were made to capture the clear understanding of the system.

(Rist et al. 2016) stated that forest involves multiple users which includes communities, tourists, researchers, and managers which different attitude, values, knowledge and perspectives related to forest managements. In the study, three different locations were evaluated which includes subtropical, tropical, and boreal forest to determine the level of equivalence between the users and the understanding of forest sustainability and management. Various hypothesis was identified and assessed toward the knowledge and perception of forest management; the analysis indicated that ecological knowledge can play a vital role in contemporary forest sustainability practice.

(McGrady et al., 2016) conducted a study to understand whether the is relationship between local community's attitudes and the way of life interm of orientations values concerning sustainable forest management at Mountain Pine Beetle Colorado. For this reason, the used data were recorded using mail survey open-ended questioner at of residents in Colorado and Wyoming. For the analysis the

quantitative results showed four different values of orientation types including biocentric, anthropocentric, spiritual, and pluralist.

(Weiss et al., 2019) discovered a conceptual framework for ownership forest across the European countries. Previous studies of the literature survey and practical suggestion from twenty-eight countries were employed as the main goal to provide an ideal overview about the state of art toward the knowledge with regards to the forest sustainable management, research and development, policy making and decision strategies. The research also explained in detail about the forest classification and ownership right policy based on individual and private partners. The research indicated that forest the relationship and links between the ownership of the forest and policy are parallel in the other words there is quite negligence between the aspect with regards to mutual understanding. However, it was recommended that the new forest management policy should be adopted towards forest ownership.

(Laakkonen et al., 2018) conducted a study to address different attitudes toward towards the management of forest based on the climatic condition which is related to the climate global concern. The study understand that the climate change plays an essential role concerning private and family forest ownership. The study also observed that there are several uncertainties related to the knowledge, guidelines, and policy facing the forest owners' attitudes which directly affect the motivation towards global climate change concern.

(Kouassi et al., 2018) studied the empirical relationship between the forest users in term of the attitudes toward forest management and sustainability. The links connecting the respondents and the attitudes concerning the participation management and characteristics were also examined. For this reason, the primary data used in this study were observed and collected from the household, interview and logical discussion within the three rural community in the Gebradima forest of southwestern Ethiopia. The results were analyses based on statistical measures such as Chi square test and the obtained results indicated that more than 79.7% of the respondent indicated showed favourable attitudes concerning participation in forest management and sustainability. The outcomes also demonstrated that the high level of acceptance in term of significance were observed between the education, gender, age, forest income, ownership with related attitudes. In other way round the family size, marital status had no or less significance with the attitudes. This study

recommended that for the specific case study there is no need of educating the local community to ensure the forest sustainability and management.

(Kobbail, 2012) evaluated the understanding of attitudes toward local community based on the data obtained from 100 people leaving within the case study area. The project is based on the implantation of forest programmers towards it is sustainable management. In this way, data were collected from random selection interview of the villagers. The results demonstrated that substantial number of the community peoples have access to knowledge, understanding, and moral attitudes toward the forest policy and management with is the results of the overall concept they received from the forest programs in running the affairs towards forest management. Even though the women were not fully active but still possess enough awareness related to the policy and forest management. Different variable was introduced including the education, age, occupation etc. to overwise the full attitudes awareness and participation toward forest knowledge. Lastly, this study suggested that the programs related to forest policy and management is paramount essential in addressing the local community level literacy, attitudes, knowledge and increase the relation intern of socio-economic development. Another important point addressed in this research was the attributed to the women's participation in community concerning the peacekeeping and settlement of disputes among the community.

(Chowdhury et al., 2014) examined different level of attitudes by analyses the local peoples surviving near to the and around the forest environments. The studies were based on how the attitudes were channelled towards the forest management and conservations. The approaches including distribution of motivational incentives among the groups of forest users to improve the attitudes of the local community. Despite different levels of attitudes among the respondents but generally a positive attitude was observed. The respondent displayed different opinion with regards to variables and factors used in this study. The results indicated that motivational incentive with no elements of inequality would increase the level of knowledge, management and sustainable policy making.

(Tadesse & Teketay, 2017) conducted research to realizes the perceptions of local community towards the sustainable forest management at Wof-Washa Forests in Ethiopia using several socio-economic variables including livestock, age, income, occupation, land ownership. For this reason, different types of hypotheses were analyzed based on perception and attitudes of the people. For data collection the

information from the total of 64 number of households were collected by employing both the open and close ended questioners concerning the main targets. The classical multiyear regression analysis was used with the addition of statistical analysis to determine the behavior and interpretation of the data sets. The obtained outcomes demonstrated the significance effect of socio-economic parameters on the perceptions with regards to forest management practice. The study further investigated that some respondent toward the forest management were still yet to accept the overall idea which probably need some forest knowledge and awareness. Hence, there is need of the future research based on the suggested outcomes in this work.

(Nuraeni et al., 2018) implemented a model which analyzed the perfectional behavior of the local community in the forest management at Bulukumba Regency, South Sulawesi, Indonesia. The models introduced structural equation techniques using different variables including knowledge, income community forest, etc., the model's results were evaluated using different statistical efficiency criteria. The results indicated that major factors affecting the community forest management is knowledge perception toward the awareness about the important and benefits of forest both from the economic and social points of views.

(Soe & Yeo-Chang, 2019) developed a study to identified among the different factors, the major ones could be engaged to improve the participation of the local community towards forest management and conservations in Bago Yoma, South-central Myanmar based on that the two objections were derived. The study also determines how to regulate the policy making for motivating the local community in forest management. The data were derived and collected from an interviewed of 330 households using a survey questioner and several hypotheses were formulated. Subsequently, binary logistic regression was used to evaluate both the qualitative and quantitative data. The finding observed that the local community mainly used forest of their domestic activities and incomes learning. Also, it was observed that illegal used of forest such is the major factors that caused deforestation which in other hand related to the lack of knowledge of forest policy and awareness. The findings also suggested that forest policy would be emphases and implemented among the local community, this would give way to good attitudes towards sustainable forest management.

(Aguilar & Kelly, 2019) conducted a study in US about family forest management integrated with natural and human systems. The study incorporated the development of different models based on reviewed of various literature.in this work different socio-economic factors were considered in which public policy emerged the main factors affecting family forest management. The research identified areas where additional research is needed, and tabulated different solution related to family forest.

(Talukdar & Gupta, 2018) examined attitudes towards forest and wildlife among Rabha, Bodo and Rajbongshi communities from three villages in the Chakrashila Wildlife Sanctuary of western Assam, India. The study was conducted through open-ended and structured interviews, focus group discussions, and participatory rural appraisal. The respondents identified availability of forest products, biodiversity conservation and the aesthetic beauty of the forest as the major justifications for the establishment of Chakras hila as a protected area. They also believed that people and wildlife could coexist peacefully, although some respondents did not have a cordial relationship with Forest Department staff. Most respondents were favorably disposed towards the golden langur Trachypithecus geei because it did not harm anybody or damage crops, and because of its shining coat and its exalted status in their religious beliefs. Most respondents did not want to relocate because they lacked skills and resources and had associations with the forest, where they maintained sacred groves and observed taboos on hunting and plant resource extraction. Thus, the attitudes of the communities were governed not only by their material needs and priorities but also by their deep-rooted cultural–religious bond with the forest. These matters would benefit from being incorporated into forest management strategies in developing countries.

(Zelenika, 2018) In the Sustainable Communities Field School (Field School) program, advertised as team building tours, participants from local organizations are guided by instructors through University of British Columbia Botanical Garden, while receiving verbal and experiential education on topics of food systems and choices, biodiversity conservation, water conservation, and waste reduction. We found that after the Field School program, participants were significantly more knowledgeable about environmental issues, more connected to nature, showed greater intentions and willingness to engage in sustainability actions compared to garden visitors from the public who did not go through the program. The results

suggest that interactive sustainability education in a botanical garden setting can be a useful education model to mobilize public engagement on sustainability.

(Woldie & Tadesse, 2019) the objectives of the study were to (1) examine the views and attitudes of local people towards community versus state forests governance and (2) evaluate the management practices implemented in the community versus state forestry and their implications on the forest status and the livelihood of local people. A structured questionnaire consisting of closed- and open-ended questions was developed to collect quantitative data from randomly selected households. Moreover, key informant interviews and focus group discussions were conducted to gather qualitative data. Descriptive statistics and multiple linear regression were used to analyze and interpret the quantitative data. The data obtained through key informant interviews and focus group discussions were synthesized and narrated using a qualitative method.

(Apipoonyanon et al., 2020) have made survey in the rural areas that the peoples in the villages have been using forest resources for a long period of time for their sustenance in Thailand, they conducted an analysis by data collection from 400 houses over two small town in the northern east Thailand, the study that conducted identified the aspects that influences the participation of household members in resident community forest management (CFM) programs. As a results of these the logit regression models shows that's the activities they are doing, years they spend in the community, earning and cost living, the information as well as training they are getting about CFM programs, the decision making in CFM program, and recognized benefits based on social and institutional advantages on how positively they influence the cooperation in the CF programs. Moreover, self-efficacy have been found to negatively effects the participation and the survey also shows that's the peoples with less privileges, laypeople in community and others who are lack in confidence and they didn't have personal goals they want to achieve have been be more likely to be participants in the CFM programs, so these finding about the community forest management CFM increased our knowledge and help us to improve our comprehending about of houses participation and cooperation on community forest management CFM feature and point the need on how community peoples committed themselves in forest management programs and on how to make solution with the excellent tactics.

(Bridhikitti et al., 2020) Made their survey on some little scale community forest are being compromised by urbanization, containing Ban Dan Na Kham Community forest (BCF), found near to the Mukdahan Special Economic Zone (MSEZ), which is in the northern eastern part of Thailand Chiefs or head of the community may encounter trouble in defending the commitments from forest to resident livelihood and will in general organize urbanizing improvement This survey plans to investigate the elements of effective community forest administration and help to increases our knowledge on community forest by using mini and little scales under the danger of urban development, put them to the case of BCF, and in suitable way provide the advice to the head of the community, The reason depended on proof from field estimations, an investigation of satellite symbolisms and meetings, gathered in 2017. The discoveries uncovered that the BCF the executives were noticeable in social jobs, particularly in positive open attitude, solid nearby inclusion what's more, information and knowledge that's help in the change of possession. The motivators from using non-timber assets had additionally been assuming a huge job in successfully managing the board. The institutional acts were frail, except for solid authority. Even though the timberland size was little, it gave adequate supplies to family units. In conclusion on these discoveries, the BCF the executives was extraordinary culturally, particularly in certain public attitude of mind, solid neighborhood contribution and great knowledge as well as good information relocation. The impetuses from forest asset use had additionally played a huge role in effective administration since nearby employments were firmly reliant on forest assets as wellsprings of foods, local supplies, and money. The institutional jobs in timberland the board were powerless, except for solid administration. They, in any case, could be improved after the presentation of the Community Forest Act. Physical highlights of the forest were very little favourable position over other comparative sort of forest in Thailand. It, nevertheless, give adequate supplies to nearby family units. They propose recommendations to the focal government for employment sustainability under the danger of urbanization. These are empowering the jobs of open arrangement organization in basic leadership, respecting every single individual voice into open conversation gatherings, advancing two-way communication, and thinking about great administration in chance alleviation and remuneration measures. Proposals coordinated to ranger service offices are spreading scholarly administrations to neighborhood networks to improve biodiversity and

increment the efficiency of the backwoods and routinely detailing current forest status to the neighborhood parts. Moreover, the Kham Pa Lai Municipality may consider timberland limit settlement and support. Extra help for the volunteers might be required for sustainability. Because of solid open inclusion, the district ought to consider pushing ahead to national acknowledgment.

(Maurer et al., 2020) tried to analyze the programs of green awareness in action on how to boost certain behavioral changes by educating and giving necessary information and knowledge to community students' parents and all other categories of peoples regarding energy expenditure and sustainability awareness. Reasonable, solid, maintainable and current vitality utilization is a crucial objective of the Plan 2030. To raise every resident's awareness for progressively viable energy consumption, appropriate training is vital. The study hall venture GAIA (Green Awareness in Action) was intended to change energy consumption examples to seek after green conduct and behavior. The class-wise point was to improve schools' CO2-balance and to advance naturally manageable conduct without affecting school life quality. Their objective was gathering 6th graders (N = 132, M = 11.03, SD ± 0.23, 53.4% = young ladies) of one Greek school. To screen the undertaking's impact, a pre- and post-test configuration was applied to measure ecological proficiency with respect to natural information, Attitude/values, and behavior. A relapse investigation uncovered that students or participant with poor past information came to higher learning impacts contrasted with those with great past information. Identified with the ecological knowledge types, an ANCOVA examination uncovered an information gain in action-related also, adequacy knowledge. In conclusion the general learning impact associates emphatically with pro-environmental inclination (high scores in conservation, low scores in exercising and use) and adversely or contrarily with feeble pro-environmental inclinations. Human-centric (utilitarian) inclinations fundamentally focusing on nature abuse have extensively reduced. The undertaking delineates how far person's behavior can be focused on green educational activities.

(Phondani et al., 2020) Invented their research on how to assess farmers' perception on benchmark and signs of sustainable management. The primary target of this survey was to research and investigate the farmers' perceptions on principles and markers for sustainable management of native and inborn agroforestry frameworks in Uttarakhand territory of India. The present examination was directed

to archive the conventional information and considered five general classifications including agriculture management, livestock management, forest sustainability, social benefits, and strategy contributions alongside with 16 criteria, indicators were 34 that have been identified. Traditional uses of 48 agroforestry species were reported along an altitudinal slope from 800 to 1800 m above ocean level (m asl). Recognitions and reactions of 150 farmers of three small town bunches situated at various agroclimatic zones viz., Saknidhar, Jakhand and Dagar dependent on their segment qualities were recorded towards the potential elements for decay and feasible choices for maintainable administration of indigenous agroforestry frameworks. The conclusions of this present survey are important to nearby farmers and arrangement organizers to analyze the present strategies and upgrade for sustainable energy supply in the Himalayan setting through usage of indigenous agroforestry species. The discoveries will assist with refining and advancing the knowledge among the partners to give a powerful system to choices and authoritative decision making to support and keep up agroforestry quality and administrations.

Literature review related to the research based on Artificial Intelligence

Artificial neural networks (ANN) are systems designed based on the computational analysis to emulate the process by which human brains handle information (Abba et al., 2017). They are comprised of different neurons as processing units, which relate to adjustable weights and biases. ANNs serves as single or multi-layered systems consisting of an input, hidden and output layer (Tayyebi et al., 2019). The present study adopts the feed-forward network with backpropagation algorithms (FFNN-BP). According to the literature, artificial neural network are tools used in processing information, which are designed and function like the biological nervous system of the brain, and include a basic component known as a neuron (node).

(Diamantopoulou, 2012) proposed three different artificial intelligence models to assess the reliability and sustainability of forest. The models include Back Propagation Artificial Neural Network (BPANN), Cascade Correlation Artificial Neural Network (CCANN), and Generalized Regression Neural Network (GRNN). The paper aimed as predicting single tree height in the sustainable management way. The three AI model demonstrated the satisfactory ability in the estimation of forest

sustainability in comparison with the classical linear model. Among the AI models BPANN and CCANN displayed the most promising capability than GRNN with superiority of CCANN than both BPANN and GRNN and hence served as the promising model. Other studies related to sustainable forest management includes (Ingram et al., 2005;Imada, 2014; Peng & Wen, 1999).

Recent research shows that there is exponential increase in the use of Artificial Intelligence (AI), which represents an alternative, attractive, quick and direct computing tool for water quality modeling (Tung & Yaseen, 2020;Sahoo & Patra, 2020;Gaya et al., 2020;Yasin and Karim, 2020;Karim and Kamsani, 2020). AI has the ability to minimize the error, effort and computation time. Artificial neural network (ANN), adaptive neuro-fuzzy inference system (ANFIS), and support vector regression (SVR) are among the popular artificial intelligence modeling methods developed for highly complicated process and handling data nonlinearity (Barzegar et al., 2016). However, several researchers have employed different combinations of AI-based models to predict the WQI (Yaseen et al., 2018; Zhu et al., 2019).

(Esteban et al, 2009; Atkinson & Tatnall, 1997; Ashraf et al., 2013; Dogan & Bugday, 2018) attested that Artificial Neural Network (ANN) was applicable for a long decade in the profession of engineering which serve them strongly for modeling any aspect of data. The result is different when it comes to application of forest; they are very rare number of write-ups that uses ANN on forest (Gimblett & Ball, 1995; Lek et al., 1996; Atkinson & Tatnall, 1997) attested that ANN has also begun to emerge as an alternative approach for modeling nonlinear and complex phenomena in forest science. In addition (Gimblett & Ball,1995) expresses that is not easy to make decision reaching concerning natural resources with empirical statistical method, due to how difficult it is, it requires extra approach more than exploratory algorithmic. That is statistical models are not suitable for solving structured problems related forest resource management. (Coulson et al., 1987) accepted that the used of artificial intelligence approach in forest and natural resources management began with the advancement of professional's initiative for solving related problems attaining to adequate decision. (Guan & Gertner, 1991a; Guan & Gertner, 1991b) proven that progress had been made regarding the use of ANN to model different types of tree mortality this development brought about successfully development of red pine model prediction using ANN for tree survival (Pinus resinosa Ait). Based on their outcomes, they arrived at the red pine survival model did not only suit the data

after statistical model rather can be used for future prediction. Also, the model has enough flexibility that can handle different varieties of red pine trees to increase. (Guan & Gertner, 1995) further said their method augmented suitable training algorithm and computation policy for modeling specific tree survival probability. Also, forest damage by fire is another obstacle to the environment that needs to be addressed. (Sakr, et.al., 2010), concurred the occurrences of fires in the Mediterranean which makes the region to become the region with leading high forest fire worldwide. Because forest fire is setback for many terrestrial ecosystems such as Mediterranean ecosystems, temperate forests, boreal forests, grasslands, and savannas to mentioned but few, the only solution done as then to control forest fire risks was implementing forest fire monitoring and allocating resources for prediction and taking measures on how to prevent and manage forest.

(Sinthumule et al., 2020) Have investigated the Conventional biological knowledge and method for forest preservations in South Africa, Thathe Vondo in Limpopo Province. This investigation consolidated qualitative along with quantitative research to distinguish and portray the key native and inborn practices used to conserve/secure the Holy or "Sacred" forest in Thathe Vondo, South Africa, and to look at the Attitude of mind held by country family units with respect to the estimation of traditional ecological knowledge (TEK) in the areas with large number of trees' conservation. Key source interviews accompanying sacred forest custodians (n ¼ 6), family carried out questionnaire surveys (n ¼ 160) in three small towns encompassing the sacred forest and field perceptions were utilized to gather information. Information got from interviews were examined utilizing topical content examination, while the questionnaires were evaluated by utilizing Statistical Package for Social Sciences (SPSS). Field perceptions assisted with supporting the outcomes from the meetings furthermore, questionnaire. The investigation found that the key TEK that is utilized to moderate sacred forest in the investigation zone incorporates ceremonies (u phasa) and customs for the security of antiquated graveyard. Other significant TEK contains fantasies (lightning birde Ndadzi and familial lion) and taboos including a total prohibition on exercises in the forest other than the previously mentioned customs. Additionally, the survey found that the nearby networks have certain Attitude of mind towards preservation of the nearby forest sacred. The uplifting dispositions compared to consistence as nearby networks were found not to gather fuelwood or chase in the sacred forest considering regard for, and

dread of, various types of TEK. These discoveries affirmed that TEK adds to the preservation and security of areas with the large number of trees in the study field.

(Regmi et al., 2019) performed their analysis based on the values of environment and attitudes of children who live in rural areas in Nepali, by using Two-dimensional Model of Ecological Values (2-MEV) they created and checked in Western Europe, effectively investigates the environmental values and attitudes of mind of the kids (11-16 years old) by use of questionnaire/things. Nevertheless, the accuracy of the 2-MEV Scale and its bi-dimensionality in a non-industrialized nation, for example, Nepal, is unexplored. Nepal exists in the storm district, which triggers extraordinary ecological emergencies, for example, deluge. As environmental values and attitudes of mind are identified with expert presentimental/versatile behavior, this examination investigations not just the values and attitudes of young peoples or children yet additionally the legitimacy of the 2-MEV Scale in a different geographical also, socioeconomic status. Consequently, the things of the 2-MEV Scale were altered, translated, also, approved in two rounds with 200 and 201 youngsters. Results brought about were inspected utilizing confirmatory factor analysis and corroborative factor and component analysis, separately. The discoveries approved the two develops of values of environment (Preservation and Utilization) with a connection of -0.93, yet the attitudes design differ from a certain found in industrialized nations. At long last, the Nepalese whose from rural areas adaptation of the 2-MEV was utilized to quantify values of environment. Most youngsters (78.62% from n = 379) show a tendency towards Preservation, 0.26% towards Utilization, 20.05% towards both values in part, and 1.05% were impartial. And generally, the youngsters adhered pro-environmental values and attitudes.

(Sigit et al., 2020) This had conducted to make an investigation and finding the effectiveness and advantages for students attitudes and knowledge to Coral Reefs which is the rock and by the accumulating and forming corals on it, and Mangroves that have been Conserve, the reason for this survey was to quantify knowledge of the students as well as attitudes in protection of mangroves and coral reefs, presenting and applying Environmental Education Community Network (EECN) to students in more extensive scale. The techniques that are using right now a graphic strategy and use a review for assemblage of the information. Sampling was chosen with simple random sampling in a few schools and Jakarta State University. In conclusions the

results demonstrated Average score of knowledge students from all levels were with low class. Average or typical amount score of attitudes students from whole levels were with high classification. Students' knowledge was still low and attitudes of mind regarding mangroves and coral reefs were high. This outcome demonstrated that students need a model that could upgrade their Attitudes and knowledge to preserve mangroves and coral reefs. EECN is one model that can possibly enable students' attitudes and knowledge in securing the environment.

(Volker et al., 2015) investigated the perceptual changes and roles of foresters in sustainable forest management ages and participations of community members. the impression of foresters and forest management in many nations is that both are firmly connected with timber harvesting and timberland abuse. Regardless of proof despite what might be expected, foresters are not seen as victors of environmental management. The act of forest management service is expanding in intricacy at operational, economic, natural, and social scales. The thoughts for these compounded changes are not new but rather foresters have been delayed spreading the message. In almost all the occasion advocacy environmental non-government organizations (ENGOs) has been the impetus for change. At the individual level proficient foresters assume a necessary job in the usage of reasonable sustainable forest management. This paper investigates the changing substance of forestry management service in the new time of ecosystems systems access, alongside sustainable forestation and expanded interest of society in forest the executives at nearby and national scales. What is the job for foresters and what abilities will be required to drive these changes?

(Richter-Beuschel et al., 2019) tried to find out how you can solve problems for sustainable development by using Student Teachers’ Knowledge. Education can be described as a main strategy as description of sustainable development (SD) and can provide solving worldwide challenges or problems like biodiversity loss, climate change and global warming or global heating. Content knowledge speaks to one base for guiding the education for sustainable development (ESD). And because of that, distinguishing learning and teaching necessities concerning sustainable development SD dispute in teaching education is vital. The focal point of the paper was to evaluate and get familiar with student teachers' process of knowledge regarding issues of climate change and biodiversity, by utilizing a specialist benchmark. The points of the investigation here are to portray what's more, recognize (I) differences among

students' and specialists' effectiveness estimations, (ii) differences in master and bachelor students' form of their knowledge, and (iii) differences between forms of knowledge of students learning different ESD-pertinent subjects. Student teachers at eight German institute (n = 236) assessed the effectiveness of clarification procedures to SD challenges. The outcomes demonstrated high deviations in the effectiveness estimations of specialists and students because of that, the forms of knowledge vary. The deficient of student teachers' multidisciplinary knowledge to lessen biodiversity deficit and climate change appeared to be to a great extent free of their learning program and ESD-pertinent subject. One logic behind this might be the mainly low number of ESD-pertinent courses they are present at. At the end of this study the researchers or investigators tried to recommend further longitudinal research to clarify explanations about changes in SD-associated knowledge throughout teacher education.

(Springer & Elliott, 2020) tried to investigate the health professionals' attitudes and knowledge on Climate changes related to non-communicable diseases NCD by using Barbados as a study area. Regardless of extensive awareness of the increase of non-communicable diseases (NCDs) and increasing risk of climate change, little research has investigated expected health results that will happen at the crossing point of these threat. The data had been collected by using ten (10) Health professionals from Barbado, and they were consulted to evaluate their knowledge of health dangers of climate change as it identifies with NCDs in Barbados as a case history of a little island state in danger. There is extensive worry between health professionals about the present day and time ahead prevalence of non-communicable diseases between Barbadians. There is less worry about the time to come burden of NCDs with regards to changing climate, mostly due to deficient of knowledge among most of the health professionals consulted. Those knowledgeable their associations likely noticed the problems that climate change would constitute to the avoidance and the controlling of NCDs, given the effects of climate aggravation to build environment, food security, as well as physiological and psychosocial health influences. Inadequacy of awareness between health experts of the hazard climate change constitute to NCD prevalence and effect is thoughtful of the nation's health First concern that neglect to perceive the danger of climate change. They suggest efforts to scatter information regarding climate change to shareholder in the health area to expand awareness.

Environmental knowledge and perception

Numerous people are ordinarily engaged with forest management, in particular networks, managers, and analysts. In such cases, imperfect administration results may, notwithstanding different variables, be indicative of a disparity in viewpoints among these actors driven by major contrasts in natural knowledge. Notwithstanding ignoring this perspective, examines have would in general spotlight on explicit pairings inside the full scope of actors included, as opposed to consider each of the three at the same time (Fig. 2). There is a considerable writing on customary environmental knowledge (CEK), an expanding center around the hole between approach producers and researchers (the "investigate usage gap"), and furthermore take a shot at the hole among directors and networks in the field of participatory administration. However, none of these perceive that there is consistently a third gathering of actors included, in this way potential missing a portion of the hindrances present, just as the chance to consider collaborations that may rise out of compelling correspondence among every one of the three gatherings. Reflection on the full triangulation of actors included is consequently expected to distinguish the numerous holes that must be crossed over to improve the board results. Thusly, we ask; how do basic contrasts in biological knowledge between all actors add to problematic results in backwoods the board, what are basic subjects inside these distinctions and by what means may these regular difficulties be survived? (Rist et al., 2016).

Review on Estimation of Covid-19 using AI based models

Despite proposals in the literature to use alternative versions of these models—such as neural networks—for innovative COVID-19 modeling, various new AI-based models have yet to be applied to COVID-19 circumstances. Another incentive to examine innovative modeling approaches is that accurate simulation of COVID-19 in a research location may save money, energy, and time; consequently, when anticipating these significant trends, the choice of modeling methodology is given a lot of care (Tang & Wang, 2020; Kucharski et al., 2020). COVID-19 image segmentation investigations, on the other hand, have been investigated in (Tang & Wang, 2020; Kucharski et al., 2020). Modeling methodologies are especially relevant in poorer nations, because the funding for environmental quality evaluation and monitoring is smaller than in wealthy countries. There is a lot of interest in

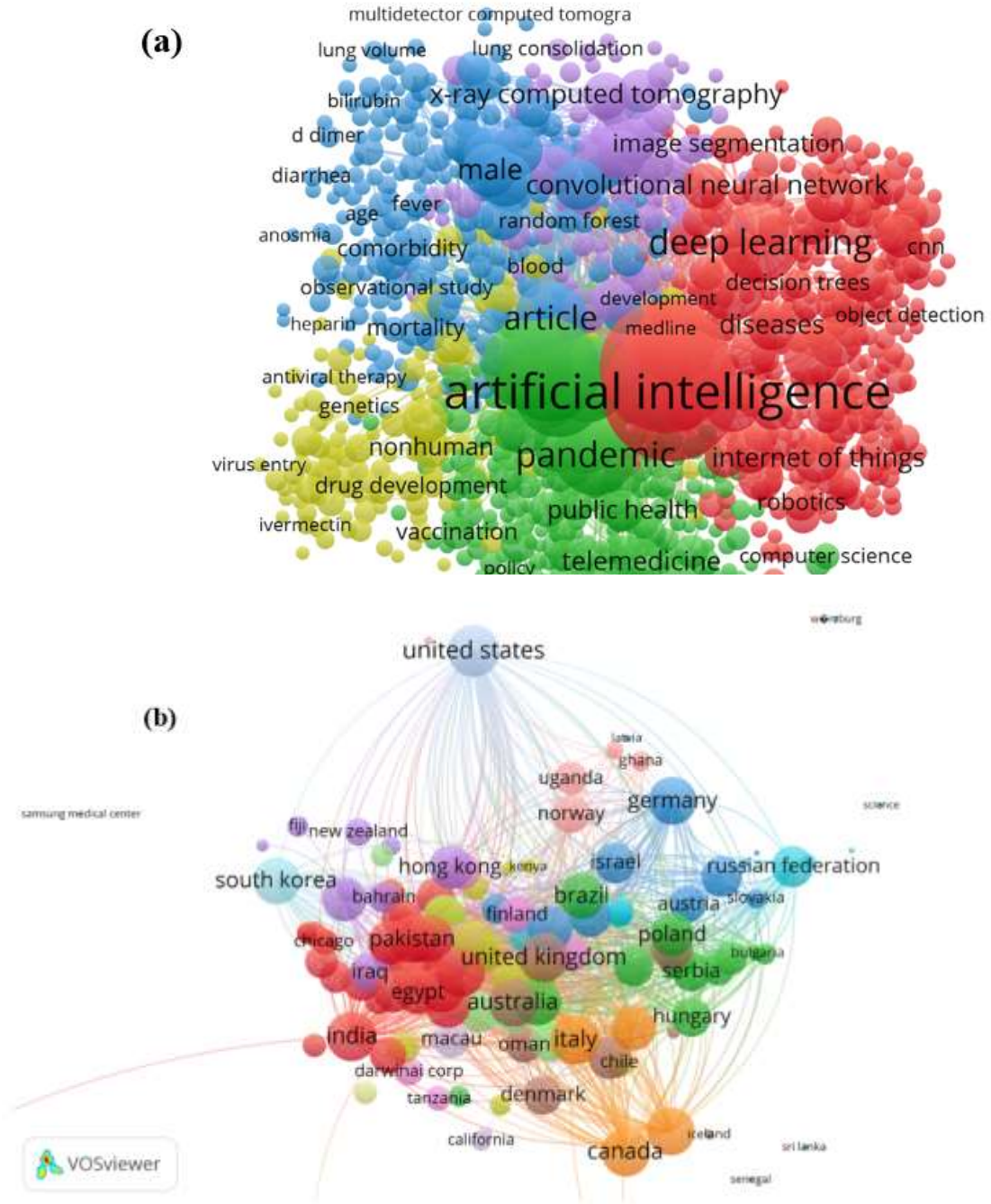
power system modeling utilizing the feasibility of ML models, according to the Scopus database's reported literature for 2020–2021. Figures 3a and 3b show the main keyword occurrence clusters and temporal regional spans found in the literature. The inclusion of almost 2000 papers demonstrates the relevance of this issue in terms of COVID-19 modeling. New machine learning models capable of tackling engineering difficulties are always being researched, and academics and scientists alike are interested in the research domain of unique and advanced modeling approaches that may be used to COVID-19

Figure 2

Actor triangle illustrating knowledge transfer gaps which result, in part, from fundamental differences in actors' beliefs. A failure to triangulate and thus consider all actors, as well as to consider the differences between different groups' ecological knowledge contributes to suboptimal forest management outcomes

Figure 3

(a) Major keywords in the literature on COVID-19, determined using machine learning models (2020–2021); (b) investigated research regions for the COVID-19 prediction.



CHAPTER Ⅲ

Methodology

Background and overview

In this chapter, the investigation of 300 students' will be used based on their personal profiles (gender, nationality, fields of study) and how nationality significantly affect the knowledge and attitudes of students toward forests in relation to the importance of forests, problems that are associated with forests, practices of taking responsibility, forests education and general attitudes toward forests. In this chapter, the design and methods that are applicable to this study will be capture. This chapter presents a comprehensive description of the research paradigm for this study, the methodology employed, research design used. Others are the population of the study, sample size, the sampling technique, data collection, research procedure and the consideration of the study by the Ethical committee. For the above purpose the approach is divided in to two:

General analysis of thesis aim using deterministic approach

A new approach of estimation forest knowledge using Artificial Intelligence

General analysis and concept using deterministic approach

Research Paradigm

The positivism paradigm which is under objective epistemology is used. The Positivism paradigm is a quantitative research methodology which applies natural sciences to discern the study of social science (Crotty, 1998). Phenomena are measured by evidence in real life thus objective not subjective (Hammersley, 2013). To this effect the relationship between the independent and the dependent variables are studied to know the influence of one on the other during the research (Cohen, Manion & Marison, 2011). The paradigm assists the positivist researcher to be able to understand the type of test he/she wants to carry out as well the method of sampling and the questions that can be design in line with the measurement to be considered. This implies that the positivist researcher gives attention to validity and reliability if the questions are consistent and the work is to be generalized based on the large population chosen (Johnson & Onwuegbuzie, 2004).

To this research survey is adopted. Survey is defined as method by which permit systematic collection or gathering of information from the targeted population which a sample is taken in constructing quantitative description of the population thus the information gathered reflect the attitudes, behavior perception and the believe which cannot be directly observed. This is the first paradigm of research methodology; thus, it was carried out mathematically with a particular way of doing things in a mathematical way (Krauss 2005).

According to (Sukamolson, 2007), quantitative methodology permits the results to be generalized, which calls for prediction. The accuracy of the result is enhanced by test of reliability and the validity that was carried out to that effect based on cause and effect. Buttressing on the above permits that the study can be replicated based on the results earlier obtained and in addition, the researcher can use the study for future study to predict (Johnson & Onwuegbuzie, 2004). Additionally, since the data is collected for objectivism epistemology, findings can be reliable which will assist the researcher to make scientific assumptions (Johnson, 2014).

Having the full knowledge of the positivist approach used for the study, it is also good to acknowledge that this present dispensation we are in, is a multiple paradigmatic era thus researchers are at liberty to choose which of the paradigm to use.

Experimental Research Design

Research design is seen as the general plan on how the entire research will be executed stressing on the lay down plans for the researcher to achieve his/her plan for the task he/ she sets before him. He added that the research design is made up of the plans on the data required, the method that can be employed to collect the data and the analyzing it and how effectively it will answer the research questions posed.

In supporting this, (De Vaus, 2001) sees research design as the whole strategy that have been put in place by the researcher which encompasses the “logical” and “coherent” way in addressing the research problem regarded as the “blueprint” applied in collecting the data, measuring the data and use in analyzing the data based on the research problem posed to guide the research.

Creswell, and Creswell (2017), consider research design to be the structure of the whole research work which is believe to “hold” or to “glue” the whole work together these are the design to the work, population, sample, and the instrumentation. This is

also agreed by this author as he perceived, design shows major aspects of the research being conducted. That is; the population, sample and its size, measures, and other vital areas in the work (Flannelly & Jankowski, 2014).

This study both uses inferential and descriptive methods to evaluate findings through a structured questionnaire (see appendix A) according to empirical observation, collection, and recording of respondents' opinion, assessment, classification, and interpretation of data through statistical software with no reason for any biased manipulation of the main objective and scope of the study. The research was piloted among the university students both at the Undergraduate and Postgraduate levels in North Cyprus to share different experiences about their knowledge and views of the forest resources in their locality. North Cyprus was selected as areas of study due to the uniqueness of the university environment, and because of the proximity to the scholar catchment, similar environmental characteristics, and challenges that are commonly associated with the Mediterranean region and other nationalities in the world. This was what propelled this study to investigate the knowledge of forests among university students of multi-nationalities in North Cyprus.

As earlier indicated a well-articulated questionnaire was organized both in English Language and Arabic Language, to reach out to Libyan and other Arabian students who mostly speak and taken Arabic as their national language. The questionnaires were administered randomly among university students in North Cyprus (Near East University, Cyprus International University, and Eastern Mediterranean University) without any regard for age, gender and study level differences; the study area was distinct culturally with students from Libya, other African nations (Nigeria, Cameron, Democratic Republic of Congo, Ghana, Zimbabwe, Gambia, Senegal, Somali, Rwanda, Sierra Leone, and Zambia), North Cyprus, Turkey and other Middle East nations(Iraq, Iran, Jordan, Syria, Palestine, Lebanon, Egypt, and Yemen). The fieldwork for administering questionnaires on face-to-face basis was supported by the voluntary assistance rendered by two university students in North Cyprus. The sum of 300 questionnaires was administered correspondingly to the university students in the targeted study area for weeks and it at most takes fifteen minutes for the questionnaire to be answered by each participant. (See figure 4).

Figure 4

Some selected case study used in this research

Most importantly, to create leading questionnaire that will answer to the fundamental objectives of the study according to the research questions; a well-structured questionnaire was developed and subdivided into seven sections with questions and responses as sub-headed which include demographic characteristics of students, evaluation of students' knowledge toward general knowledge of forests, forest protection, importance of forests, poor forest administration, danger of deforestation, and the practices of taking responsibility about forests by individual and government. Thus, to be able to acknowledge the opinions of the students toward the theme of study, participants were given the privilege of several options in making their views known for assessment; such as Yes, No and Not Sure; Agree, Disagree and No option Count; these options are responding to some values and activities regarding forest resources (Ghent & Haines, 2013).

Population and Sample

The research aimed at exploring the preference of SNS by international students during communication with different places since in some research conducted older ones are drifting from certain platforms for certain reasons. This research work tends to consider undergraduate and postgraduate students in all faculties of Near East University, Cyprus International University, and East Mediterranean University.

The Near East University, established in 1988, is in Nicosia, capital of North Cyprus, and as an international higher education institution employing highly qualified staff, offers the most extensive undergraduate and postgraduate education opportunities to over 26 thousand students coming from over 100 countries.

The Near East University has 19 faculties comprising 220 departments and programs, 8 graduate schools with around 218 graduate and postgraduate.

Cyprus International University was established in 1997, because of rising interest in higher educational institutions and instruction in English, and in recognition of the increased need for universities which conduct education in foreign languages in Cyprus and other countries in the region.

Eastern Mediterranean University Established in 1979 as an institute of Higher learning Technology for Diploma awarding purposes after which Engineering courses were introduced, it got converted into a State University in the year 1986 with the approval of the Turkish Republic with the name EMU subsequently other schools like those of Engineering, Arts and Science, Business and Economics with those of computing Engineering were introduced in the year 1990 thus the University continue to enlarge.

Data Collection Instrument

The data for this research are distributed and collected from 300 undergraduate and postgraduate students at Near East University, Cyprus International University, and East Mediterranean University. This study contained quantitative research where the major objective shall be focused on students' knowledge and attitudes toward forests. After administering the questionnaire and retrieving the feedback from the survey exercise, the results from the surveys are entered into a statistical analysis software program (SPSS). Thus, the outcome of the results shall measure central tendency such as mean and standard deviation of each variable relating to the

attributes of study on undergraduate and postgraduate students' knowledge and attitudes toward forests.

Simple Random sampling was done because every student stands the chance of being selected from the population. In–house questionnaire was designed by the researcher to collect the data. The questionnaire serves as a means of linking up with the respondents this also help the respondents to be sure that they are guaranteed of their confidentiality, personality, and their identity on the process of information gathering (Brace, 2018).

The questionnaire drafted serve as a guide to assist the researcher to carefully answer all the research questions put in place for testing. This serves as a clear guide for understanding the aim and the objectives of the study. Thus, some of the questions can be in an open ended while some are in close ended form. Although the two types, have their reasons for being used. Close ended limit the respondents from what they may wish to add while the researcher goes straight to pick what he/she wants. It is worth knowing that while structuring a questionnaire, the researcher to ensure capturing all the questions that will need to be answered based on the questions (Burgess, 2001).

Administration of Survey Instrument

Items on the questionnaire were designed to answer the research questions thus the essence why the questions were framed in such a manner is to elicit responses from the respondents that will appropriately help in answering the questions and clearly show the relationship between the variables based on the hypothesis postulated. In this study, the students were contacted and adequately be informed to determine consent for participation in the survey. The researcher is optimistic of 100% response from the respondents in the survey field. The survey shall be scheduled for 300 participants across different faculties in the three designated universities. Each survey shall last approximately 15 minutes. Before the survey, the researcher shall make a quick brief of the study and survey activities, and as well provide each participant with a consent form to read and sign.

Data Analysis

This study shall be quantitative research where the major objective shall be focused on students' knowledge and attitudes toward forests. After administering the

questionnaire and retrieving the feedback from the survey exercise, the results from the surveys shall be entered into a statistical analysis software program (SPSS). Thus, the outcome of the results shall measure central tendency such as mean and standard deviation of each variable relating to the attributes of study on undergraduate and postgraduate students' knowledge and attitudes toward forests.

The descriptive and inferential statistics are measured. In this study hypothesis were tested, the hypothesis serves as a wise guess or a mere explanation with the intention of trying or testing if the hypothesis can be accepted or disproved (Kothari, 2004).

It is paramount that a researcher must be capable of upholding or falsifying a hypothesis postulated; this will depict its scientific procedure and show the dependent and independent variable (causal and effect relationship). Additionally, in testing the hypothesis, descriptive statistic was also carried out to support the quantitative statistics posed for the study. Inferential statistics were also conducted such as correlation and regression analysis.

Validity and Reliability of research Instrument

To be sure of the validity and the reliability of the data used for the research, a pilot study was first conducted, the pilot study helps in assessing the uniqueness of the instruments used by providing an understanding of the work ahead.

The essence of the pilot study is

- To be able to dictate gray areas especially when the questionnaires are designed and given out for the pre-test. Through pilot studying the researcher will know the time taken to answer a question, the length of respondents is not complaining and their observation on the questions can easily be presented (Van Teijlingen & Hundley, 2001).
- Van Teijlingen & Hundley observed that, some of the questions that are not clear are easily identify during pilot studying to be handled during the process.
- It helps to improve the internal validity and be sure the questions have been responded adequately. Hence to confirm if questions are all answered by respondents.

- ❖ This will assist the researcher to work on the questions and also to recast or reframe the question that are not answer at all for may be sake of clarity (Van Teijlingen & Hundley, 2002).
- ❖ Enabling the researcher to re-pilot the study again in checking the questions that are not clear to be precise, straight, and concise (Van Teijlingen & Hundley, 2001; 2002).
- ❖ To this effect researcher can try which of his work is clearer and more result yielding then concentrate on such questions (Mathers et. al. 1998).

Reliability test was conducted to ensure there is consistency during measurement of the instruments. The reliability test is aimed at ensuring that there is equal authentication and balance in measurement of instruments which cuts across the items and time in instrument of the study when a study is being replicated or adapted for use in another research (Carcary, 2009).

Yet some not all affirm with the dependable nature of the validity and reliability of cases when replicated for a case study but tries to accept it the way is presented hence the validity and reliability results help in ascertaining the consistency and worth of a data and how they are acquired (Riege, 2003).

Estimation forest knowledge using Artificial Intelligence

This approach proposed three different AI based models viz: artificial neural network (ANN), adaptive neurofuzzy inference system (ANFIS), and support vector machine (SVM) and one linear model namely, multilinear regression models for the estimation of knowledge forest among university students in North Cyprus. It is worth mentioning that since the pronouncement of AI based techniques, to the best of the authors' knowledge, up to date no study has been conducted in technical literature indicating the knowledge forest application using these models. The motivation of work is presented in different aspects. First, investigation of the potential capability of AI based mode (ANN, ANFIS, and SVM) models for the estimation of knowledge forest.

Artificial Intelligence Based Models

For any data-driven method, the knowledge of data science and analysis is quite crucial; as such, the data used for the estimation of forest knowledge in this study were obtained using the procedure describe in above section. Hence, this study

proposes the application of four data-driven algorithms, including three non-linear models: ANN (the most widely used data-driven model), SVM (as recently developed model), ANFIS (as hybrid learning algorithm) and a classical model (MLR as commonly used linear model) for the estimation of forest knowledge using different input variables. The primary motivation for employing different data-intelligence models is attributed to the difficulty in understanding whether a specific model is superior to others in practice. Therefore, choosing appropriate models for a particular case can be challenging for modelers. This complexity can only be overcome by selecting and comparing different data-driven models, including the linear models despite their weaknesses in handling highly nonlinear and complex data. For the development of the current study, Fig. 3 shows the flowchart of the methods used. From the flowchart, it can be observed that the input data are collected, pre-processed, and normalized based on Equation 1. The normalization of the data was conducted before the model training, which is usually performed to increase the accuracy and speed of the model.

$$\boldsymbol{y} = 0.05 + \left(0.95 \times \left(\frac{x - x_{min}}{x_{max} - x_{min}}\right)\right) \qquad (1)$$

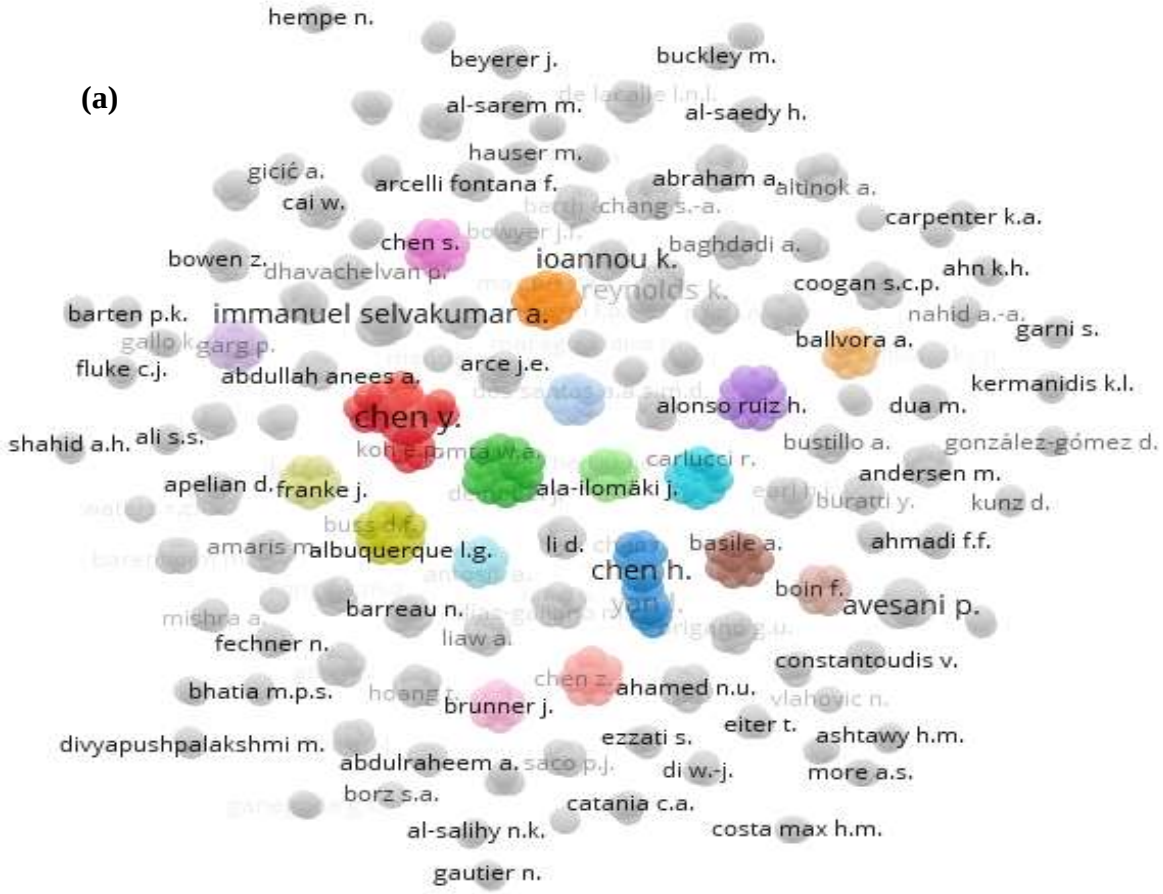
where y is the normalized data, x is the measured data, x_{max} and x_{min} are the maximum and minimum value of the measured data, respectively.

For the development of this study the important variables were selected based on the sensitivity analysis in which the following variables were used: Forest knowledge (FK), Forest importance to the country (FIC), Importance for recreational activities (ICA), Vital goal of forest (VGF), Government is responsible for taking care of forest problem (GRT), Sources of forest knowledge (SFK), Benefit of forest protection to man and his environment (BFE), Responsibility of individual to protect forest in their locality (RIF), Danger of cutting forest (DCF).

Based on the reported literature, the Scopus database reported that 143 research articles started from 2010 to date adopted over the literature using artificial intelligence in knowledge forest management. In Figure 5a, more than 200 keywords between that research indicate the lack of deep learning implementation, an ensemble model for evaluating forest knowledge. Also, the popularity of this research domain explored for 48 regions all around the world, the majority for the USA, China, and Germany (see, Figure. 5b).

Figure 5

a) the major authors used over the literature on applying artificial intelligence and forest knowledge (1984-2021), b) the investigated the research region for artificial intelligence and forest knowledge.



Artificial Neural Network (ANN)

Artificial neural networks (ANN) are systems designed based on the computational analysis to emulate the process by which human brains handle information (Abba et al., 2017). They are comprised of different neurons as processing units, which relate to adjustable weights and biases. ANNs serves as single or multi-layered systems consisting of an input, hidden and output layer (Tayyebi et al., 2019). The present study adopts the feed-forward network with backpropagation algorithms (FFNN-BP). According to the literature, artificial neural network are tools used in processing information, which are designed and function like the biological nervous system of the brain, and include a basic component known as a neuron (node). Due to their promising abilities, ANNs with FFNN-BP have proved to be effective tools for overcoming highly non-linear processes in different fields of science and engineering (Elkiran et al 2018; Nourani et al 2019). The proposed ANN architecture used in this study can be presented in Fig. 7.

Adaptive-Neuro Fuzzy Inference System (ANFIS)

One of the data-intelligence algorithms, adaptive neuro-fuzzy inference system (ANFIS) is a technique that involves the learning capacity of neural networks and fuzzy logic. ANFIS serves as real-world estimator due to its ability to approximate real functions (Nourani et al 2018). Generally, there are three types of ANFIS, namely Tsumoto, Sugeno, and Mamdani, where the Sugeno system has wider applications (Sanikhani & Kisi, 2012). Fuzzier and defuzzifier are the major parts of the fuzzy database system. Fuzzy logic involves the conversion of input data into fuzzy values through the application of membership functions. The values range between 0-1. Nodes work as membership functions (MFs) and permit the modelling between the relations of the input with the output. There are various types of membership function, such as triangular, sigmoid, Gaussian and trapezoidal (Hušek & Narenathreyas, 2016).

Figure 6

Proposed AI based models used in this study

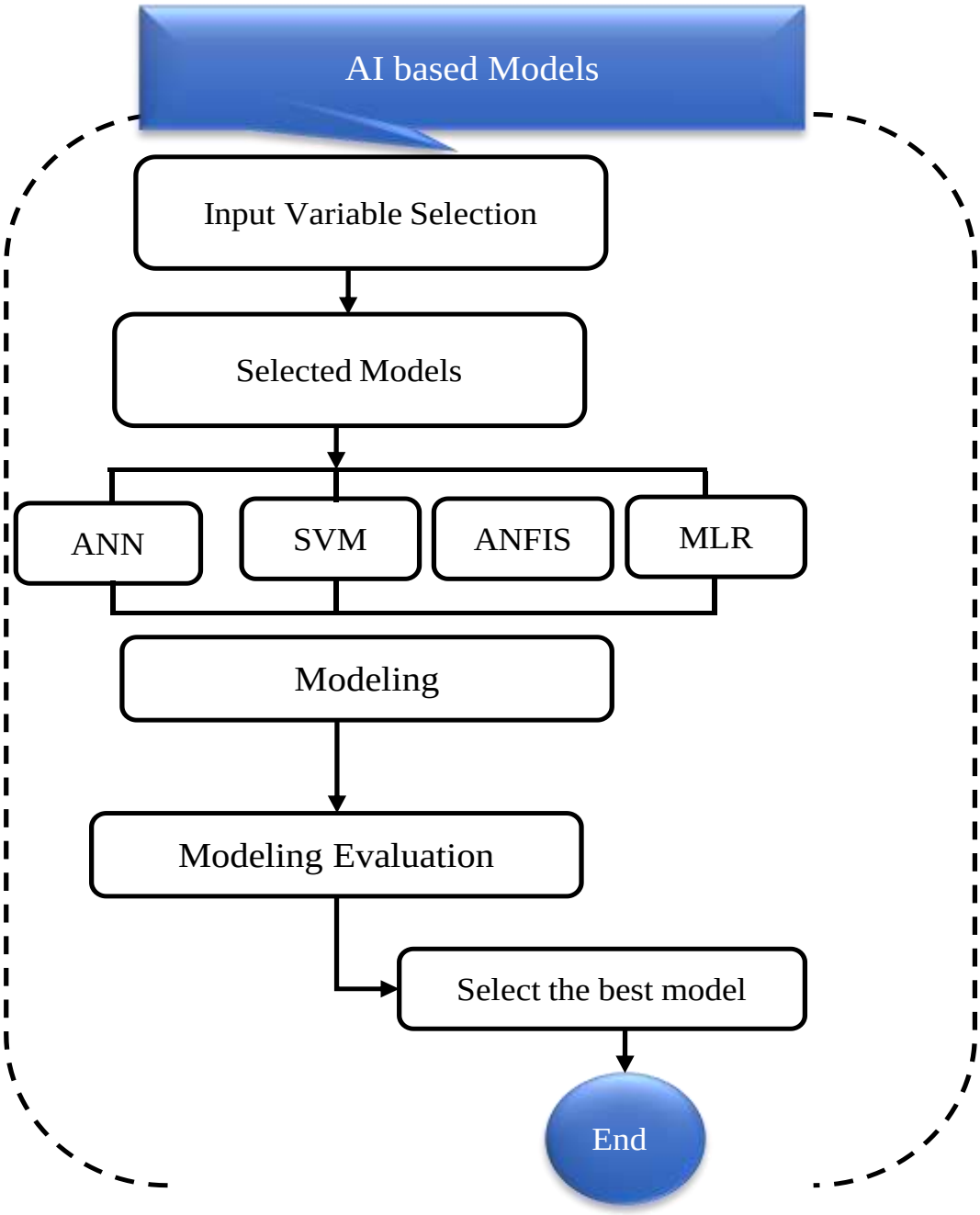
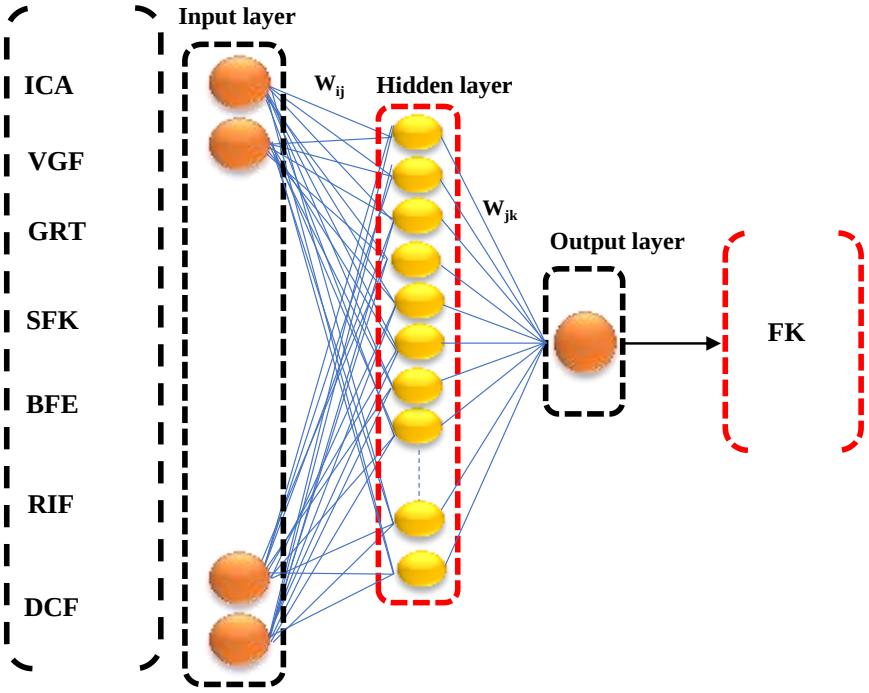


Figure 7

Architecture of ANN used in this study



Assume the FIS contains two inputs ‘x’ and ‘y’ and one output ‘f’, a first order Sugeno fuzzy has the following rules.

Rule 1: if $\mu(x)$is A_1 and $\mu(y)$ B_1then $f_1 = p_1x+q_1y+r_1$ (2)

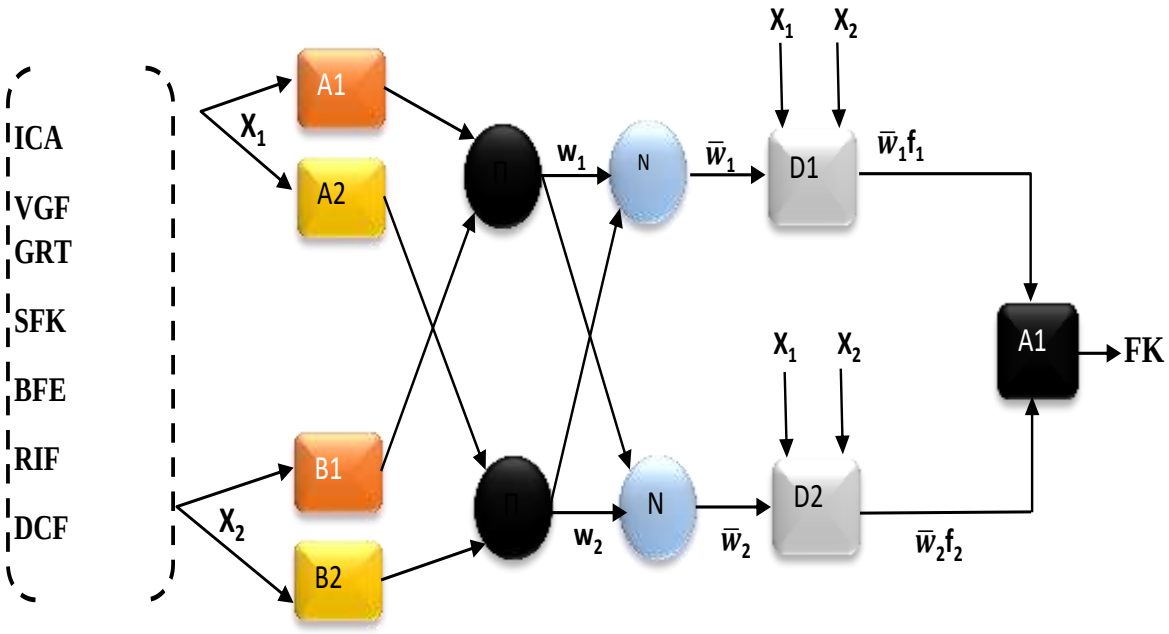
Rule 2: if $\mu(x)$is A_2 and $\mu(y)$is B_2 then $f_2 = p_2x+q_2y+r_2$ (3)

A_1, B_1, A_2, B_2 Parameters are membership functions for x and y inputs

$p_1, q_1, r_{1,} p_2, q_2, r_{2,}$ are outlet function parameters. The structure and formulation of ANFIS follows a five-layer neural network arrangement. Refer to (Akrami et al 2014; Kyada & Kumar 2015; Gayaa et al 2014; Sharifi et al, 2013; Yaseen et al., 2018) for more information about ANFIS. Fig.7 present the architecture of ANFIS used in this study.

Figure 8

ANFIS architecture used in this study



Support vector Machine (SVM)

Vapnik in the year 1995 introduced and proposed learning in context of Support Vector Machine (SVM), and it gives a desired approach to some of the drawbacks of prediction, pattern recognition. SVM comprises of data driven model which is based on concept machine learning (Cortes and Vapnik, 1995). There are major essential function of support vector machine that are elaborated in (Nourani et al., 2018) which makes it quite different from ANN due to its ability in minimizing the complexity, error and increasing generalization of the network performance(Hong et al.,2008). In support vector machines, kernel function has been used widely in different areas of engineering such as rainfall forecasting etc. Usually, SVMs is grouped into linear support vector regression (L-SVR) as well as non-linear support vector regression (N-SVR) (Granata et al 2017). More also, SVR can be considered as a form of SVM which is based on two fundamental structural layers. The kernel function which weighs the input variable as the first and the second weighs the sum of the outs of the kernel (Cortes and Vapnik,, 1995). For a given set of training data $\{(x_i, d_i)\}_i^N$ (xi is the input vector, di is the actual value and N is the total number of data patterns), the general SVR function is given in equation 12.

$$y = f(x) = w\varphi(x_i) + b \tag{4}$$

Minimize: $$\frac{1}{2}\|w\|^2 + C\left(\sum_i^N (\xi_i + \xi_i^*)\right) \tag{5}$$

Subject to: $$\begin{cases} w_i\varphi(x_i) + b_i - d_i \le \varepsilon + \xi_i^* \\ d_i - w_i\varphi(x_i) + b_i \le \varepsilon + \xi_i^* \\ \xi_i, \xi_i^* \end{cases} \quad i=1, 2,\ldots,N$$

$$w^* = \sum_{i=1}^N (\alpha_i - \alpha_i^*)\varphi(x_i) \tag{6}$$

So, the final form of SVR can be expressed as (Wang et al. 2013):

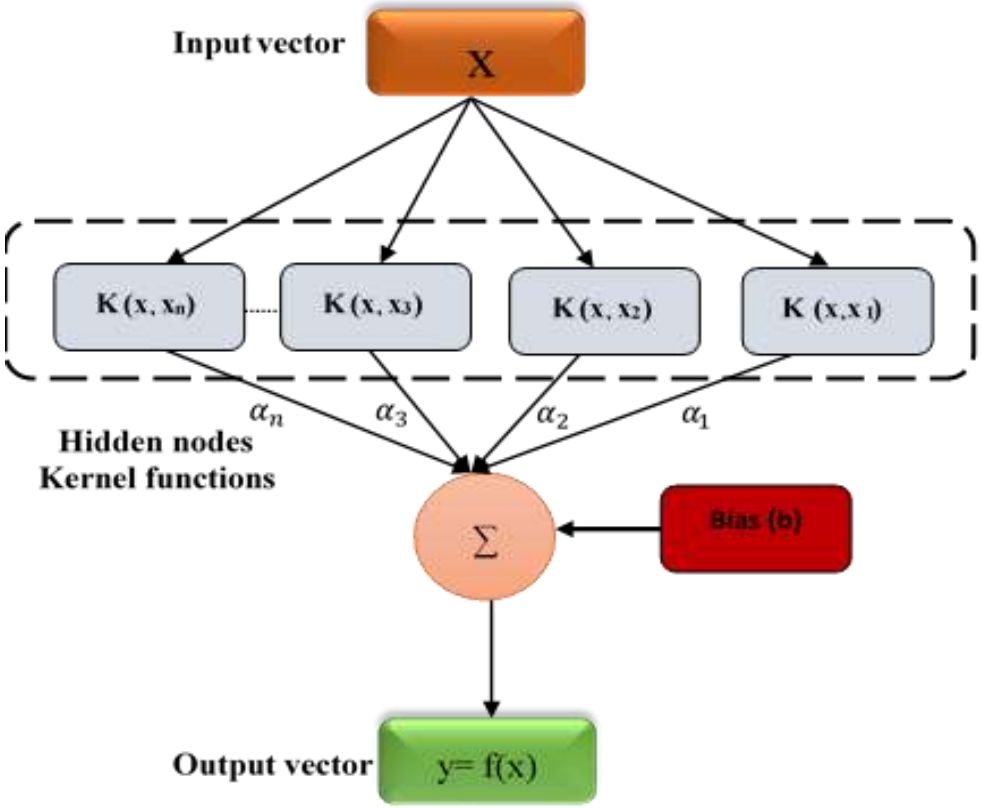
$$f(x, \alpha_i, \alpha_i^*) = \sum_{i=1}^N (\alpha_i - \alpha_i^*)K(x, x_i) + b \tag{7}$$

$$k(x_1, x_2) = \exp(-\gamma\|x_1 - x_2\|^2) \tag{8}$$

where, γ is the kernel parameter.

Figure 9

Conceptual Network Architecture of SVR Algorithms



Multi linear regression (MLR)

A linear regression is considered simple if it is aimed at predicting the correlation between a single output by using a single input variable. However, if the aim is to estimate the correlation between two or more input variables in order to determine a single criterion variable, this model is referred to as Multiple Linear Regression (MLR) (Abba et al 2019). MLR is the most widely utilized form of linear regression that has been used in various areas of study, in which each value of the input parameter is associated with a value of the output variable. It is worth mentioning that MLR shows a correlation in terms of a straight line which best estimates all the data points involving both the output as well as the target variables

(Khademi & Behfarnia, 2016; Khademi et al 2016). The general form of the MLR model is as shown in Eq. (3.16)

$$y = b_0 + b_1 x_1 + b_2 x_2 + \cdots b_i x_i \quad (9)$$

Where x_1, is the value of the i^{th} predictor, b_0 is the regression constant, and $b_i$is the coefficient of the i^{th} predictor.

Model performance criteria

For any data-driven method, the performance accuracy is evaluated using different criteria based on a comparison between the predicted and measured values(Hadi et al., 2019),(Legates & McCabe Jr., 1999). In this study, the determination coefficient of (R2) and correlation coefficient (R) as a goodness-of-fit and two statistical error, including root mean- squared error (RMSE), mean- squared error (MSE) were used for the evaluation of the models:

$$R^2 = 1 - \frac{\sum_{j=1}^{N}\left[(Y)_{obs,j} - (Y)_{com,j}\right]^2}{\sum_{j=1}^{N}\left[(Y)_{obs,j} - \overline{(Y)}_{obs,j}\right]^2} \quad (10)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(Y_{obsi} - Y_{comi})^2}{N}} \quad (11)$$

$$\text{MSE} = \frac{1}{N}\sum_{i=1}^{N}(Y_{obsi} - Y_{comi})^2 \quad (12)$$

$$R = \frac{\sum_{i=1}^{N}(Y_{obs} - \bar{Y}_{obs})(Y_{com} - \bar{Y}_{com})}{\sqrt{\sum_{i=1}^{N}(Y_{obs} - \bar{Y}_{obs})^2 \sum_{i=1}^{N}(Y_{com} - \bar{Y}_{com})^2}} \quad (13)$$

Where N, Y_{obsi}, $\bar{Y}$ and Y_{comi} *a*re data number, observed data, average value of the observed data and computed values, respectively.

CHAPTER IV

Findings And Discussion

Background and overview

This chapter provides a breakdown to answer the research questions. The first section gives a breakdown to the demographics of the respondents to help in understanding the entire study, which served the first scenario. While the second approach describe the estimation of knowledge using artificial intelligence models and linear regression analysis.

Evaluation of forest knowledge using deterministic experimental assessment

The deterministic analysis of in this study can be categorized into demographic characteristics of the respondent, students' knowledge about forests versus nationality, students' knowledge about poor forest administration and danger of deforestation versus nationality, and students' knowledge of individual and government responsibility regarding forest and nationality. Table shows the demographic characteristics of the respondent.

Demographic Characteristics of The Respondent

Table 1

Descriptive result for demographic data

	Frequency	Percentage
Gender		
Male	179	59.7%
Female	114	38.0%
Total	293	97.7%
Missing value	7	2.3%
Total	300	100.0%
Nationality		
Libya	66	22.2%
Cypriots	60	20.0%
Turkish	58	19.3%

Middle East	51	17.0%
Africa	53	17.7%
Total	288	96.0%
Missing value	12	4.0%
Total	300	100.0%
University		
Near East University	75	25.0%
CIU	110	36.7%
Eastern Mediterranean	109	36.3%
Total	294	98.0%
Missing	6	2.0%
Total	300	100.0%
Educational background		
Undergraduate	172	57.3%
Master	84	28.0%
PhD	33	11.0%
Total	289	96.0%
Missing value	11	3.7%
Total	300	100.0
Age categories		
Under 21	45	15.0%
21-25	84	28.0%
26-30	73	24.3%
31-35	33	11.0%
36-40	23	7.7%
41-45	16	5.3%
45 above	9	3.0%
Total	283	94.3%
Missing	17	5.7%
Total	300	100.0%

Table 1 above described the statistics for gender, nationality, schools, university, educational background, and age category. The male gender emerges as the highest

with 59.7% while females gave the least with 38.0%. student nationality revealed that more responses came from Libya with 22.0% while middle east recorded with the least response of 17.0%. Representation of student from various universities, showed CIU record with higher number of 36.3% respondent and near east with fewer number of 25% respondents, basing on their programed, it showed that undergraduate showed a higher response 57.7% with least of 11% response from PhD. However, student age group revealed that age group 21 to 25 showed a higher response while age group 46 and above gave the least with response of 3%.

Figure 10

Student's response based on country of origin

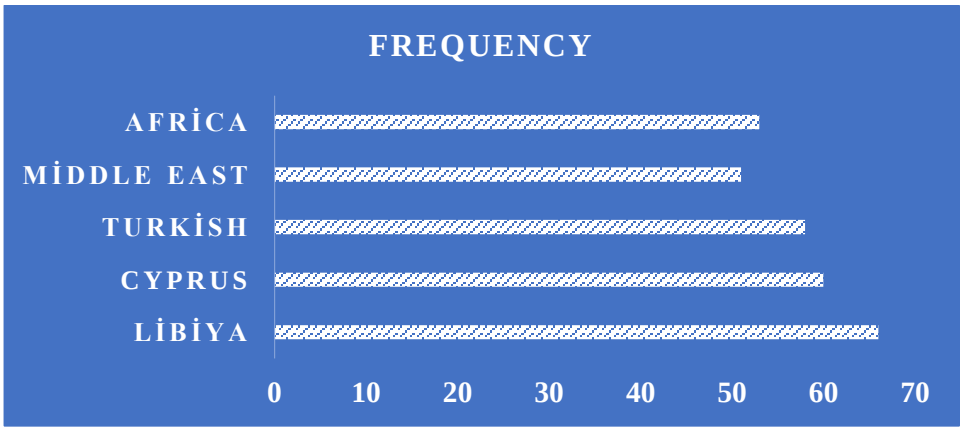


Figure 11

Student's response based on gender

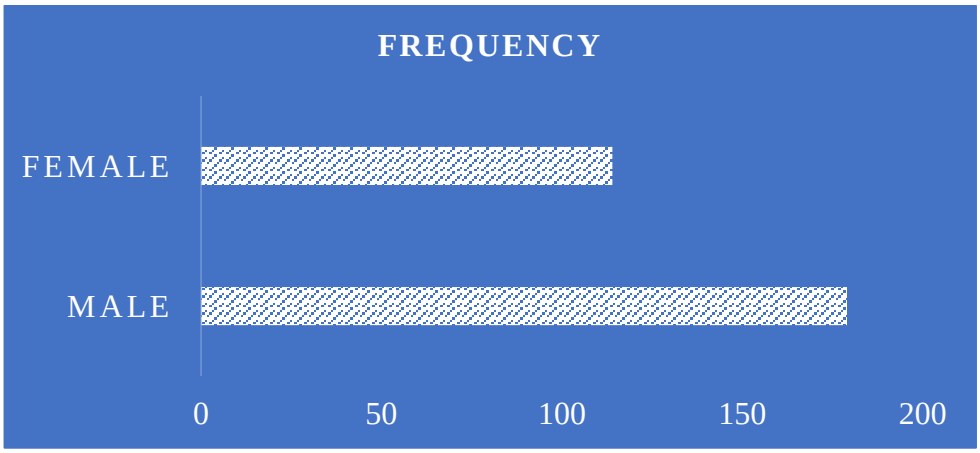


Figure 12

Student's response-based on age group

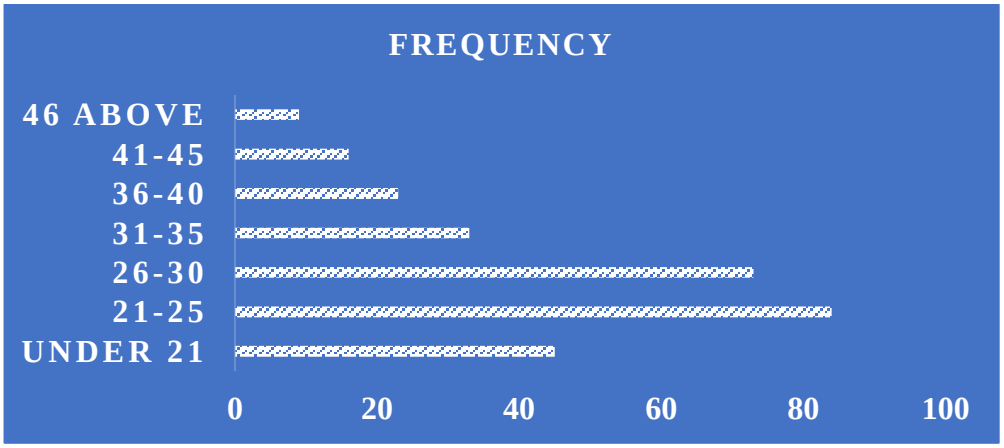


Figure 13

Student's response-based on university

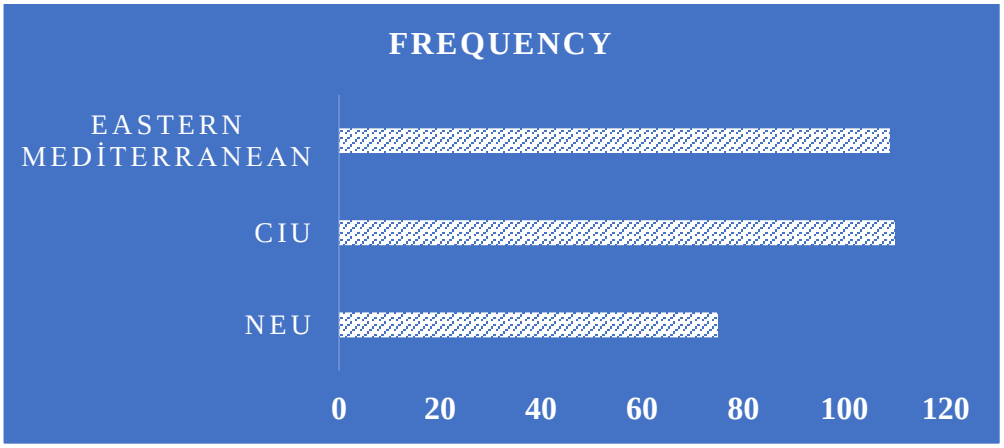
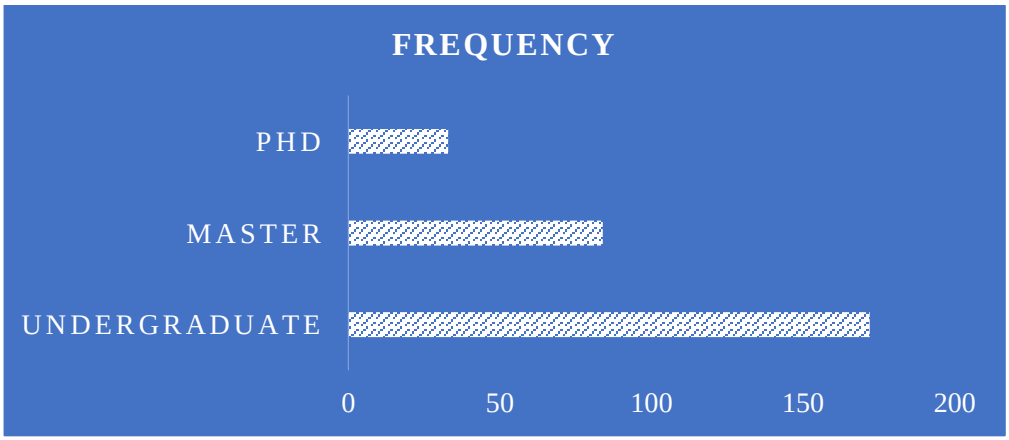


Figure 14

Student's response-based on educational level



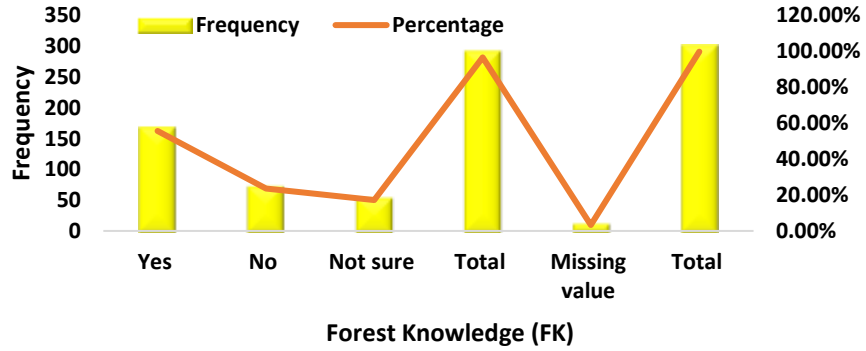
The figures above displayed result statistics for the demographic responses, which figure 10 showed Libya student represented with higher response while middle east showed lower response. Figure 11 showed there was higher response from male compared to female response. Figure 12 revealed a higher response in age group 21 to 25 while lower was seen in age group category 46 years and above. Students from four universities showed a higher response of student from CIU followed by Eastern Mediterranean then NEU respectively (see figure 13). And lastly, program level showed undergraduate student recorded with higher response while PhD recorded with the least responses (figure 14).

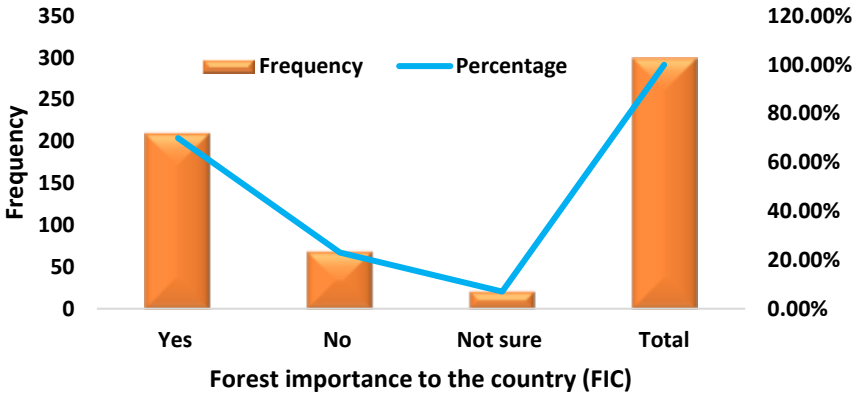
Forest assessment responses

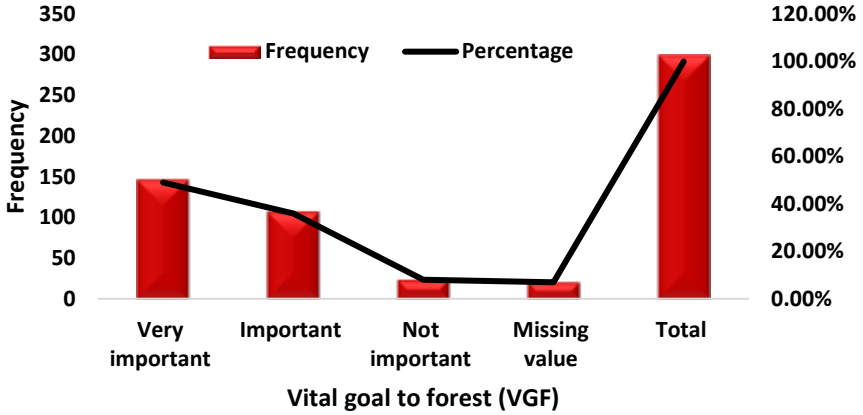
The exploratory response from the despondent are presented and categorized as, Nationality of student Response, Gender Response, Response of age categories, Response of Students from various Universities, Response of Students background of education, Response of forest knowledge, Response of those that agreed forest need protection, Response of forest importance to the country, Response of forest importance to recreational activities, Response of importance of forest to individuals and country economy, Response of poor forest administration, Response of none implementation of forest programmed, Response of individuals towards commitment to forest protection, response of government responsibility to tackle forest problem, response of knowledge with regards to forest, Response of importance of forest to animal, Response of forest protection to man and his environment, response of having passion whenever in forest, response of individuals responsibility to protect forest in their locality, response of harming forest by cutting them, Response of awareness to community about forest destruction, and Response of importance of forest to individuals and country economy. For exploratory and data-driven analysis, the important variables were selected based on the dependency analysis in which the following variables from the questionnaire were used: Forest knowledge (FK), Forest importance to the country (FIC), priority for recreational activities (ICA), Vital goal of forest (VGF), the government is responsible for taking care of forest problem (GRF), Sources of forest knowledge (SFK), Benefit of forest protection to man and his environment (BFE), Responsibility of individual to protect the forest in their locality (RIF), the danger of cutting forest (DCF) (see Fig. 15 and Appendix B).

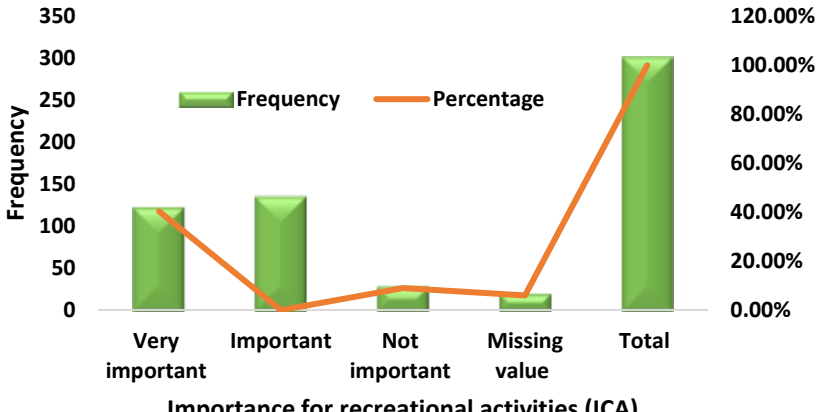
Figure 15

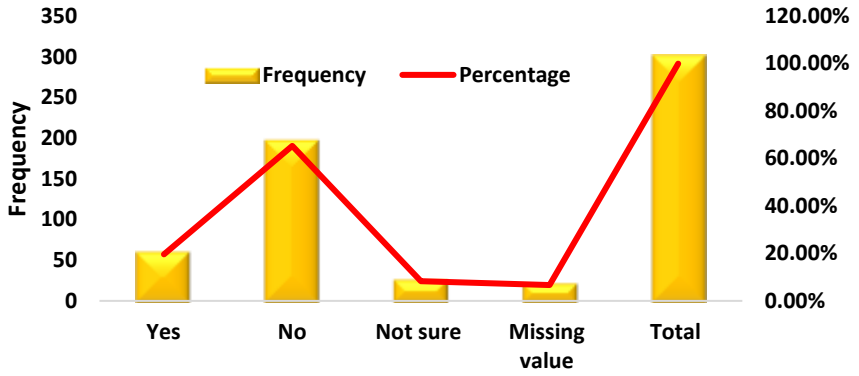
Exploratory response from the selected dependency analysis



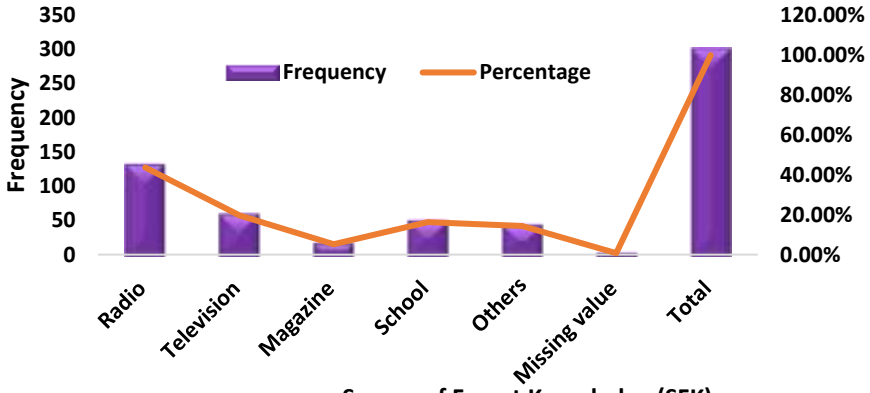




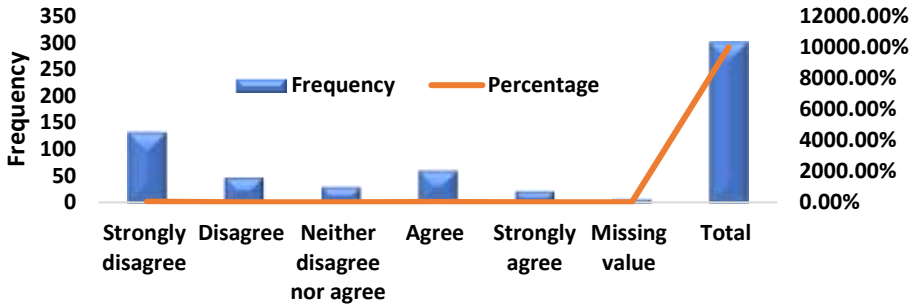




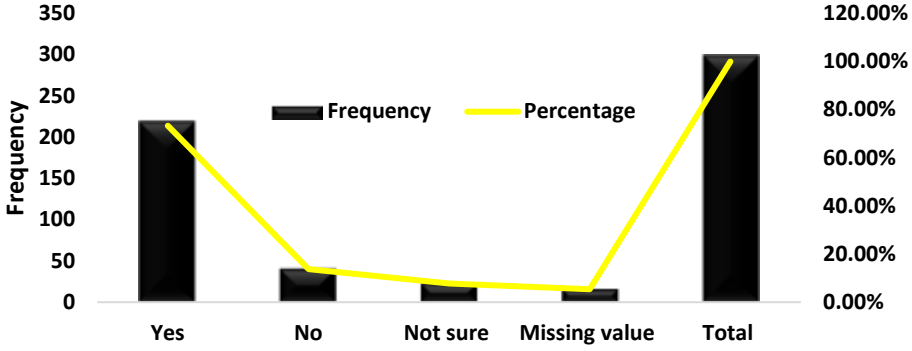
Goverment Responsibility to take care with Forest (GTF)



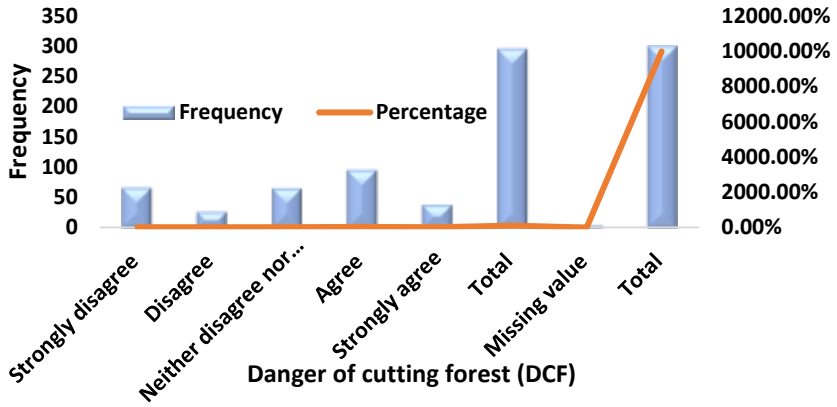
Source of Forest Knowledge (SFK)



Benefit of forest protection to man and his environment (BFE)



Responsibility of individual to protect forest in their locality (RIF)



Students' Knowledge About Forests Versus Nationality

The results of Cross-tabulation analysis as detailed in Table 2 - categorically revealed that students' knowledge about forest has no significant effect on nationality; it implies that there is no remarkable effect between forest knowledge and nationality or implies that students' knowledge about forest stand as independent variable without any association with nationality – in which P-value for the Chi-Square (0.150) is greater than the Alpha-value (0.005). This is because the students come from different geographical regions and nations across the world have different knowledge and view about forests. Tertiary institutions that have many multinational students are positioned globally to provide methodological understanding about forests to the students – through innovation, professionalism, public enlightenment program and promotion of forest activism(Parsons & Daniel, 2002),(Segura-bonilla & Rica, 2003). Although, the overall results showed no ties of connection between students' forest knowledge and nationality – because some students have a great idea about forest values, management, and social responsibility – without any connection with their nationalities. Thus, any tertiary institutions that are endowed with so many multinational students need to be constantly connected with innovation on forest knowledge; these higher institutions ought to be conscious with the reformation happening around the globe – this could be achieved through collaborative works with the corporate organization, informal organizations, people, community and activists on matters relating to forest knowledge and sustainability (Gordon, 2006). Knowledge about the forest is an optional thing – which could be supported by societal norms, principles, beliefs, political philosophy, and nationalism. Understanding and insight about forestry could emerge from diverse ways – which in

turn inspire man on the possibility of making its immediate forest endowments very supportable over a long period. Before the advent of modernization and organized society, native people across the entire globe have devised various means of forestry and land-use that long supported their primary occupation and traditions with no adverse effects on the immediate environment (Wilson, 2008) . Fig. 16 shows the forest knowledge based on nationality.

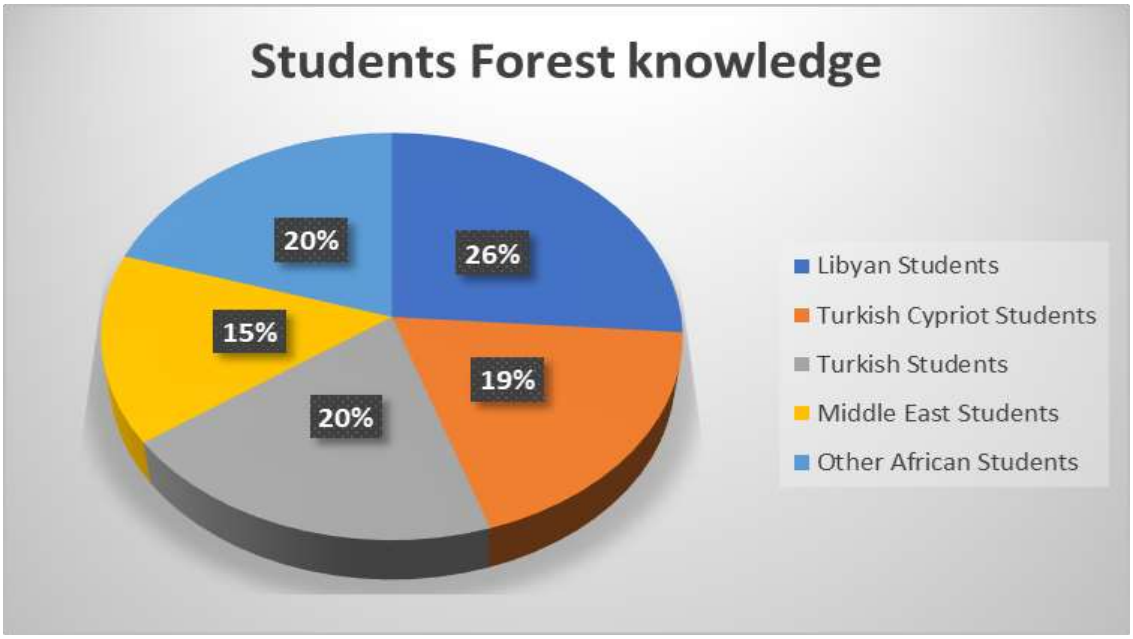
Table 2

Cross Tabulation (Chi-Square 0.150 greater than Alpha-value 0.005) Analysis for Forest knowledge versus Nationality

Nationality					
Students Forest knowledge Count	Libyan Students	Turkish Cypriot Students	Turkish Students	Middle East Students	Other African Students
Yes count	43	30	32	24	32
Forest knowledge %	26.2%	18.8%	20.0%	15.0%	20.0%
Nationality %	67.7%	52.6%	58.2%	47.1%	61.5%
No Count	7	19	14	17	10
Forest knowledge %	10.4%	28.4%	20.9%	25.4%	14.9%
Nationality%	11.3%	33.3%	25.5%	33.3%	19.2%
Not sure Count	13	8	9	10	10
Forest knowledge %	26.0%	16.0%	18.0%	20.0%	20.0%
Nationality %	21.0%	14.0%	16.4%	19.6%	19.2%

Figure 16

Forest knowledge based on nationality



Students' Knowledge About Forest Protection Versus Nationality

The Cross-tabulation analysis explicitly stated according to the details in Table 3 students' knowledge about forest protection has strong significant effect on nationality; regardless of the diverse nationalities of the students, they firmly acknowledged that forest and its vast resources ought to be seriously protected – because it has so many tremendous values render to the people and the environment. On the account of the Chi-square results, the P-value showed 0.002 which is less than the constant Alpha-value (0.005); the result statistically concluded that students' knowledge about forest protection has a remarkable impact on nationality – which could be interpreted that students' knowledge about forest protection and nationality are both dependable variables. Figure 17 shows the pictorial view of the forest protection.

Table 3

Tabulation (Chi-square P-value is 0.002 less than Alpha-value 0.005) Analysis for Students Knowledge about Forest Protection versus Nationality

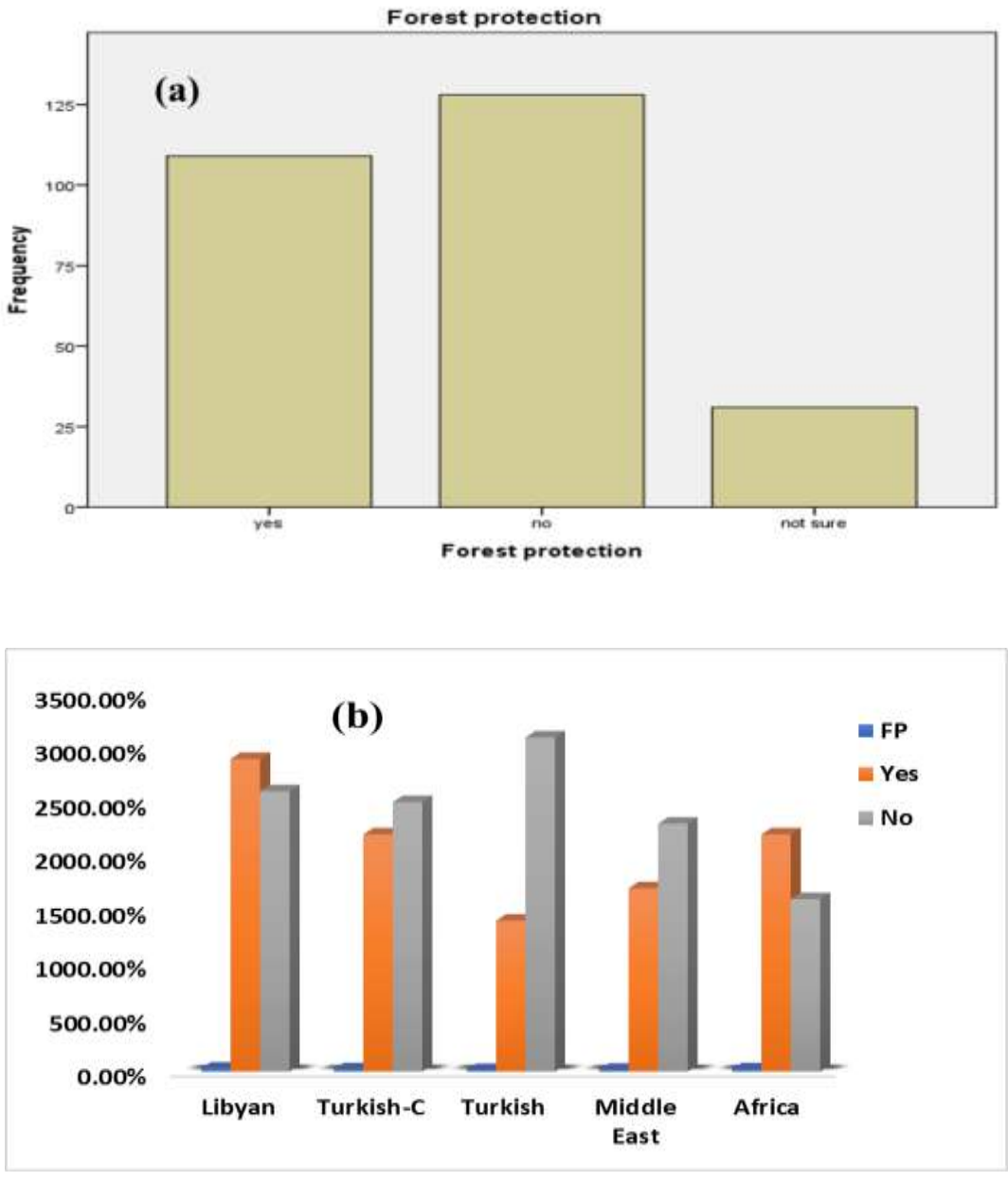
	Nationality				
Students Knowledge about Forest Protection Count	Libyan Students	Turkish Cypriot Students	Turkish Students	Middle East Students	Other African Students
Yes count	29	22	14	17	22
Forest protection %	27.9%	21.2%	13.5%	16.3%	21.2%
Nationality %	50.0%	42.3%	28.0%	37.8%	42.3%
No Count	26	25	31	23	16
Forest protection %	21.5%	20.7%	25.6%	19.0%	13.2%
Nationality%	44.8%	48.1%	62.0%	51.1%	32.0%
Not sure Count	3	5	5	5	12
Forest protection %	10.0%	16.7%	16.7%	16.7%	40.0%
Nationality %	5.2%	9.6%	10.0%	11.1%	24.0%

In addition to the above analysis, there are so many people globally from different environments and professions especially students of diverse nationalities who have the same motive for vegetation conservation; the necessity and liberality may not be the same – but their agenda is in line with the general forestry conservation – probably occupation and sources of revenue may not be the same. Also, the results indicated a strong correlation between students having or not having knowledge about forest protection has a lot do with the nations of their origin; the cultural and political practices of any nation have a significant impact or effect on citizens toward forest sustainability. With the increment in vegetation destruction worldwide, these challenges call for more studies reaching out to all nationalities to enlighten and direct all the programs of nature passionate people toward the

protection of tree-plant endowments. Thus, a study of this nature that covers different ethnic groups in universities of multinational ties regarding knowledge of forest among university students – perhaps may be very rare and often cumbersome – regardless of whether such diverse ethnic groups being previously considered for others or other empirical works elsewhere (Bonera, Corvi, Codini, & Ma, 2017). The result indicates higher response of 42.7% was revealed from those that do not know that forest need protection while those that not sure that forest need protected gave the least of 10.3%.

Figure 17

Graph showing the frequency interm of knowledge protection



nationality – which means there is no association between importance of forest and nationality; the Chi-square showed P-value 0.067 greater than the Alpha-value 0.005; the conclusion and implication of this result indicated that students' knowledge about the importance of forest has no significant effect on their nationality. Also, a wide margin of students from different nationalities attested with Yes count on how forest and its resources extremely important to the economy, human and environment. Most importantly, with much regard with the students' diversity in nationality and demographic characteristics – there always exist those great connections betwixt forestry reserves impact and man continual survival and sustainable environment. Much research works that were conducted in advanced and developing nations concerning the people knowledge about forestry impacts – the aftermaths of the research depicted an incredible result that the people have more regards for forestry endowments both financially, socially, environmentally, and medically; also, students' knowledge about the importance of vegetation could strongly be determined by their perceptions, traditions, faith, principles, and exposures. Fig. 18 Graph showing the frequency interm of forest importance to the country. The result showed a higher result of 44.7% form those that says forest has important for recreational activities while 9.0% form those that say forest has no important to recreational activities

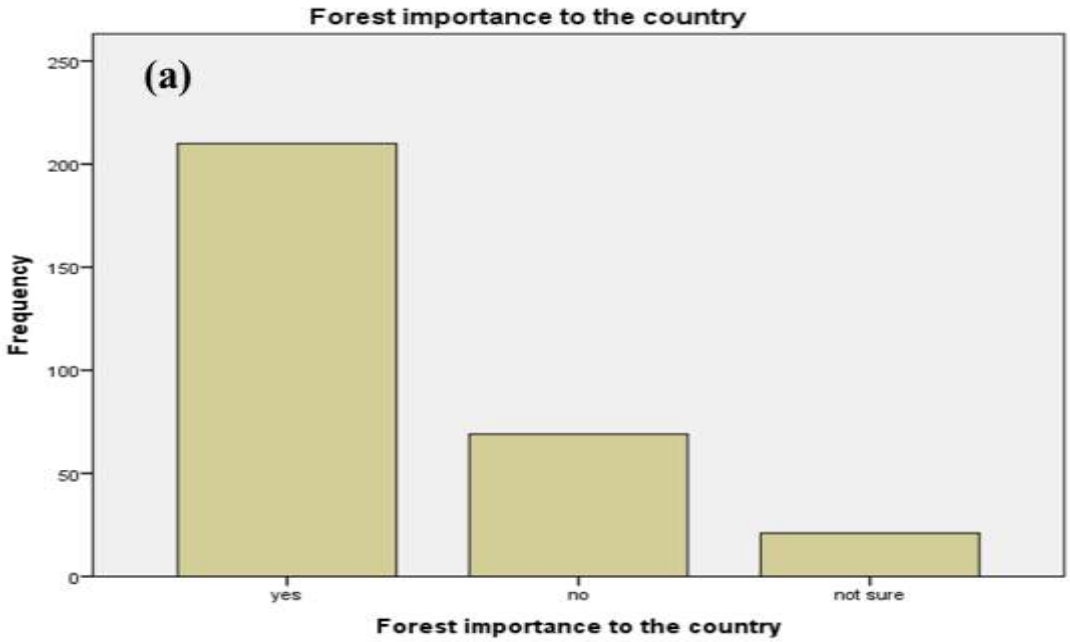
Table 4

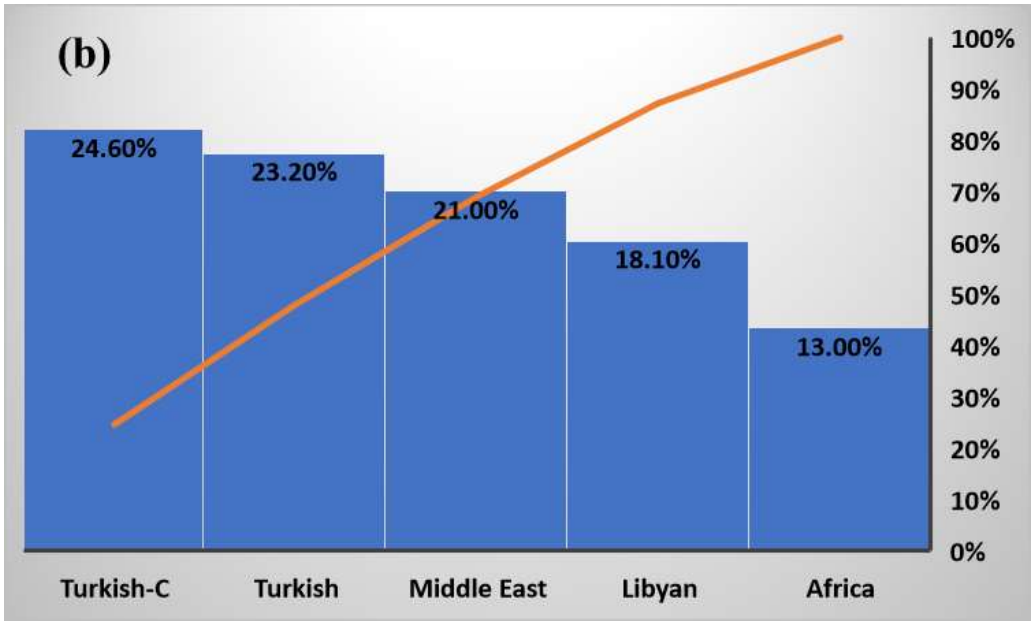
Cross Tabulation (Chi-square P-value 0.067 greater than the Alpha-value 0.005} Analysis of Students Knowledge about the importance of Forest versus Nationality

	Nationality				
Students' Knowledge about the importance of Forest Count	Libyan Students	Turkish Cypriot Students	Turkish Students	Middle East Students	Other African Students
Yes count	29	34	32	25	18
Forest important to the economy, human and environment %	18.1%	24.6%	23.2%	21%	13%
Nationality %	47.5%	63.0%	64.0%	50%	34.6%
No Count	28	18	13	20	28
Forest important to the economy, human and environment %	26.2%	16.8%	12.1%	18.7%	26.2%
Nationality %	45.9%	33.3%	26.0%	40.0%	53.8%
Not sure Count	4	2	5	5	6
Forest important to the economy, human and environment %	18.2%	9.1%	22.7%	22.7%	27.3%
Nationality %	6.6%	3.7%	10.0%	10.0%	11.5%

Figure 18

Graph showing the frequency interm of forest importance to the country





Students' Knowledge About Poor Forest Administration and Danger of Deforestation Versus Nationality

The results of the Cross tabulation finally indicated with Chi-square P-value 0.191 which is greater than Alpha-value 0.005; this critically concluded that students' knowledge about poor forest administration and danger of deforestation has no significant effect on nationality – this implies that the identified variables functioned independently (Table 5). The results of the Cross tabulation revealed that the students Agree Count was more remarkably higher on percentage rating than

Table 5

Cross Tabulation (Chi-square P-value 0.191 Greater than the Alpha-value 0.005} Analysis Students' Knowledge about Poor Forest Administration and Danger of Deforestation versus Nationality

	Nationality				
Students' Knowledge about Poor Forest Administration count	Libyan Students	Turkish Cypriot Students	Turkish Students	Middle East Students	Other African Students
Agree	50	50	46	40	43
Poor forest administration and Danger of Deforestation %	21.8%	21.8%	20.1%	17.5%	18.8%
Nationality %	78.1%	86.2%	85.2%	80.0%	81.1%
Disagree	11	6	6	3	8
Poor forest administration and Danger of Deforestation %	32.4%	17.6%	17.6%	8.8%	23.5%
Nationality %	17.2%	10.3%	11.1%	6%	13.1%
No opinion	3	2	2	7	2
Poor forest administration and Danger of Deforestation %	18.8%	12.5%	12.5%	43.8%	12.5%
Nationality %	4.7%	3.4%	3.7%	14%	3.8%

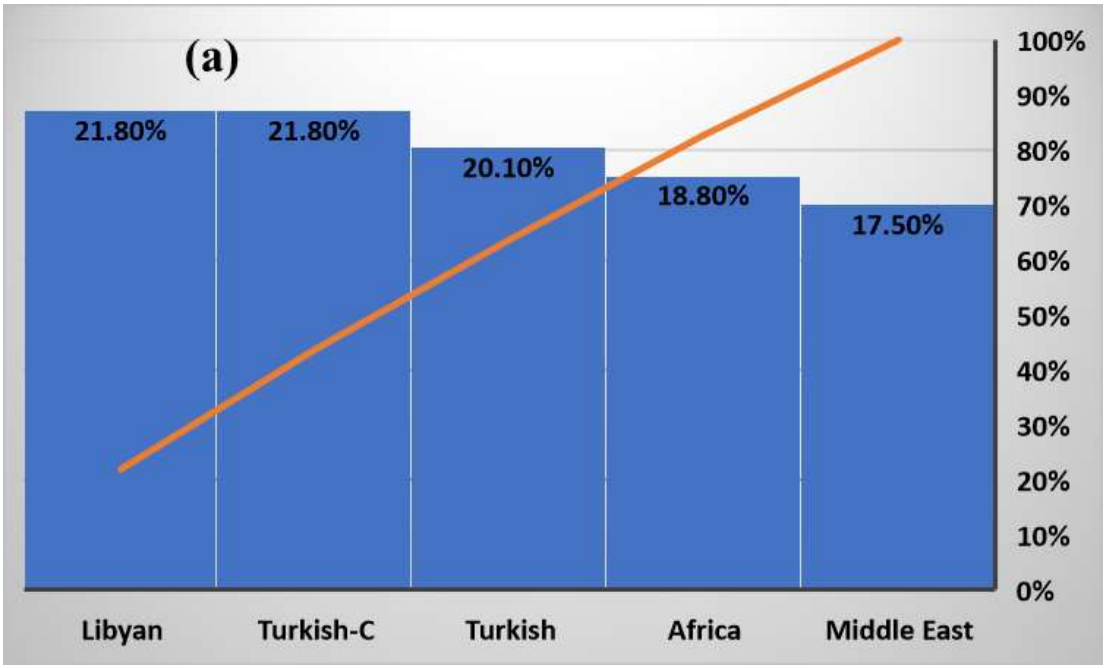
Disagree and No option count based on poor forest administration and danger of deforestation versus nationality; Thus, it is quite cumbersome considering the above reports administering vegetation resources at a continuous supporting capacity – due

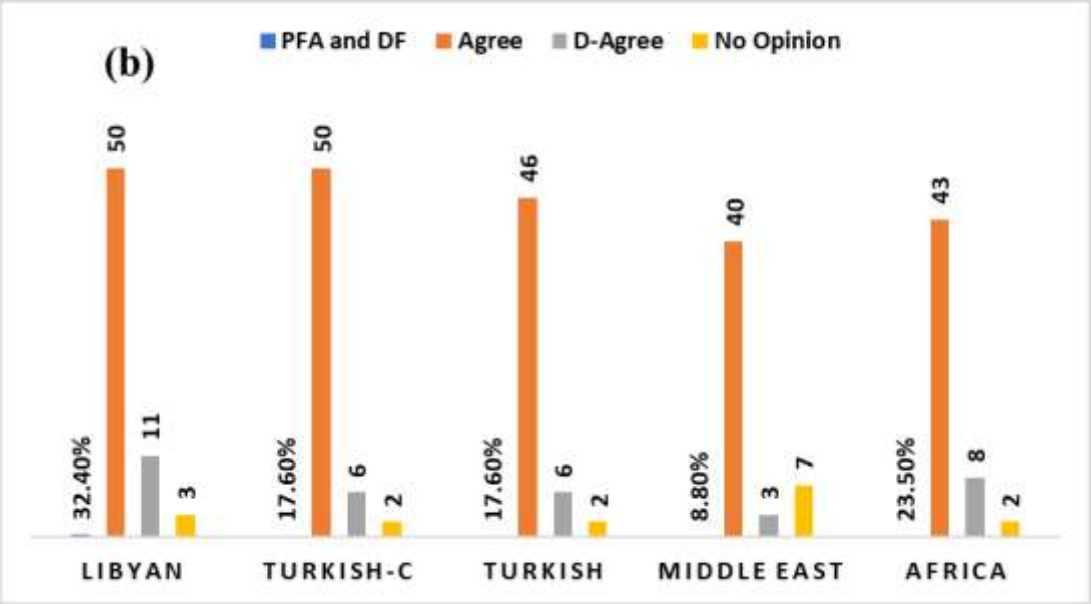
to policy and obligation differences among diverse concern groups and students; this is posing serious risk to forestry and other related vegetation endowments as a result of diverse consequences of climatic variation, persistent lumbering activities, urbanization, rapid human growth in headcount, poor forestry, failure of state governance, lack of grass roots and academic environments involvement and lack of legal frame on tree-plant sustainability. Poor forestry is a clear issue affecting the global communities (including several African, South American, Asian, European, and Middle East and North American nations) in attaining supportable forestry – because of lack of valuable information based and other related tips of environmental information on forestry.

From nationalism perspective, this implies that there should be a strong public push from academic institutions, native people, environmental activists, private social institutions, and corporate profit-making firms; all these interest groups could work in collaboration with the state forest administration toward combating deforestation and reinforcing policy that will enhance forest restoration. Adversely, several nations worldwide are not working efficiently toward these suggestions based on funding, policymaking, implementation, and human capability building – to convey their proposed plan and program on forest administration.

Figure 19

Graph showing the frequency interm of Poor Forest Administration and Danger of Deforestation versus Nationality





Students' Knowledge of Individual and Government Responsibility Regarding Forest and Nationality

The Cross tabulation analytical results Table 6 disclosed that students' knowledge about individual and government responsibility to take care of forest has no significant effect on nationality – which indicated Chi-square critical P-value as 0.295 is greater than the Alpha-value 0.005. In the actual sense, nationality is not a determinant factor that could influence people's knowledge either as an individual or government among various nationalities; it is thus concluded that individual and government responsibility to take care of the forest has no remarkable impact on nationality. Academic communities, relatives, government, and other civic organizations are usually anticipated and obliged to play a crucial role to enlighten learners on norms, traditions, and principles governing a given society or state, taking responsibility of caring for forest either by individual or public institution could be a constitutional duty from the perspective of citizenry or nationalism, and as well could be regarded as a voluntary activity which prove a sense of self-responsibility. Social obligation either on the part of individual or government on caring for forest – it is never any way connected to understanding or wisdom; to a certain extent, it is a feature that defined several manners or attitudes; thus, it is internal attribute of an individual being determined by societal principles; such principles could be ethical or nationalistic in nature. This concept of social obligation

could enhance students to take positive steps or tasks toward taking care of the forest and other environmental resources.

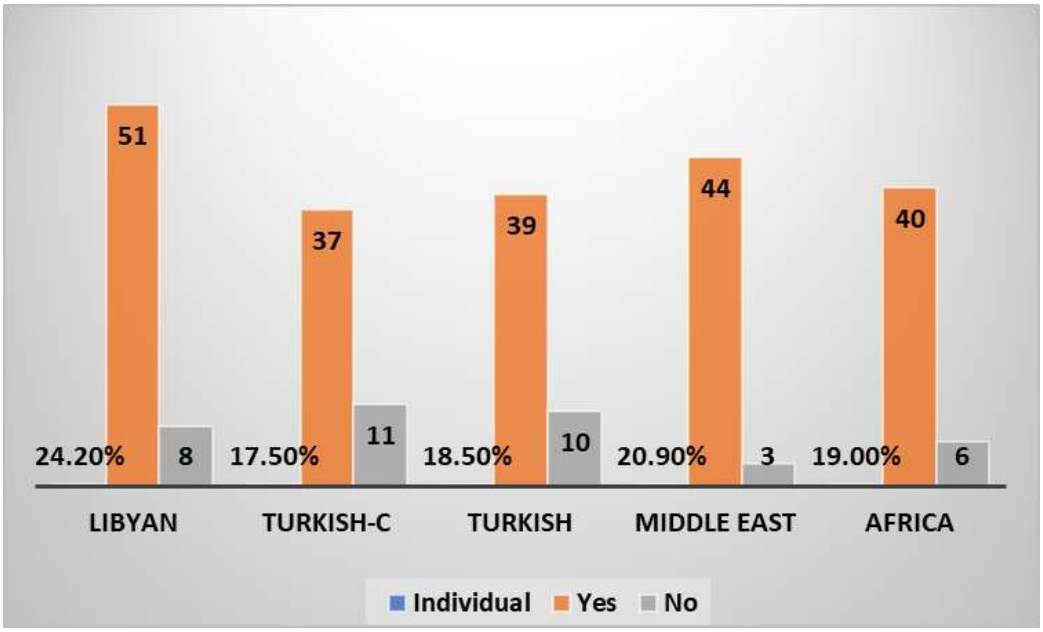
Table 6

Cross Tabulation (Chi-square P-value 0.295 Greater than the Alpha-value 0.005} Analysis Students Knowledge of Individual and Government Responsibility of Forest Versus Nationality

	Nationality				
Students' Knowledge of Individual and Government Responsibility of Forest count	Libyan Students	Turkish Cypriot Students	Turkish Students	Middle East Students	Other African Students
Yes count	51	37	39	44	40
Individual and Government responsibility to take care of forest %	24.2%	17.5%	18.5%	20.9%	19.0%
Nationality %	82.3%	69.8%	75.0%	86.3%	75.5%
No count	8	11	10	3	6
Individual and Government responsibility to take care of forest %	21.1%	28.9%	26.3%	7.9%	15.8%
Nationality %	12.9%	20.8%	19.2%	5.9%	11.3%
No opinion	3	5	3	4	7
Poor forest administration and Danger of Deforestation %	13.6%	22.7%	13.6%	18.2%	31.8%
Nationality %	4.8%	9.4%	5.8%	7.8%	13.2%

Figure 20

Graph showing the frequency interm of Individual and Government Responsibility of Forest Versus Nationality



Association between forest knowledge and forest protection

Table 7

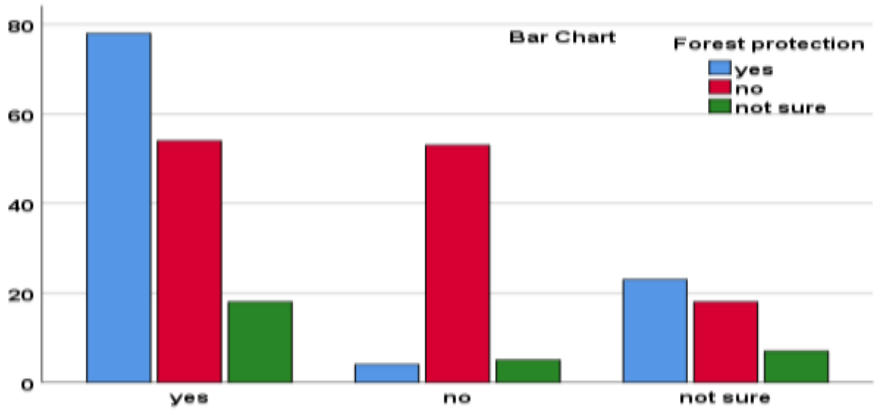
forest knowledge vs forest protection

Forest knowledge with forest protection (p-value = 0.000)			
Forest knowledge	Forest protection		
	Yes	No	Not sure
Yes count	78	54	18
% Within forest knowledge	52.0%	36.0%	12.0%
% Within forest protection	74.3%	43.2%	60.0%
No count	4	53	5
% Within forest knowledge	6.5%	85.5%	8.1%
% Within forest protection	3.8%	42.4%	16.7%
Not sure count	23	18	7
% Within forest knowledge	47.9%	37.5%	14.6%
% Within forest protection	21.9%	14.4%	23.3%

(Table 7, Figure 21) displayed knowledge on forest with protecting of forest which resulted in given P-value (0.000), revealing a significant association between knowledge on forest with protecting of forest. Thus, having knowledge on forest will greatly assist individuals in protecting of forest.

Figure 21

forest knowledge vs forest protection



Association between Government responsibility to take care of forest and Nationality

Table 8

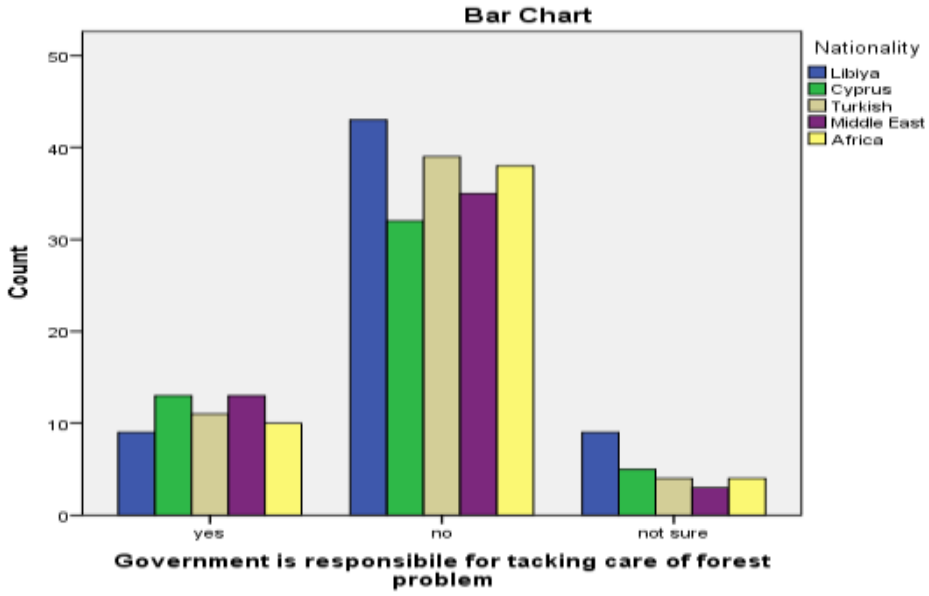
association between Government responsibility to take care of forest and Nationality

Government responsibility to take care of forest vs Nationality					
Government responsibility to take care of forest	Nationality				
	Libya	Cyprus	Turkish	Middle East	Africa
Yes count	9	13	11	13	10
Government responsibility to take care of forest %	16.1%	23.2%	19.6%	23.2%	17.9%
Nationality %	14.8%	26.0%	20.4%	25.5%	19.2%
No count	43	32	39	35	38
Individual responsibility to take care of forest %	23.0%	17.1%	20.9%	18.7%	20.3%
Nationality%	70.5%	64.0%	72.2%	68.6%	73.1%
Not sure count	9	5	4	3	4
Individual responsibility to take care of forest %	36.0%	20.0%	16.0%	12.0%	16.0%
Nationality %	14.8%	10.0%	7.4%	5.9%	7.7%

(Table 8, Figure 22): Is there an association between Government responsibility to take care of forest and Nationality. H0: Government responsibility to take care of forest has no effect with Nationality. The Chi-Square P-value (0.685) is greater than the Alpha-value (0.005). We therefore accept the alternative hypothesis and reject null hypothesis and conclude that Government responsibility to take care of forest has no effect on Nationality.

Figure 22

Graph showing association between Government responsibility to take care of forest and Nationality



Effect between feeling passion around forest and Nationality.

Table 9

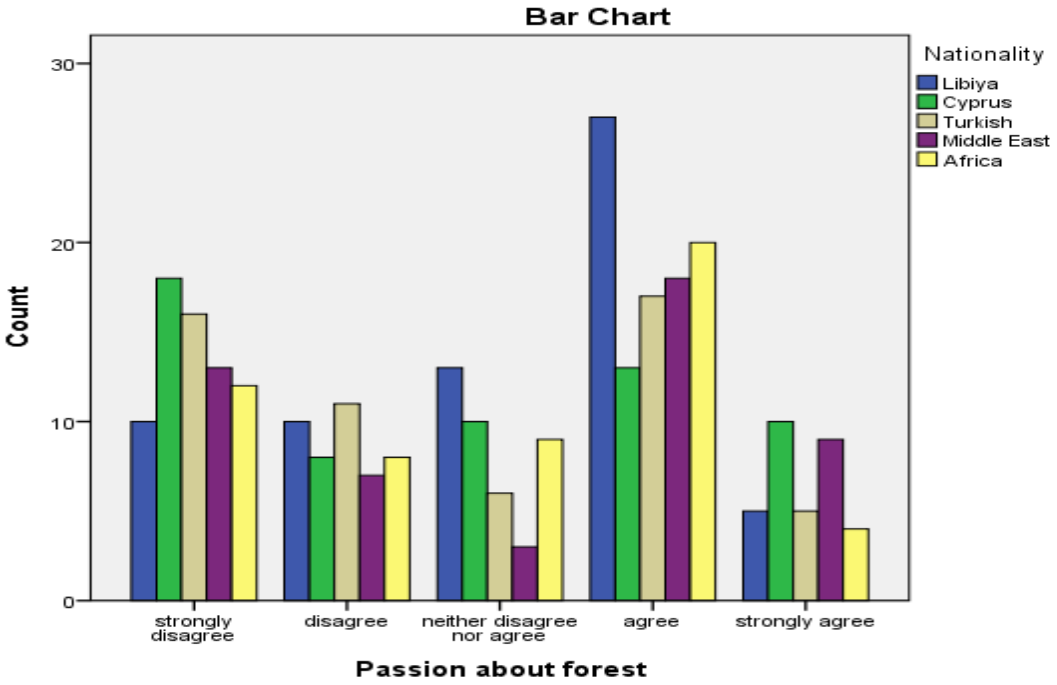
effect between feeling passion around forest and Nationality.

Passion about forest vs Nationality					
Passion about forest	Nationality				
	Libya	Cyprus	Turkish	Middle East	Africa
Strongly disagree count	10	18	16	13	12
Passion about of forest %	14.5%	26.1%	23.2%	18.8%	17.4%
Nationality %	15.4%	30.5%	29.1%	26.0%	22.6%
Disagree count	10	8	11	7	8
Passion about of forest %	22.7%	18.2%	25.0%	15.9%	18.2%
Nationality%	15.4%	13.6%	20.0%	14.0%	15.1%
Neither disagree nor agree.	13	10	6	3	9
Passion about of forest %	31.7%	24.4%	14.6%	7.3%	22.0%
Nationality %	20.0%	16.9%	10.9%	6.0%	17.0%
Agree count	27	13	17	18	20
Passion about of forest %	28.4%	13.7%	17.9%	18.9%	21.1%
Nationality %	41.5%	22.0%	30.9%	36.0%	37.7%
Strongly agree	5	10	5	9	4
Passion about of forest %	15.2%	30.3%	15.2%	27.3%	12.1%
Nationality %	7.7%	16.9%	9.1%	18.0%	7.5%

(Table 9, Figure 23): Is there any effect between feeling passion around forest and Nationality. H0: Passion about forest has no relation with Nationality. The Chi-Square P-value for (0.295) is greater than the Alpha-value (0.005). We therefore fail to reject the null hypothesis; and conclude that feeling passion around forest has no effect on Nationality.

Figure 23

Graph showing effect between feeling passion around forest and Nationality.



Association between danger of cutting forest and Nationality.

Table 10

Association between danger of cutting forest and Nationality

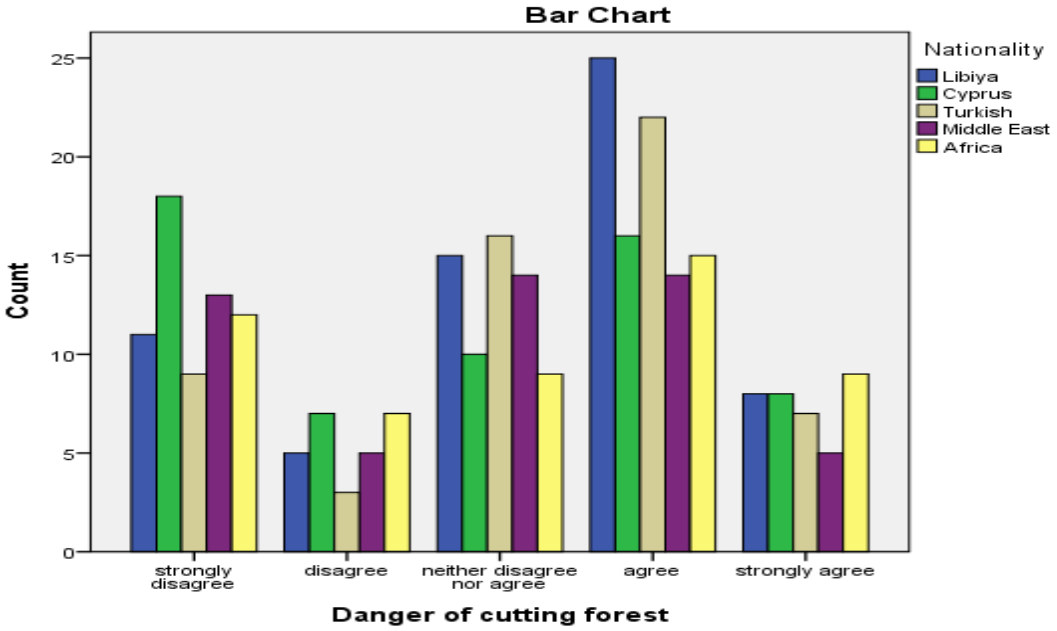
Danger of cutting forest vs Nationality					
Danger of cutting forest	Nationality				
	Libya	Cyprus	Turkish	Middle East	Africa
Strongly disagree count	11	18	9	13	12
Danger of cutting forest %	17.5%	28.6%	14.3%	20.6%	19.0%
Nationality %	17.2%	30.5%	15.8%	25.5%	23.1%
Disagree count	5	7	3	5	7
Danger of cutting forest %	18.5%	25.9%	11.1%	18.5%	25.9%
Nationality%	7.8%	11.9%	5.3%	9.8%	13.5%
Neither disagree nor agree count	15	10	16	14	9
Danger of cutting forest %	23.4%	15.6%	25.0%	21.9%	14.1%

Nationality %	23.4%	16.9%	28.1%	27.5%	17.3%
Agree count	25	16	22	14	15
Danger of cutting forest %	27.2%	17.4%	23.9%	15.2%	16.3%
Nationality %	39.1%	27.1%	38.6%	27.5%	28.8%
Strongly agree	8	8	7	5	9
Passion about of forest %	21.6%	21.6%	18.9%	13.5%	24.3%
Nationality %	12.5%	13.6%	12.3%	9.8%	17.3%

(Table 10, Figure 24): Is there any effect or an association between danger of cutting forest and Nationality. H0: Danger of cutting forest has no relation with Nationality. The Chi-Square P-value (0.677) is greater than the Alpha-value (0.005). We therefore failed to reject the null hypothesis and conclude that danger of cutting forest has no effect on Nationality.

Figure 24

effect or an association between danger of cutting forest and Nationality



Association between responsibility of individual to protect forest and importance of forest to individual and economy.

Table 11

association between responsibility of individual to protect forest and importance of forest to individual and economy.

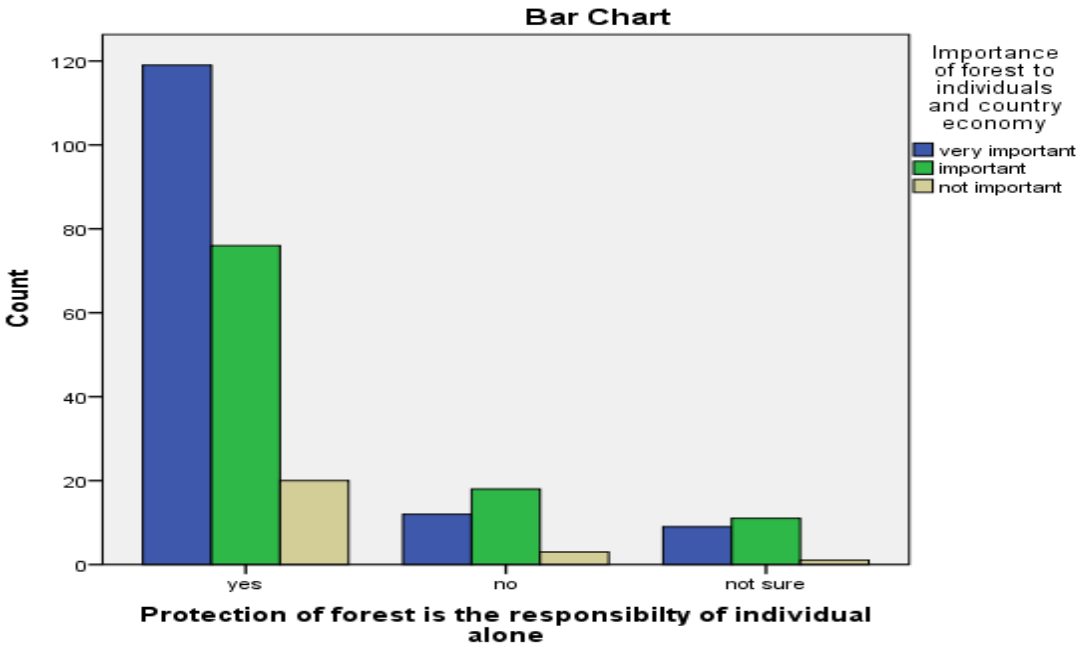
Responsibility of individual to protect forest vs importance of forest to individual economy			
Responsibility of individual to protect forest	Importance of forest to individual and the economy		
	Very importance	Important	Not important
Yes count	119	76	20
Individual responsibility to take care of forest %	55.3%	35.3%	9.3%
Importance of forest to individual and economy %	85.0%	72.4%	83.3%
No count	12	18	3
Individual responsibility to take care of forest %	36.4%	54.5%	9.1%
Importance of forest to individual and economy %	8.6%	17.1%	12.5%
Not sure count	9	11	1
Individual responsibility to take care of forest %	42.9%	52.4%	4.8%
Importance of forest to individual and economy %	6.4%	10.5%	4.2%

(Table 11, Figure 25): Is there any effect or association between responsibility of individual to protect forest and importance of forest to individual and economy. H0: Responsibility of individual to protect forest has no relation with importance of forest to individual economy. The Chi-Square P-value (0.163) is greater than the

Alpha-value (0.005). We therefore failed to reject the null hypothesis; and conclude that responsibility of individual to protect forest has no effect on importance of forest to individual and the economy.

Figure 25

association between responsibility of individual to protect forest and importance of forest to individual and economy



Effect or association between forest knowledge and level of education.

Table 12

forest knowledge vs educational background

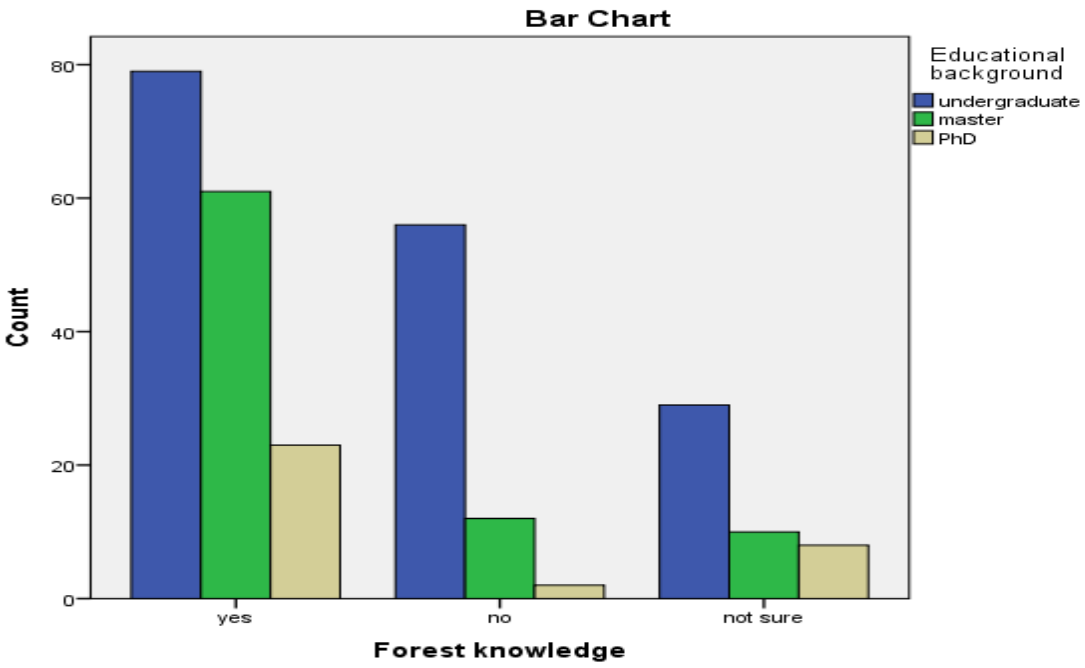
Forest knowledge vs educational background			
Forest knowledge	Educational background		
	Undergraduate	Master	PhD
Yes count	79	61	23
Forest knowledge %	48.5%	37.4%	14.1%
Educational background %	48.2%	73.5%	69.7%
No count	56	12	2
Forest knowledge %	80.0%	17.1%	2.9%
Educational background %	34.1%	14.5%	6.1%
Not sure count	29	10	8

Forest knowledge %	61.7%	21.3%	17.0%
Educational background %	17.7%	12.0%	24.2%

(Table 12, Figure 26): Is there any effect or association between forest knowledge and level of education. H0: Forest knowledge has no effect on educational background. The Chi-square P-value (0.000) is less than the Alpha-value (0.005). The null hypothesis is rejected, and the alternative hypothesis is accepted, and we therefore conclude that Forest knowledge has effect on educational background.

Figure 26

forest knowledge vs educational background



Educational Background versus forest protection

Table 13

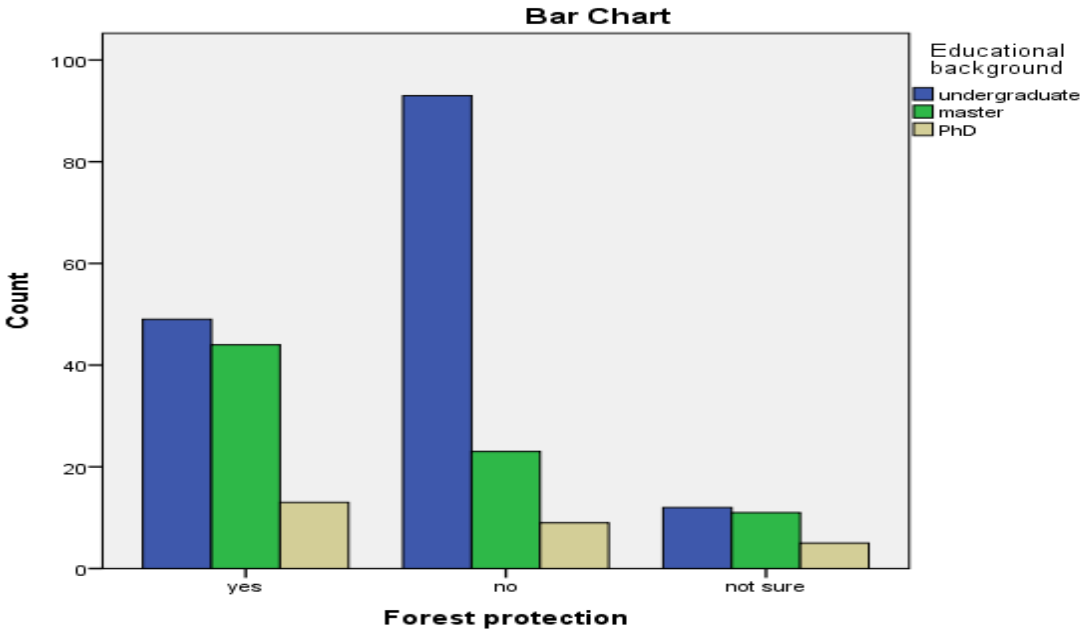
Forest protection vs educational background

Forest protection vs educational background			
Forest protection	Educational background		
	Undergraduate	Master	PhD
Yes count	49	44	13
Forest protection %	46.2%	41.5%	12.3%
Educational background %	31.8%	56.5%	48.1%
No count	93	23	9
Forest protection %	74.4%	18.4%	7.2%
Educational background %	60.4%	29.5%	33.3%
Not sure count	12	11	5
Forest protection %	42.9%	39.3%	17.9%
Educational background	7.8%	14.1%	18.5%

(Table 13, Figure 27): Is there any association between Forest protection and educational background. H0: Forest protection has relation with educational background. The Chi-Square P-value (0.000) is less than the Alpha-value (0.005). The null hypothesis is rejected; we therefore conclude that forest protection has effect on educational background.

Figure 27

Forest protection vs educational background



Association between Creating community awareness on forest and educational background

Table 14

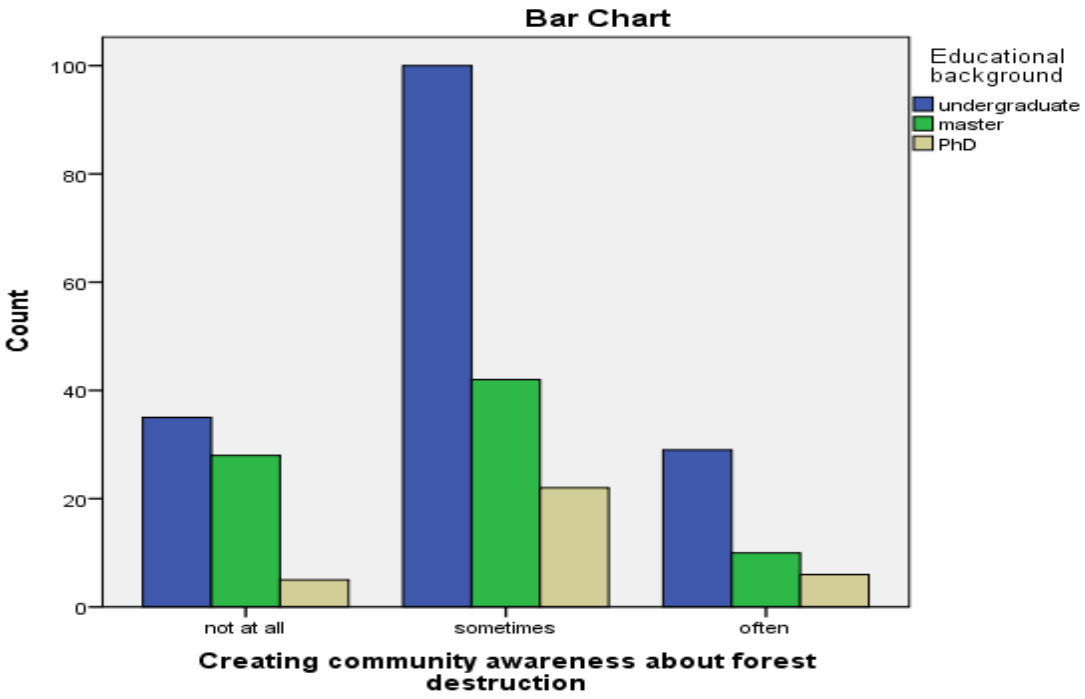
Creating community awareness on forest vs educational background

Creating community awareness on forest vs educational background			
Creating community awareness on forest	Educational background		
	Undergraduate	Master	PhD
Not at all count	35	28	5
Creating community awareness on forest %	51.5%	41.2%	7.4%
Educational background %	21.3%	35.0%	15.2%
Sometimes count	100	42	22
Creating community awareness on forest %	61.0%	25.6%	13.4%
Educational background %	61.0%	52.6%	66.7%
Often count	29	10	6
Creating community awareness on forest %	64.4%	22.2%	13.3%
Educational background %	17.7%	12.5%	18.2%

(Table 14 and figure 28): Is there any effect or an association between creating community awareness about forest destruction and educational background. H0: Creating community awareness about forest destruction has no effect on educational background. The Chi-Square P-value (0.116) is greater than the Alpha-value (0.005). We therefore accept the null hypothesis and conclude that creating community awareness about forest destruction has no effect on educational background. This means community awareness about forest those not required going to school.

Figure 28

Creating community awareness on forest vs educational background



Results of AI based models

For the development of the data-driven models, MATLAB 9.3 (R2020a) was employed in the ANN, SVM, and ANFIS models, while the deterministic linear MLR model was developed using the simulation tool in the EViews software 9.5. According to(Nourani et al., (2018a), obtaining suitable hidden nodes is the crucial aspect of any ANN modeling in order to avoid overfitting caused by different factors. As has been reported in several works of literature in the field of science and

engineering, there is no standard method for determining the appropriate number of hidden neurons. According to (Ji, Shang, Dahlgren, & Zhang, 2017; Olyaie, Zare Abyaneh, & Danandeh Mehr, 2017), the proper number of nodes in the hidden layer ranges from (2n1/2 + m) to (2n+1) for the identification of the optimum number of hidden layers, where n is the number of input neurons and m is the number of output neurons. Hence, 5-21 was found to be the range of the hidden neurons of the ANN model for the estimation of forest knowledge (FK). Furthermore, appropriate, and optimal determination of parameters (Cε, γ) in the SVM models is very important in choosing the best structure for the models. In this research, optimal values were obtained by employing the kernel function of the grid procedure, as suggested by(Pham et al., 2019). For ANFIS modeling, various types of membership functions (MFs) and epoch iteration were explored using trial and error to identify the best structure.

The modeling comprises of two different model's combinations (M1 and M2) in which M1 contained five variable combinations (FIC, ICA, BFE, DCF, and GRT) and M2 contained eight variables (FIC, ICA, BFE, DCF, GRT, VGF, RIF, and SFK). The sensitivity analysis was performed to determine the combination of the models that as presented in Table 4.7. Sensitivity using correlation describes how well the relationship between the variables can be described using a linear function. The strength of the correlation is not dependent on the direction or sign. A positive coefficient indicates that increase in the first parameter would correspond to an increase in the second parameter, while a negative correlation indicates an inverse relationship whereby one parameter increases and the second parameter decreases (Eisinga, Grotenhuis, & Pelzer, 2013). It can be seen from Table 15 that the high correlation between target variables FK could be attributed to the combination M1 then subsequently M2.

Table 15

Spearman Pearson correlation analysis between the variables

Variables	*FIC*	*ICA*	*VGF*	*GRT*	*SFK*	*BFE*	*RIF*	*DCF*	*FK*
FIC	1								
ICA	0.1841	1.0000							
VGF	0.0706	0.2726	1.0000						
GRT	-0.0298	-0.0611	0.0694	1.0000					
SFK	-0.0791	0.0853	0.1282	-0.0774	1.0000				
BFE	-0.1215	-0.0438	0.2815	0.0287	0.1619	1.0000			
RIF	-0.0112	0.0387	-0.1667	0.0970	-0.1187	-0.2943	1.0000		
DCF	-0.2425	-0.0228	0.1085	0.0544	0.1226	0.3560	-0.0075	1.0000	
FK	0.2793	0.1337	-0.1118	-0.1317	-0.0973	-0.1424	0.0970	-0.1641	1.0000

Table 16 shows the results of the performance analysis for ANN, SVM, ANFIS, and MLR models. It can be seen from the models that all the three AI based models are able to produce the best performance accuracy over the linear MLR model. This is due to the powerful nature of nonlinear AI based models in capturing the complex system. Among the AI based models, SVM- M1 emerged to be the best combination for the estimation of FK with the values of R^2=0.8893, MSE=0.0950, and R=0.9430 in the testing phase.

Table 16

Performance Analysis of the models

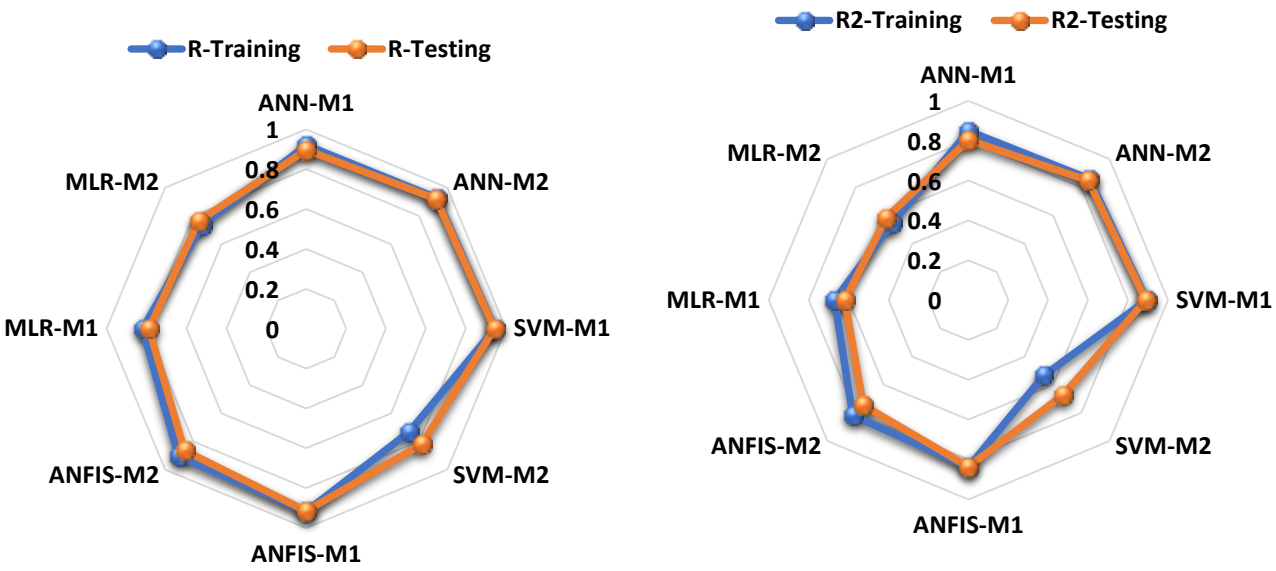
	Training				Testing			
Models	R^2	MSE	R	RMSE	R^2	MSE	R	RMSE
ANN-M1	0.8482	0.1205	0.9210	0.3472	0.8026	1.0705	0.8959	1.0347
ANN-M2	0.8582	0.1126	0.9264	0.3355	0.8485	0.8215	0.9212	0.9064
SVM-M1	**0.8947**	**0.0836**	**0.9459**	**0.2891**	**0.8893**	**0.0950**	**0.9430**	**0.3082**
SVM-M2	0.5345	0.3696	0.7311	0.6079	0.6721	1.7783	0.8198	1.3335
ANFIS-M1	0.8376	0.4205	0.9152	0.6485	0.8364	0.8874	0.9145	0.9420
ANFIS-M2	0.8189	0.1438	0.9049	0.3792	0.7455	1.5518	0.8634	1.2457
MLR-M1	0.6715	0.2608	0.8195	0.5107	0.6202	2.0599	0.7875	1.4352
MLR-M2	0.5440	9.9607	0.7375	3.1561	0.5831	9.9329	0.7636	3.1516

Further analysis of the results demonstrated that ANN-M2 served as the second-best follow by ANFIS-M1 and lastly MLR-M1. The estimation results with regards to goodness-of-fit are presented with a radar chart (Fig. 29). From the table 16 it can be concluded that the performance accuracy of the best models follows the following order: SVM-M1>ANN-M2>ANFIS-M1>MLR-M1. The MLR models was attributed

to the poor results that cannot serve the estimation purpose because MLR is a linear model that cannot capture the nonlinear relationship between the variables. This can be proved in several technical literature (Hadi et al., 2019),(Ghorbani, et al, 2018; Hameed et al., 2017; Yaseen, et al., 2019; Yaseen, Sulaiman,et al, 2019). To compare the predictive performance of this study the following literature (Abba et al., 2020; Yaseen, Ebtehaj, et al., 2019; Yaseen, Ehteram, et al., 2019) confirm that for the good analysis of the model R values should be greater than 0.7. In addition, according to (Abba et al., 2020; Yaseen et al., 2019; Yaseen et al., 2019) the R2 greater that 0.8 is satisfactory for any analysis using AI based models.

Figure 29

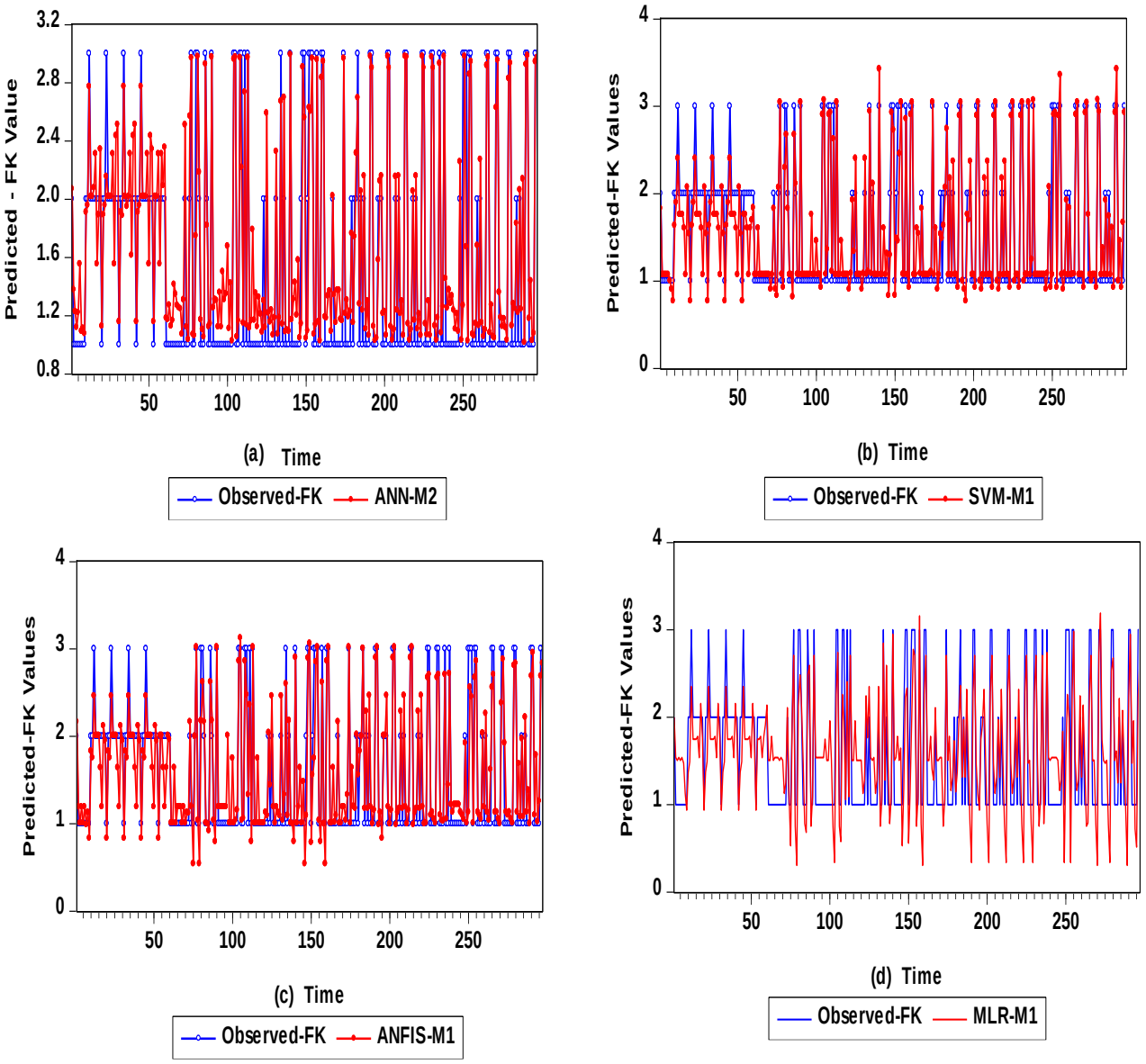
Radar chart for all the models (ANN, SVM, ANFIS, and MLR)



For more explanation about predictive analysis of the model, point by point plot are generated between the observed and the predicted values for the best models as depicted in Fig. 30. From the plots it can be observed that the high agreements between the observed and predicted values were attributed to the SVM-M1. For this reason, the quantitative analysis of the models can be generated using determination coefficient (R^2). SVM-M1 increased the prediction accuracy of ANN, ANFIS, and MLR by 3%, 5%, and 22% in the training phase while in the testing phase it increased the prediction accuracy by 4%, 5%, and 26%, respectively.

Figure 30

Point by point plot between the observed and predicted values for (a) ANN-M2 (b) SVM-M1 (c) ANFIS-M1, and (d) MLR-M1



According to (Legates & McCabe Jr., 1999) a good analysis of any predictive models is the one that contained at least one goodness-of-fit e.g. R2, and one absolute error e.g. MSE, hence Fig. 31 present the different variation of MSE and RMSE in both the training and testing phases. Form the figure MLR model emerge to be with the highest error variance with the lowest error associated to SVM-M1. Based on the predictive comparison of the models, it is clearly shown that the non-linear models (ANN, SVM and ANFIS) outperformed the traditional linear

regression model (MLR). The figure further proved that all AI models can predict the FK. It is important to note that the performance efficiency of all four models in terms of R2, MSE, R and RMSE shows a satisfactory and reliable accuracy. This can be due to the cross validation process conducted before model calibration, which is very significant in model evaluation (Elkiran,et al 2018). Lastly, the comparison of all the models can be demonstrated using box-plot presentation (Fig. 32).

Figure 31

shows the error performance in term of MSE, and RMSE for all the models

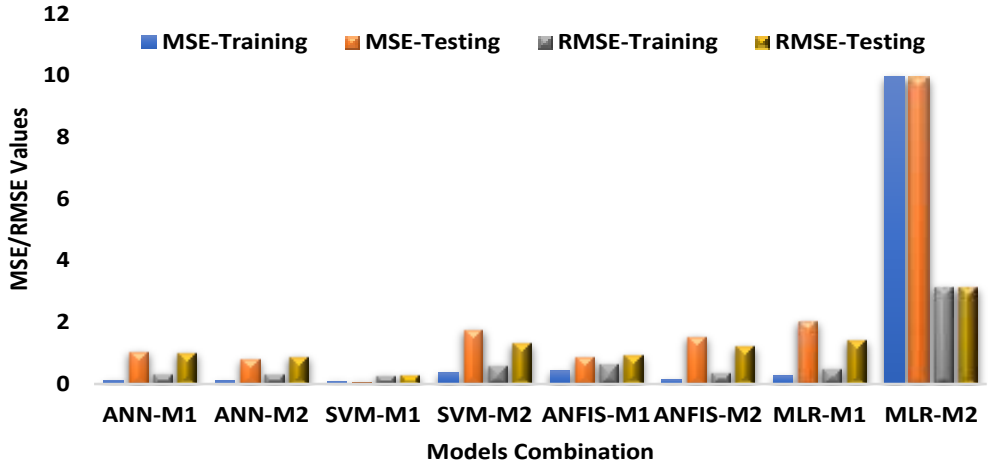
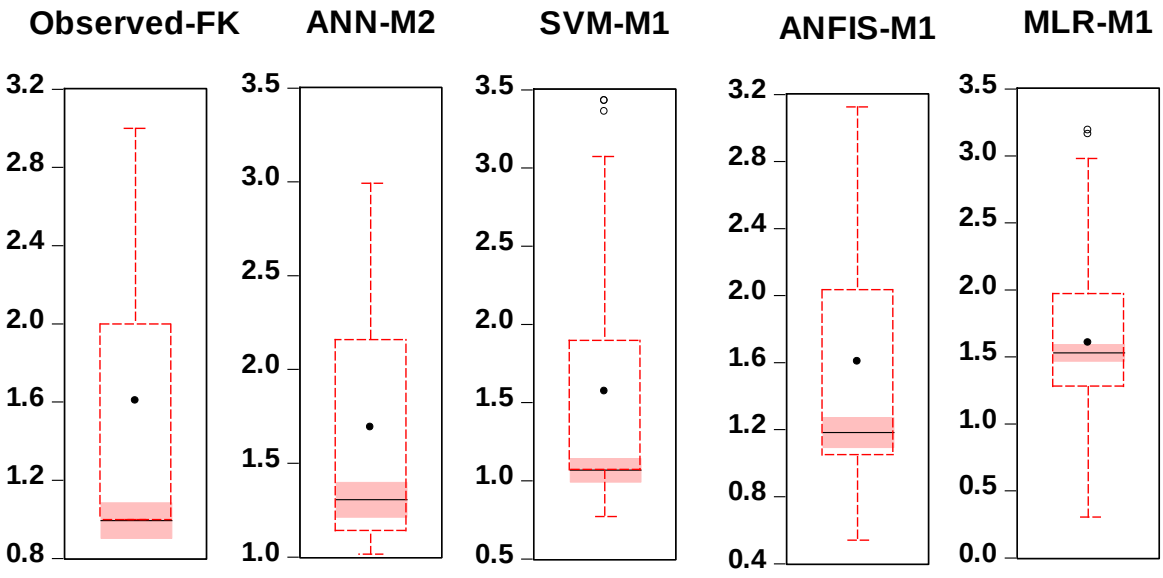


Figure 32

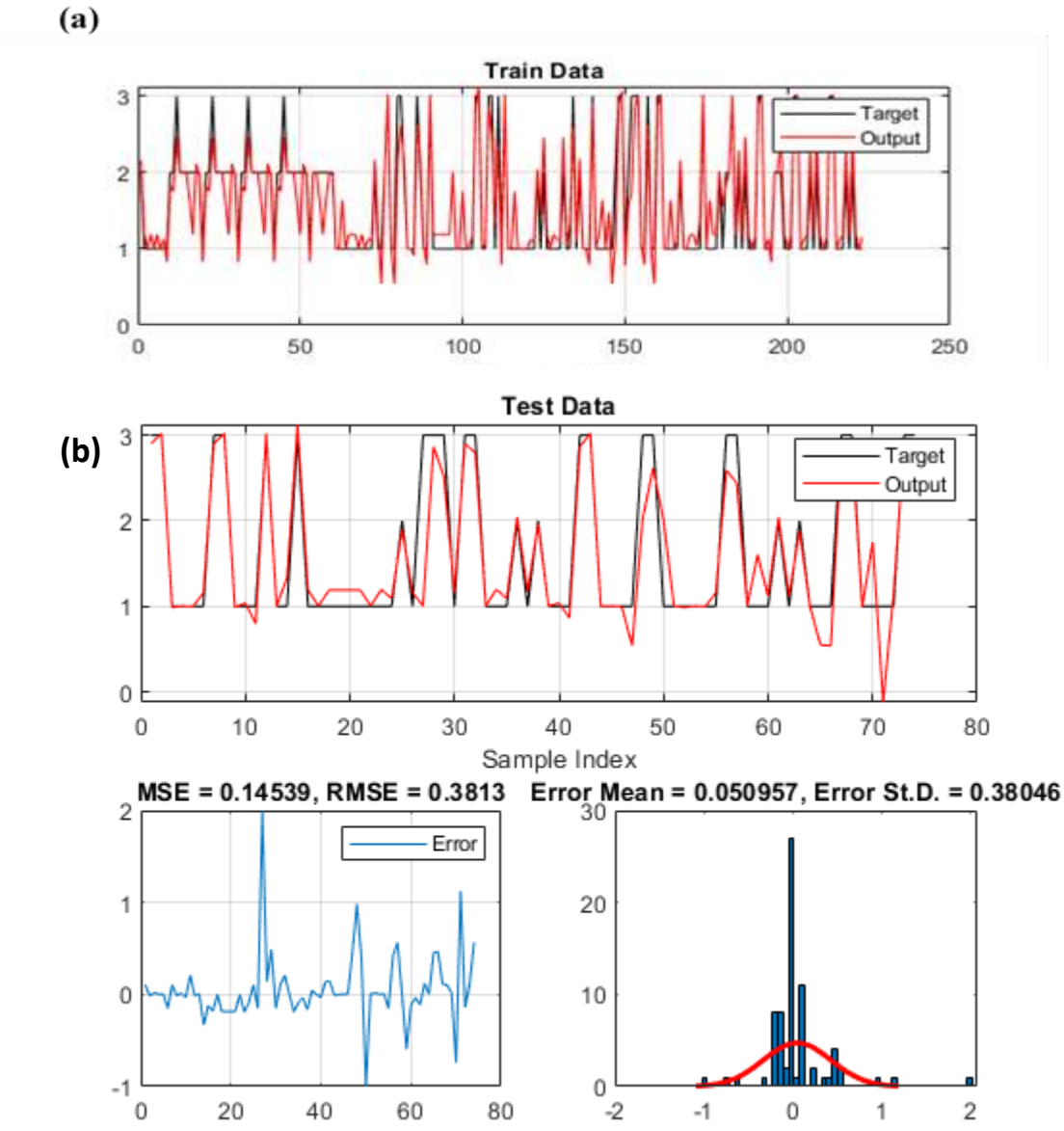
Boxplot between the observed and the best predicted models for ANN, SVM, ANFIS, and MLR

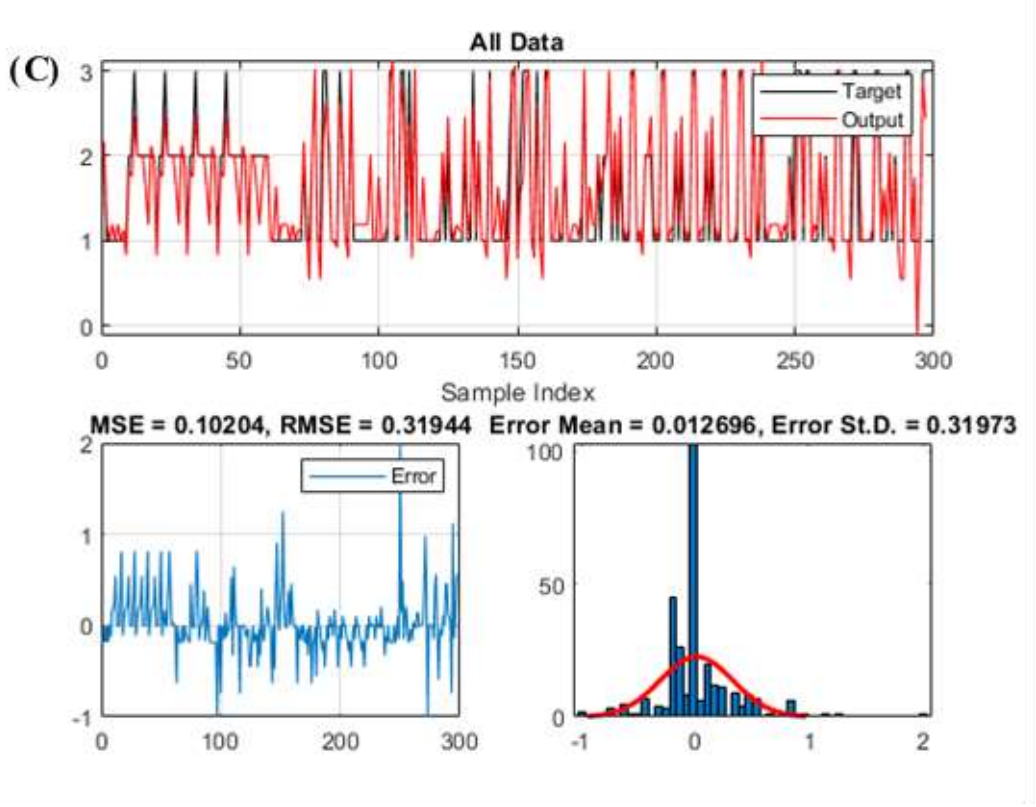


Generally, the behavior of knowledge forest estimation can be display in the following three graphs for training phase, testing phase, and all data. We can see from the graph that all the phases are within or above the require estimation accuracy. For example, the MSE are below the require standard according to literature. Point by point plot between the observed and predicted values for (a) training (b) testing (c) All (see, Fig. 33).

Figure 33

Point by point plot between the observed and predicted values for (a) training (b) testing (c) All



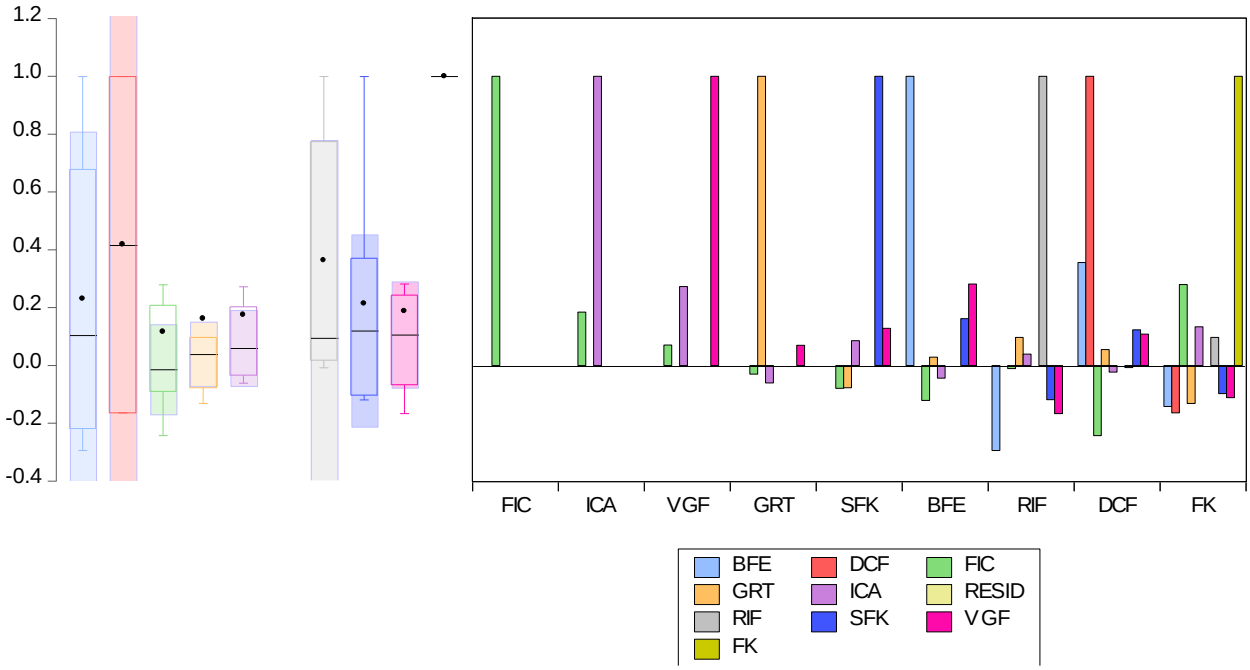


Results for Estimation of FK using Deep Learning

The following variables from the questionnaire were used for exploratory and data-driven analysis: forest knowledge (FK), forest importance to the country (FIC), priority for recreational activities (ICA), vital goal of forest (VGF), the government is responsible for forest problems (GRF), sources of forest knowledge (SFK), benefit of forest protection to man and his environment (DCF). A sensitivity analysis was carried out to discover the most dominating parameter and to understand the influence of COVID-19 on forest knowledge. The results are shown in Figure 34.

Figure 34

Box-auto correlation analysis between the variables



The simulated quantitative assessment findings are provided in tabular form, and the anticipated outcomes were generated from M1 and M2. The performance analysis findings for the RF, LSTM, and EML models are shown in Table 17. The results show that all three AI-based models can produce high performance accuracy for FK and management assessment. This is owing to non-linear AI-based models' remarkable capacity to de-scribe complicated systems. In the calibration phase, SLSTM-M1 emerged as the best combination for FK estimation among the two AI-based models (RF and LSTM), with R2 = 0.9393, MSE = 0.0450, and R = 0.9692. Further analysis of the results demonstrated that RF-M2 served as the second-best model, follow by RF-M1, and lastly LSTM-M1. The estimation results regarding goodness-of-fit are presented by radar charts (see Figure 35).

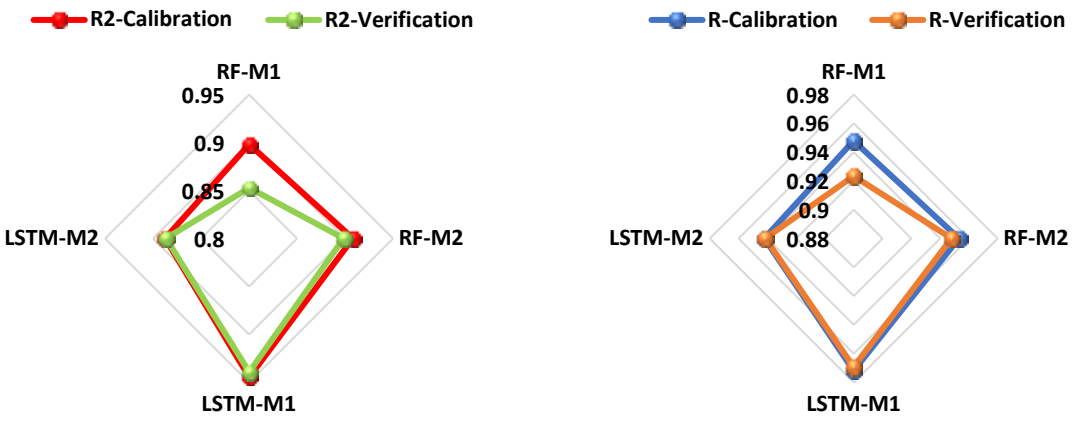
Table 17

Results and performance analysis of the models

	Calibration Phase				Verification Phase			
Models	**R^2**	**MSE**	**R**	**RMSE**	**R^2**	**MSE**	**R**	**RMSE**
RF-M1	0.8982	0.0705	0.9477	0.2655	0.8526	1.0205	0.9234	1.0102
RF-M2	0.9082	0.0626	0.9530	0.2502	0.8985	0.7715	0.9479	0.8784
LSTM-M1	0.9447	0.0336	0.9720	0.1833	0.9393	0.0450	0.9692	0.2121
LSTM-M2	0.8876	0.3705	0.9421	0.6087	0.8864	0.8374	0.9415	0.9151
NN-EML	0.9776	0.0305	0.9881	0.1746	0.9694	0.0374	0.9845	0.1933

Figure 35

Radar chart for all the models for R2 and R.



CHAPTER V

Conclusion And Recommendation

The current chapter is designed to provide a conclusion to the current research by

Summarizing the results, the implications of the results for practice as well Make recommendations for further research.

Summary of Findings

The outcome of the result revealed that students' knowledge about forest, importance of forest, individual and government responsibility of taken care of forest has no significant effect on nationality; while on the contrarily, the result indicated that students' knowledge about forest protection, poor forest administration and danger of deforestation has significant effect on nationality. The results revealed a significant association between knowledge about forests and forest protection. Thus, having knowledge about forests will greatly help individuals in protecting forests, government responsibility to take care of forest has no effect on Nationality, feeling passion around forest has no effect on Nationality, danger of cutting forest has no effect on Nationality, responsibility of individual to protect forest has no effect on importance of forest to individual and the economy, forest knowledge has effect on educational background, forest protection has effect on educational background, and creating community awareness about forest destruction has no effect on educational background. This means community awareness about forest those not required going to school.

Implications for practice

Sustainable education for forest management is paramount for meeting the environmental needs, which led to forced employing prominent safety factors and expensive prototype rules due to a lack of an accurate and user-friendly methodology for determining the forest knowledge. Besides, there is a scarcity of published research and test data on the performance of newer forest management. Recently several studies were established in different field of science engineering using other exploratory analysis. However, there is still a notable level of challenges attributed to this deterministic approach due to the emerging AI-based models. The principal motivation of this research is presented in two different ways. Namely, various

methods, including deterministic analysis with factor analysis and deep learning ensemble models, were employed to evaluate and estimate knowledge forest among university students from different countries in North Cyprus. An ensemble model was used to improve the prediction accuracy of the model. For this purpose, a structured questionnaire according to empirical observation, collection, and recording of respondents' opinion, assessment, classification, and interpretation of data through statistical software with no reason for any biased manipulation of the main objective and scope of the study. The research was piloted among the university students at the Undergraduate and Postgraduate levels in North Cyprus to share different experiences about their knowledge and views of the forest resources in their locality.

In this thesis two different approaches including deterministic analysis and data driven models (ANN, SVM, ANFIS, and MLR) were employed for the evaluation and estimation of knowledge forest among university students in North Cyprus.

For deterministic analysis, students at all levels of education should strive to have a better understanding of forest – because it has impacted our world in every area financially, ecologically, medically, and socio-traditionally. The unique diverse functions of forest endowments are yet to be acknowledged by a great number of nationalities across the globe. Several nations worldwide still place a low priority on forest administration at local, state, and central levels; these have resulted in a low passion for forest care and protection; this also makes forest segments to be short of improvement, efficiency and public advocates. Most essentially, probably not every area of vegetation and ecosystem could be known or exposed to all students at the tertiary institution level – while having in mind that their various course of study which differs. Although, the tertiary institution students have a strong capability for personal learning or learning autonomy – provided sufficient or adequate facilities are provided. Also, the tertiary institutions or higher academic communities ought to take complete liability or task for adequate teaching of forest administration and sustainability; students should be taught on critical thinking about forest, environment, human and socio-economic activities; in all these, they would be able to query and find out more about origin of forest, forest protection, importance of forest, forest administration, danger of deforestation, and social responsibility regarding forest resources.

However, for AI based models two different models were developed based on sensitivity analysis to estimate the forest knowledge using ANN, SVM, ANFIS, and MLR models. The performance criteria were evaluated using R2, R, MSE, and RMSE. The predictive results demonstrated that AI based models can predict forest knowledge with less input combination. The results further indicated that MLR models is incapable and unsatisfactory tool for modeling forest knowledge. Among the AI model, SVM-M1 emerge best and hence served as the most reliable estimation model. The outcomes also suggested that for the development of AI in this field other nonlinear models and optimization techniques should be employ such as extreme learning machine, genetic algorithm, ensemble learning to improve the estimation accura.

Nonetheless, AI-based models based on sensitivity analysis were constructed for the DL findings to assess FK using RF and LSTM models. The performance requirements were assessed using R2, R, MSE, and RMSE. The results of the prediction demonstrated that AI-based models could predict forest knowledge with fewer inputs. According to the findings, all deep learning method models are capable and appropriate tools for modelling forest data. Deep learning LSTM-M1 emerged as the best and most reliable estimation model among the AI models studied. Although ranking the models according to their achieved accuracies is difficult, the ELM techniques approach provided the best relative prediction accuracy, with a goodness of fit of over 97 percent.

Recommendations for Further Research.

Future studies shall be focused on the following: ecological enlightenment, understanding, beliefs and values; assessment of learning institution ecological classroom working schemes; instructors or academicians and scholars perspectives to forests education, creation of programs and strategies that will champion the course of ecosystem and forest resources, qualities that depicts environmental conscious scholars; governmental ecosystem, theories regarding forest views ; forests protection and awareness

We recommend conducting a search on other nationalities from developed countries and making a comparison

The research was conducted prior, and during the COVID 19 pandemic. The full data analysis was taken before the commencement of the lock-down, and after the lockdown other parameters were re assessed to define the impact of lockdown on forest knowledge. Hence, we are recommending to first use other statistical and uncertain parameter in the questioner to answer the forest knowledge effective.

The use of principal component analysis is highly recommendable to reduce the dimension of the variables. The post-covid 19 is another era which need to be analyses accordingly. Among the AI based models the application of should be explore as stated in the above section.

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Appendix A: Questionnaires

EVALUATION OF FOREST KNOWLEDGE USING DETERMINISTIC ANALYSIS INTEGRATED WITH ARTIFICIAL INTELLIGENCE BASED MODELS: CASE STUDY NORTHERN CYPRUS

This questionnaire is designed to assess student information about the importance of forests, assess their knowledge of forest-related problems and issues, as well as students 'knowledge of forest responsibility, forest education, and assess of students attitude and opinions towards forests. There are no correct or false answers to these questions. We are looking for your general impressions of questions and statements. The information that we receive from this questionnaire will help us guide and develop educational programs related to forests and the environment in general as well. Your answers will be compared to the students in other countries. This comparison will help us better understand how people see different backgrounds of forest ecosystems and resources. Your answers are very important to us. Please complete these questions yourself. All replies will be kept very confidential

SECTION A: Demographic Profile of Respondents

Instruction: Please fill in and put a tick (√) where applicable

1. Nationality: ……

2. Gender: Male ☐ Female ☐

3. Age: ☐ Under21 ☐ 21-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ 46-50 ☐ 51-55 ☐ 56 above

4. University: …….

5.: Department ……...

6. Studentship Status: ☐ Undergraduate ☐ Master ☐ PhD

SECTION B: Assessment of students' knowledge towards the importance of forests

	(Please circle one number of each statement)	Yes	N0	Not sure
7	Are you interested in issues that are related to forests usage in your country?	1	2	3
8	Are you aware of forests protection activities in your country?	1	2	3
9	Do you know the importance of forests of your country?	1	2	3

10. How important are forest/woodlands resources to each of the following aspect of life in your community? (Please circle one number of each)

Aspects of life	Very Important	Important	Not Important
Wealth	1	2	4
Recreation	1	2	4
Household economy	1	2	4
Quality of life	1	2	4
Quality of environment	1	2	4
Country's economy	1	2	4
Other (specify)	1	2	4

11. What are the values of forests in your country? (Tick (√) all that is applicable)

Help us breath ☐ ; keep us and earth cool ☐ ; They make it rain ☐ ; They fight flooding ☐ ;

Fuel wood ☐; They block wind ☐ they clean up soil and air ☐ ; They muffle noise pollution ☐

Wood for furniture ☐ ;Wild herbs ☐ ;Edible wild fruits ☐ ;Mushrooms ☐; Honey ☐ ; Wild

animals or bush meat for food ☐; Medicinal Plants; ☐ ; Reeds for construction ☐ Grass/Tree for

livestock ☐ Others (Specify)…….

SECTION C: Assessment of the students' knowledge towards the problems that are associated with forests

12. Tick accordingly as you know the following problems that are associated with forests:

Forest diseases ☐ Wildfire ☐ Bush burning ☐ Droughts ☐ Lumbering ☐ Deforestation ☐

Urbanization ☐ Desertification ☐ Overgrazing ☐ High demand for wood for the growing

population ☐ Climate change ☐ High rate of poverty ☐ Mining activities ☐ Soil degradation ☐

Shortage of water ☐ Illegal exploitation of forests ☐ Lack of Government supports for

forest resources ☐ Others (Specify)…….

(Please circle one number of each statement)	agree	disagree	No opinion

13	Poor forests administration and policy.	1	2	3
14	Loss of forests reserve to urbanization	1	2	3
15	No adequate protection for forests reserve	1	2	3
16	Building activities across forest land.	1	2	3
17	Non implementation of afforestation programs	1	2	3

SECTION D: Assessment of the students' knowledge towards the practice of taking responsibility about forests protection (Please circle one number of each statement)

		Yes	No	Not sure
18	Forests must be protected to ensure well-being of all wild species of trees, plants, and animals.	1	2	3
19	Forests have ways of renewing themselves whether we care or not	1	2	3
20	Protecting the job of forest workers is more essential than protecting threatened bio diversities.	1	2	3
21	The vital goals of forests administration should be to protect the environment for all	1	2	3
22	Everybody must be committed and do something towards protecting the forests	1	2	3
23	It is government responsibility alone to protect forests	1	2	3
24	Forests are nature gift from God in meeting our needs and we must not neglect such ecological right	1	2	3
25	If we want wildlife to survive, we must look after the natural places where they live	1	2	3
26	Exploited forests must be allowed to renew through natural process unhindered	1	2	3
27	Leaving bunches of plants for animals is quite eco-friendly	1	2	3
28	Forests must be protected against indiscriminate lumbering or felling of trees	1	2	3

SECTION E: Assessment of students' knowledge about forests education

29. what is your first source of information? (Please tick (√) one of the following.):

Radio ☐ Television ☐ Newspapers/Magazine ☐ School/Colleges teachers ☐ Conference ☐

seminar/workshop ☐ Poster/Pamphlet ☐ Government environment workers ☐ Neighbors/friends ☐

Don't Know☐ Other (specify)…….

	(Please circle one number of each statement)	Good	Fair	Poor
30	What is your assessment of people's knowledge of forests in your country?	1	2	3
31	What is your assessment of people's knowledge of forests in your country?	1	2	3

32. Who must take care of forests? (Please tick (√) one of the following sources):

Government only ☐ people only☐ rural dwellers only☐ Government, people, and rural dwellers ☐

33. Kindly list five major solutions that could help to enhance forests protection in your own country.
……
……
……..
……..

SECTION F: Assessment of the Students attitude toward forests (Please circle one number of each statement)

		Strongly disagree	disagree	Neither Disagree nor Agree	agree	Strongly agree
34	Forests comprise of many bio diversities in plant and animal on earth	1	2	3	4	5
35	Forests mainly comprise of plants without any vital functions to living things	1	2	3	4	5
36	Forests could be important in other countries but no relevance in my own country	1	2	3	4	5
37	I don't actually see any relevance in forests	1	2	3	4	5
38	Forests are threats and so challenging to our immediate environment	1	2	3	4	5
39	Trees are basically for the purpose of man	1	2	3	4	5
40	Forests are terrifying environment	1	2	3	4	5
41	It will really encourage me if I could be enlightened about living things that depend on plants for feeding	1	2	3	4	5
42	The notion of creating passion for forest is senseless	1	2	3	4	5
43	I am highly curious and passionate anytime I found myself in forest environment	1	2	3	4	5
44	Forests that are administered by human appear to be better than the natural vegetation	1	2	3	4	5
45	Forests also have privilege like man in a civic society	1	2	3	4	5
46	The utmost valuable forest varieties are the ones that support man with vital produces	1	2	3	4	5

47	Man, independently lives with no support from trees	1	2	3	4	5
48	Taking responsibility to plant trees will safeguard the natural surrounding or nature	1	2	3	4	5
49	The utmost essential need for trees conservation is mainly to safeguard the uninhabited land	1	2	3	4	5
50	There is high possibility that trees reserve areas can harm somebody	1	2	3	4	5
51	Trying to get gain knowledge about forests respiration system could be uninteresting	1	2	3	4	5
52	I have high passion for some specific varieties of forests.	1	2	3	4	5
53	It is quite uninteresting to picnic round extinct threatened trees	1	2	3	4	5
54	People should be more involved in protecting forests in their locality	1	2	3	4	5
55	A forest that produces wood products is more important than one that is just beautiful	1	2	3	4	5
56	Being alone in the forests frighten me a lot	1	2	3	4	5
57	I clamor for trees in the surrounding than any other things	1	2	3	4	5
58	Just like human, forests feel harm once they are cut down	1	2	3	4	5
59	There is high tendency for trees to be utilized without being destroyed	1	2	3	4	5
60	Vegetation are vital aspect of life	1	2	3	4	5
61	It is necessary that vegetation is safeguard from various human activities	1	2	3	4	5
62	It is also necessary to safeguard the vegetation from bush burning and outbreak of wildfire	1	2	3	4	5
63	Vegetation adds esthetic values to the environment	1	2	3	4	5
64	You feel happy as the forests are being destroyed	1	2	3	4	5
65	You think that man can show kindness to trees like they show to pet animals.	1	2	3	4	5
66	You think it is vital to preserve vegetation for medicinal values	1	2	3	4	5
67	You think it is necessary to reserve land for both vegetation and animals	1	2	3	4	5
68	You devote time moving round the environment in order to be cheerful?	1	2	3	4	5

69	You desire to know how vegetation grows	1	2	3	4	5

70. How many times have you contributed to each of the following activities over the past years? (Please circle one number of each statement)

	Not at all	sometimes	often
• Talked to your relatives, friends or colleagues about the problem of forest destruction	1	2	3
• Contributed his article on the protection of forests in the newspaper or newspaper school wall	1	2	3
• Asked your friend or relative or anyone to stop doing things that are harmful to trees and plants	1	2	3
• participated in a campaign to clean the gardens and forests	1	2	3
• participated in afforestation campaigns	1	2	3

Thank You Very Much for Your Participation

Appendix B: Forest assessment responses

	Frequency	Percentage
Forest knowledge		
Yes	**167**	**55.7%**
No	**71**	**23.7%**
Not sure	**52**	**17.3%**
Total	**290**	**96.7%**
Missing value	**10**	**3.3%**
Total	**300**	**100.0%**
Does forest protection		
Yes	**109**	**36.3%**
No	**128**	**42.7%**
Not sure	**31**	**10.3%**
Total	**268**	**89.3%**
Missing value	**32**	**10.7%**
Total	**300**	**100.0%**
Response of individuals towards commitment to forest protection		
Yes	**220**	**73.3%**
No	**41**	**13.7%**
Not sure	**23**	**7.7%**
Total	**284**	**94.7%**
Missing value	**16**	**5.3%**
Total	**300**	**100.0%**
Government responsibility in tackling forest problem		
Yes	**59**	**19.7%**
No	**196**	**65.3%**
Not sure	**25**	**8.3%**
Total	**280**	**93.3%**
Missing value	**20**	**6.7%**
Total	**300**	**100.0%**

Importance to the country		
Yes	**210**	**70.0%**
No	**69**	**23.0%**
Not sure	**21**	**7.0%**
Total	**300**	**100.0%**
Importance forest to recreational activities		
Very important	**121**	**40.3%**
Important	**134**	**44.7%**
Not important	**27**	**9.0%**
Total	**282**	**94.0%**
Missing value	**18**	**6.0%**
Total	**300**	**100.0%**
Importance of forest to individuals and country economy		
Very important	**147**	**49.0%**
Important	**108**	**36.0%**
Not important	**24**	**8.0%**
Total	**279**	**93.0%**
Missing value	**21**	**7.0%**
Total	**300**	**100.0%**
poor forest administration		
Agree	**239**	**49.0%**
disagree	**36**	**36.0%**
No opinion	**16**	**8.0%**
Total	**291**	**93.0%**
Missing value	**18**	**7.0%**
Total	**300**	**100.0%**
none implementation of forest programed		
Agree	**228**	**76.0%**
Disagree	**35**	**11.7%**
No opinion	**25**	**8.3%**

Total	**288**	**96.0%**
Missing value	**12**	**4.0%**
Total	**300**	**100.0%**
knowledge with regards to forest		
Radio	**131**	**43.7%**
Television	**59**	**19.7%**
Magazine	**16**	**5.3%**
School	**49**	**16.3%**
Others	**43**	**14.3%**
Total	**298**	**99.3%**
Missing value	**2**	**0.7%**
Total	**300**	**100.0%**
Importance of forest to animal		
Strongly disagree	**33**	**11.0%**
Disagree	**27**	**9.0%**
Neither disagree nor agree	**30**	**10.0%**
Agree	**80**	**26.7%**
Strongly agree	**120**	**40.0%**
Total	**290**	**96.7%**
Missing value	**10**	**3.3%**
Total	**300**	**100.0**
Forest protection to man and his environment		
Strongly disagree	**132**	**44.0%**
Disagree	**48**	**16.0%**
Neither disagree nor agree	**30**	**10.0%**
Agree	**61**	**20.3%**
Strongly agree	**22**	**7.3%**
Total	**293**	**97.7%**
Missing value	**7**	**2.3%**
Total	**300**	**100.0**

Ethical Report

YAKIN DOĞU ÜNİVERSİTESİ

BİLİMSEL ARAŞTIRMALAR ETİK KURULU

01.04.2019

Dear Abdelgader Yousef E Alamrouni

Your application titled “Comparing knowledge, attitudes and opinions of university students towards sustainable forestry in multicultural groups” with the application number YDÜ/EB/2019/299 has been evaluated by the Scientific Research Ethics Committee and granted approval. You can start your research on the condition that you will abide by the information provided in your application form.

Assoc. Prof. Dr. Direnç Kanol

Rapporteur of the Scientific Research Ethics Committee

Note:If you need to provide an official letter to an institution with the signature of the Head of NEU Scientific Research Ethics Committee, please apply to the secretariat of the ethics committee by showing this document.

Curriculum Vitae

Abdelgader Yousef E Alamrouni

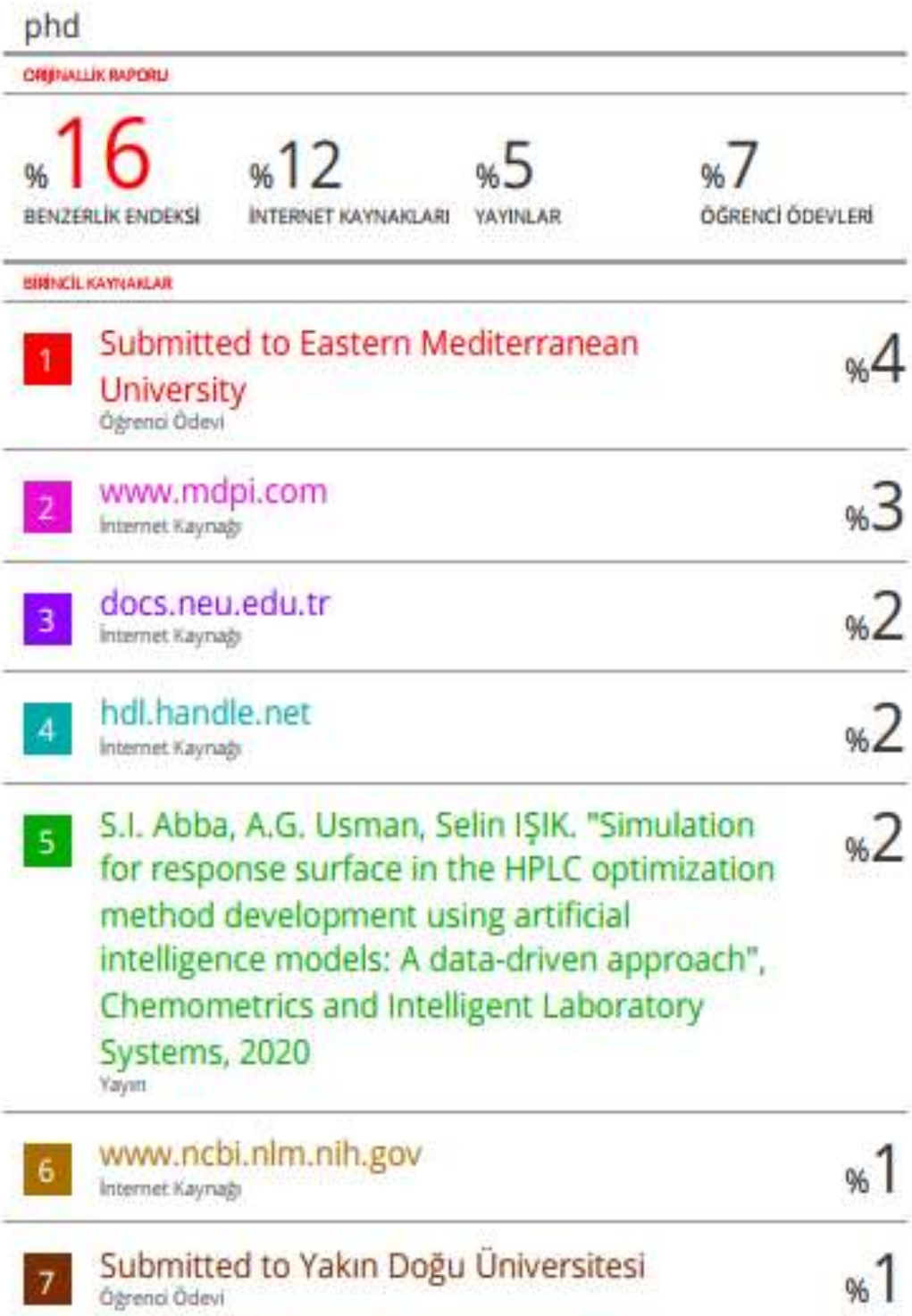
General Information

- Name: Abdelgader Yousef E Alamrouni
- Sex: Male
- Birth Date: 20 January 1966
- Address Permanent: Elgawarsha - Benghazi - Libya
- Marital Status: Married
- Nationality: Libyan
- Telephone: Mobile -00218923109168
- E-mail: gader18071993@gmail.com
- Languages: Arabic, English

Academic Development

- BSc in chemistry (1987-1988) Factuality of sciences, University of Benghazi
- MSc in Environmental Science (2008) Academy of graduate studies Benghazi branch
- Advanced training course in Analytical chemistry; July2005-Marsh2006, Cardiff-UK, university of Glam organ
- Intermediate English Language Ielts School
- Upper-intermediate English language EC School
- IELTS certificate score 5

Turnitin



phd

ORİJİNALLİK RAPORU

%16	%12	%5	%7
BENZERLİK ENDEKSİ	İNTERNET KAYNAKLARI	YAYINLAR	ÖĞRENCİ ÖDEVLERİ

BİRİNCİL KAYNAKLAR

1	Submitted to Eastern Mediterranean University Öğrenci Ödevi	%4
2	www.mdpi.com İnternet Kaynağı	%3
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5	S.I. Abba, A.G. Usman, Selin IŞIK. "Simulation for response surface in the HPLC optimization method development using artificial intelligence models: A data-driven approach", Chemometrics and Intelligent Laboratory Systems, 2020 Yayın	%2
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7	Submitted to Yakın Doğu Üniversitesi Öğrenci Ödevi	%1