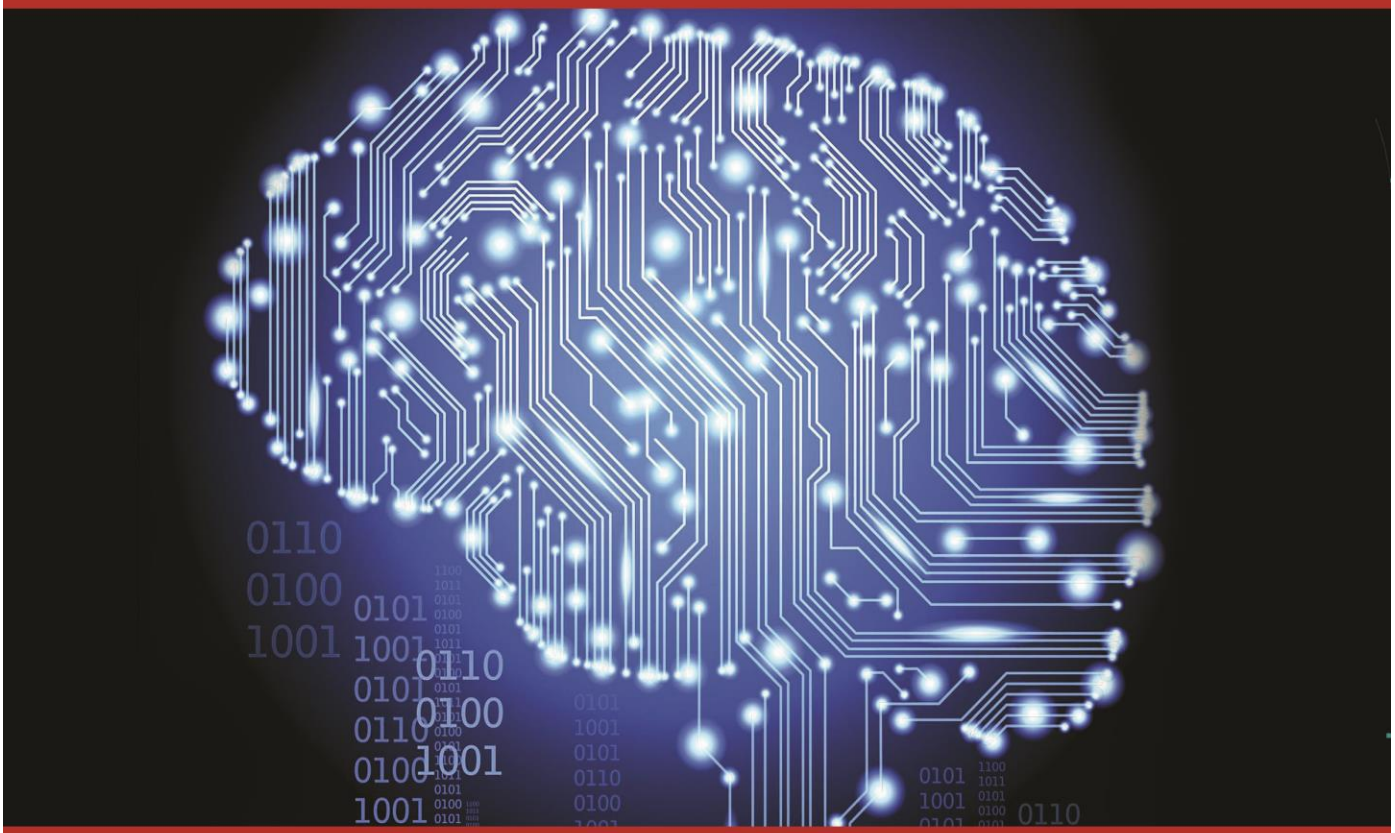
ISSN : 2454-1311

International Journal of Advanced Engineering Management and Science

(IJAEMS)

An Open Access Peer Reviewed International Journal

Vol. - 5 Issue - 2 Feb, 2019



Journal DOI: 10.22161/ijaems

Issue DOI: 10.22161/ijaems.5.2

INFOGAIN PUBLICATION

http://www.ijaems.com/ | editor@ijaems.com

Editorial Board

International Journal of Advanced Engineering, Management and Science (IJAEMS)

(ISSN: 2354-1311)

DOI: 10.22161/ijaems

Vol-5, Issue-2

February, 2019

Editor in Chief

Dr. Uma Choudhary

Publisher

Infogain Publication

Email: ijaems.editor@gmail.com ; editor@ijaems.com

Web: www.ijaems.com

FOREWORD

I am pleased to put into the hands of readers Volume-5; Issue-2: Feb, 2019 of **"International Journal of Advanced Engineering, Management and Science (IJAEMS) (ISSN: 2354-1311)" ,** an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Dr. Uma Choudhary
Editor-in-Chief
Date: March, 2019

https://dx.doi.org/10.22161/ijaems.5.2.1 ISSN: 2454-1311

Determination of Nitrogen Quantities in the Aminoacid Fertilizer with Kjeldahl Device

Elif Esra ALTUNER[1], Yener TEKELİ[2]

[1]Department of Chemistry, Faculty of Science, Selçuk University, Konya-Turkey
[2]Department of Pharmacy Technology, Faculty of Pharmacy, Adıyaman University, Adıyaman, Turkey
*Corresponding author's e-mail: ee_altuner@hotmail.com

***Abstract*—** *Nitrogen is the most important feed source for plants an essential element for plant growth and development (LiuCW et al.- 2014) because the cells are made of nitrogen. It is seen enhance in plant growth in the absence of nitrogen. Therefore, the most important nutrient source of the plant is nitrogen containing fertilizers. Fertilizers are divided into two main parts; organic fertilizers and chemical fertilizers. Organic fertilizers are healthier than chemical fertilizer because it does not conclude chemical substance. All cells are eminent from protein and many of amino acids carry out protein sequence. And amino acids has nitrogen (N) element In general, the nitrogen element is derived from amino acids in organic fertilizer sources from animal waste or vinasse. Nitrogen analysis is the most healthy method to determine with Kjeldahl instrument. The Kjeldahldevice is a nitrogen meter that determines the amount of nitrogen in the fertilizer. The nitrogen content of the Kjeldahlapparatus was determined by the amount of amino acids contained in the extract. Amino acids used as commercial fertilizers are amino acids used in the L-conformation in optical conditions, which are generally produced in laboratory conditions. Lysine is the main one.*

***Keywords*— Aminoacid fertilizer, nitrogen, Kjeldahl device, Nitrogen meter.**

I. INTRODUCTİON

In order to obtain more and higher quality products and to improve the physical and chemical properties of the soil, fertilizer is called artificial organic fertilizer which contains plant nutrients.

With fertilization, the soil is enriched with plant nutrients. Water saving and ventilation is provided to the soil. The buffering properties and exchange capacity of the soil are regulated.

Both humans and animals need to increase the quality of agricultural materials.Fertilizers are divided into organic and chemical.

Organic fertilizers are divided into nitrogen fertilizers, phosphorus fertilizers, potassium fertilizers, trace element fertilizers, secondary element fertilizers and mixed fertilizers.

In this study, aminoacids fertilizer was studied as an artificial organic fertilizer.Due to the amino acid chains in its content, the amino acid fertilizer at hand contains three main nutrients,nitrogen, phosphorus and potassium. Since the amount of amino acid in the sample of this sample of lacquer is not known, this rich nitrogen analysis has been done.

Fertilizers are divided into organic and chemical fertilizers.

Chemical fertilizers are derived from urea, mono ammonium phosphate, di ammonium phosphate, nitric acid, potassium sulphate, potassium nitrate, boric acid, zinc sulphate hepta hydrate, manganese sulphate mono hydrate, iron sulphate hepta hydrate,copper sulphate hepta hydrate and many sources etc.

Organic fertilizers are made from animal and plant materials, including manure, worm castings, peat, seaweed, aminoacid and humic acid to name a few. Using organic fertilizers has been found to improve soil structure, microbial biomass and may lead to increased agriculture output *(Sarker et al.- 2012) (Wiens JT-2107)*. In addition, some organic fertilizer have high nutritional elements that enhance plant growth and yields, while organic fertilizers may often be less expensive when compared to chemical fertilizers *(Mantovi et al- 2005)*. *According to (Pascual et al-, 1997)* and *(Allenk et a.l-1998)*, soil organic matter is an essential source of nutrients in order to maintain high microbial populations and activities in the soil. This in turn increases biomass for efficient basal respiration as well as improves total organic ratio in the soil. Animal manures, yard wastes, food wastes and compost are organic resources that are used to provide nutrients for plant growth and yield as well as maintain the fertility of the soil *(Arancon et al.-2005*). Furthermore, residue and animal manure applications may lead to high crop production rates *(Johnston et al- 1995)*

Organic fertilizers are divided into organic, unnatural organic and organic fertilizers, while chemical

https://dx.doi.org/10.22161/ijaems.5.2.1 *ISSN: 2454-1311*

fertilizers are divided into nitrogen fertilizers, phosphorus fertilizers, potassium fertilizers, trace element fertilizers, secondary element fertilizers and mixed fertilizers. In this study, an amino acid fertilizer was studied as an artificial organic fertilizer. Due to the amino acid chains in its content, the aminoacid artificial fertilizer at hand contains three main nutrients, nitrogen, phosphorus and potassium. Since the amount of amino acid in the sample of this sample of lacquer is not known, this rich nitrogen analysis has been done.

The three main plant nutrients, N-P-K should contain high amounts of Ca, Mg, S and other micronutrient elements at the sametime.

It should be hard, round-grain (about 0.25 cm in diameter). It should not be affected by moisture as much as applied to the soil but it should be immediately soluble when applied to dry soils and should be fully usable for short season crops. Acidic soils should be given alkaline and alkaline soils should be given acidic fertilizers.

Once organic fertilizers are applied to soils and mineralization begins, inorganic nitrogen is released and absorbed by plants.*(WiensJ.T-2107)*. However, the rate of mineralization is controlled by several factors, including agriculturalmanagement, microorganism, soil properties, temperature, and water content*(Griffin TS-2008)*, *(Dessureault-Rompré J.-2010)*,*(Fan XH et a.l-2010)* as well as the type of organic fertilizer *(Lobell DB-2007)*. Many models have been developed to predict the release of nitrogen in applied organic fertilizers

Such standards, which matrix is commutable with patients´ samples, compensate for the offset caused namely by lipids and bilirubin in most normal and partly in pathological patients sera and fertilizer samples *(Vinlarkova B. et al.-2015)*.

II. MATERİAL AND METHOD

Nitrogen fertilizers are the most important fertilizer class.The most important nitrogen source is air. There is nitrogen in the air at 70%.

But plants can not take nitrogen directly from air. For this reason, nitrogen is supplied to the plants through fertilizers. The most useful nitrogenous fertilizers are amino acid fertilizers. Through the use of amino acid fertilizer, both the protein requirement and the nitrogen requirement of the plant are ensured. *(Vinklarkova B et al.-2015)*

There are 2 main classes of N fertilizers, solid and liquid.*(Yoder N.-2014)*. Solid fertilizers are often incorporated into the soil before planting, liquid is generally applied post planting and is frequently applied season-long through irrigation. All of these organic materials are rich in slowreleasing organic N and the rate of mineralization make it difficult to predict when planning to meet crop uptake needs. In a 2006 study by Hartz and Johnstone, fish powder, blood meal and feather meal were all found to have very high levels of organic N (93%-99% of total N was in organic form). These fertilizer types and their application methods may provide N at different rates because they rely on soil microbes to convert organic N into inorganic N forms such as ammonium (NH4 +) and nitrate (NO3 -) prior to plant uptake *(Gaskell at al.- 2007) (Yoder N.-2014)*.

In this study, the ratio of an amino acid containing gibbic nitrogen, which is present in the sample but whose nitrogen content is unknown, was analysed.

The Kjeldahldevice is assisted to determine the nitrogen content. *(Vinlarkova B. et al.-2015)*.

The Kjedahl device we use is the Buchi Speed Digester K-436/K-439. It is seen at fig 1 Kjeldahl device. *(Operation manual SpeedDigester K-425 / K-436)*

The Kjeldahl method was named after Johan Kjeldahl, who in 1883 developed the method for analysing nitrogen in organic substances. After historical improvement, nowadays Kjeldahl method can be divided into three main steps: digestion, distillation, titration. In the first step, sample is digested by sulphuric acid in the presence of catalyst to ammonia sulphate*(LejskovaB.-2016)*.

Organic N $\xrightarrow{H_2SO_4}$ $(NH_4)_2SO_4 + H_2O + CO_2 + H_2SO_4$ +matrix by-products

All ammonia sulphate is converted in the distillation step into ammonia*(LejskovaB.-2016):*

$(NH_4)_2SO_4 + NaOH \rightarrow 2NH_3 + Na_2SO_4 + 2H_2O + NaOH$

The liberated ammonia is distilled into a suitable receiving slution with boric acid, acidimetric indicator and water*(LejskovaB.-2016*):

$NH_3 + H_3BO_3 \rightarrow NH_4H_2BO_3 + H_3BO_3$

The ammonium dihydrogen borate is titrated by sulphuric acid*(LejskovaB.-2016):*

$2NH_4H_2BO_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_3BO_3$

As boric acid captures ammonia gas, the colour of the indicator changes*(LejskovaB.-2016)*.

Such a method is the determination of soil quality according ISO 11261:1995*(ISO 11261:1995 soil Quaility-2016)*. This standard method was used to investigate the relationship between Kjeldahl nitrogen and organic carbon and to compare the methods for the determination of inorganic carbon by using dry combustion, loss on ignition and volumetric calcimeter in samples from river systems with low inorganic carbon content. Results from this article verified also proper function of apparatus*(Regulation (EC) No 2003/2003)*.

https://dx.doi.org/10.22161/ijaems.5.2.1 *ISSN: 2454-1311*

Fig.1: The Kjeldahl apparatus Buchi digester K 436/ K 439 , in which the nitrogen is determined by the amino acid stain (Operation manual SpeedDigester K-425 / K-436)

Firsly, we wanted that porduce our fertilizer that content amino acid fertilizer. For this, all equipments of fertilizers were provided from İgsaş A.Ş-Turkey.

3 gram manganese sulphate mono hydrate were stirred in 54 grams distilled water until solving. Then, 12 grams iron sulphate hepta hydrate were added until solving. Then, 23 grams zinc sulphate hepta hydrate and 2 grams copper hepta hydrate were added with 0.60 gram sodium molybdate. Sodium molybdate were used for chelate. Finally, 4 grams amio acids (lysine) were added until solving.

We determinated nitrogen ratio of this fertilizer sample by Kjeldahl method.

Determination of Nitrogen

Nitrogen is found in many important substance as protein, fertilizer, explosives, drugs , pesticides and waters.

The most popular method for determining nitrogen is Kjeldahl method, devolop in 1883. It is based on the conversion of the bounded nitroge to ammonia (NH_3)which is then separated by distillation and determinated by titration.*(Chromy V. et al-2017)*

We carried out nitrogen determination analysis by Kjeldahl appratus (fig 1) . And the needed chemicals were used that hydrogen chloride, sulphuric acid, sodium hidroxide ,kjeldahl tablets - each tablet 2grams - and the needed apparatus were used that weighing balance, kjeldahl appratus, volumetric flask, wask bottle, isomental, pipette, burette, pipette filler, magnetic stirrer, magnetic barr, beaker, funnel.

The hydrochloride acid, the sulphuric acide and the sodium hydroxide were used from sigma- aldrich.

The kjeldahl apparatus, Kjeldahl tablets , weighing balance, volumetric flask and the boric acid, were used from Anamed& analytic group Ltd, Turkey.

The burette, pippette, burette stand, pipette filler, magnetic stirrer, magnetic barr, beaker, isomental and funnel were used from Labkon Ltd. Sti , Turkey.

For the 0.1 N HCl Solution Preparation we took9,86 in a 100 ml volumetric flask make up with distilled water*(Chromy V. Et al- 2015)*.

Forthe standardization of HCl titrate it against standardized 0,1 N NaOH solution.

At the end pointcolourless of NaOH used x Normality (0,1 N)/ Volume of HCl (10 mL)

For 0.1 N NaOH Solution we took 4 gm of analtycal grade NaOH in 1 L vol. Flask make up with distilled water &sonicate for 10 minutes.

For boric Acid '% percentage Solution we took 20 mg boric acid in a 1000 Volumetric Flask, add some distilled water and heat some time to dissolve the Boric Acid, make up with distilled water&sonicate for 20 mins.

For the 32% NaOH Solution we took 32 gm NaOH in a 100 volumetric flask and add some distilled water to dissolve NaOH, cool to room temperature&make up with distilled water.To prevent to contamination by aerial ammonia, all reagents and solution were kept in tightly bottles and closed the Kjeldahl reaction immediately before use *(Vinklarkova B. et al-2015)*.

Analysis Method:

For the sample digestion we took 0,7 g of sample in a Round Bottom Flask, then add 2 g of digestion Mixer in it, Rinse with water if necessary .

Add 15 mL of commercial H_2SO_4 in it and heat the sample for 1 hour 10 minutes at 100˚C, and then 45 minutes at 70-80 ˚C*(Vinlarkova B. et al.-2015)*.

Cool digested sample to room temperature and add 70 mL distilled water in it (by adding water temp. Raised to 80˚C. Again cool sample to room temperature.)

Setting up KJELDAHL Apparatus for distilation:

Take 200 ml 2% Boric Acid solution in the beaker and dip condenser in the beaker. Add 2 g devarda's Alloy in sample and then add 70 ml 32% NaOH solution drop by drop with dropping funnel after complete addition, swicth on Isomenta and start distillation. Distillate the sample for 1,5 hours at 100˚C.

And the titration was carried out. For this, titrate distillate with 0,1 N standardized HCl.

https://dx.doi.org/10.22161/ijaems.5.2.1 *ISSN: 2454-1311*

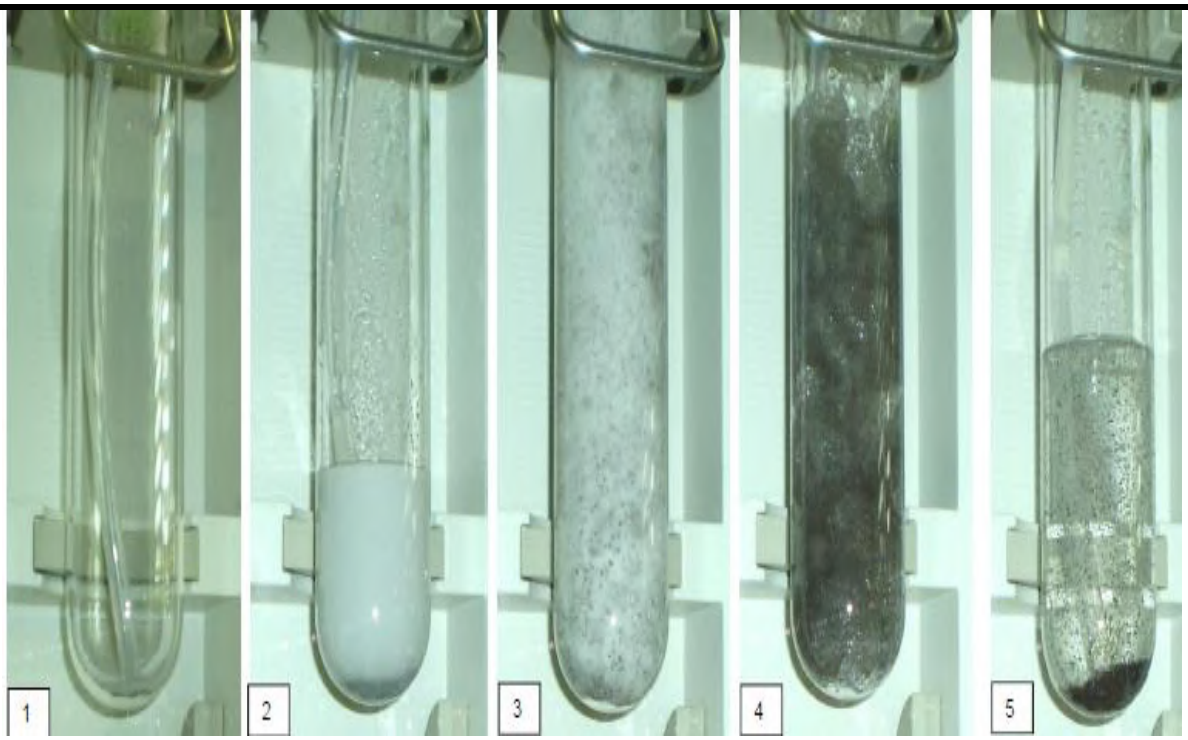


Fig.2: Devarda process at Kjeldahl device

III. RESULTS AND DİSCUSSİON

The digestion system was preheated at 420 ˚C and the samples were digested for 120 minutes at the temperature prior to distillation*(Operation manual SpeedDigester K-425 / K-436)*.

If the samples are not analysed on the same day, dilute them with 50 ml of water in order to prevent crystallization. Otherwise, the reaction with the concentrated acid is violent and the sample may be lost. Gently swirl the tube to mix the digested sample with the water .

Distillation and boric acid titration

The Kjeldahl device unit was set according to the parameters list in the table 1

Table.1: The parameters of the used Kjeldahl apparatus

Distillation		**Titration**	
Water	80 mL	Type	Boric acid
NaOH	90 mL	Titration solvent	H_2SO_4. 5N
Reaction time	5 s	Volume receiving solvent	60 mL
Distillation time	300 s	Min.titration time	1 s
Digested sample	+	Min.titration volume	40 mL
Reaction solution	+	Titration mode	standart
Stirrer speed	5	Stirrer speed	7
-	-	Titration pH measurement type	Endpoint
-	-	Endpoint type	4.65

Firstly, we wanted before the determination of our nitrogen of fertilizer, we tried the Kjeldahl device for sodium nitrate (table 2)

Table.2: The results of the determination nitrogen content in sodium nitrate are presented

Sample	**m-sample(g)**	**V-sample (mL)**	**% N**	**Recovery Rate %**
Sample1	0.2571	6.321	16.646	101.5
Sample2	0.2505	6.039	16.296	99.36
Sample3	0.2515	6.074	16.328	99.56
Sample4	0.2512	6.067	16.328	99.27

https://dx.doi.org/10.22161/ijaems.5.2.1 *ISSN: 2454-1311*

Sample5	0.2575	6.196	16.28	99.55
Sample6	0.25	6.038	16.326	99.56
Sample7	0.2524	6.068	16.254	99.11
Sample8	0.2574	6.214	16.341	99.64
Sample9	0.2563	6.214	16.373	99.65
Sample10	0.2568	6.107	16.342	99.78
Sample11	0.2527	6.143	16.364	99.82
Sample12	0.2539	6.253	16.271	99.64
Sample13	0.2585	6.237	16.341	99.78
Sample14	0.2583	6.201	16.363	99.82
Sample15	0.2564	6.117	16.36	99.8
Sample16	0.2527	6.110	16.363	99.65
Average (%)	-	-	16.35	99.7
SD	-	-	0.5	0.5
Rsd(%)	-	-	0.3	0.3

Finding conlusions were presented table 3. We found the the nitrogen ratio of amino acid 3.13% (˜3%).

Table.3: The conclusion as to parameters of the sample

	Weight (g)	**Weight (g)**	**Weight (g)**		
Weight	0.8510	0.7580	0.8967		
Blind(mL)	0.2	0.2	0.2	**Average**	
VH_2SO_4.N0,5	3.1	3	3.3	3.13	

The amino acid content of unknown nitrogen fertilizer content was determined as 3% in the Kjeldahl instrument again. We repeated same analysis again by Kjeldahl device.

We used the volume of sample titrant (HCl) 50ml, volume of sample blank 49,7 ml and normality 0,5 N for the 0.7 g amino acid sample.

We calculated the conclusion following this equality:

Nitrogen %= (Volume of sample titrant-Volume of titrant blank) x Normality x1,401 /Weight of Sample

Nitrogen %=(50mL-49,7 mL)x 1,401x 0,5 N / 0,7 g
=3
Nitrogen %= 3.

According to these two-repeated samples our amino acid ratio fertilizer is 3%.

IV. CONCLUSİON

We can say all nitrogen analysis of fertilizers and food can analysis with Kjeldahl device apparatus. Kjeldahl apparatus give us the ratio of nitrogen true. Also, the new methods of this apparatus can improve for different fields.

The Kjeldahl method for determination is referred in all standard textbooks of clinical chemistry as a clasical method generally accepted as reference method on which other methods are based *(Chromy V. et al.- 2015) (Vinklorkova B. et al.- 2015)*

Data Availability

The data used to support the findings of this study are available from corresponding upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Disclosure

The research did not receive specific funding, but was performed as part of employment of the company Sector Agriculture A.Ş, Konya, Turkey..

REFERENCES

[1] Allen, Michael F, & Zink, Thomas A. ,The effects of organic amendments on the restoration of a disturbed coastal sage scrub habitat. Restoration Ecology, 6(1), 52-58-1998

[2] Arancon, Norman Q, & Edwards, Clive A. ,Effects of vermicomposts on plant growth. Soil Ecology Laboratory, The Ohio State University, Columbus, OH, 43210 -2005

[3] Cheng-Wei L., Yu S., Bo-Ching C., Hund-Yu La- Effects of Nitrogen Fertilizers on the Growth and Nitrate Content of Lettuce (*Lactuca sativa* L.) – China-2014

[4] Chromy V., Vinklarkova B., Sprongl L., Bittova M., Zaludova L., Changes in Proteins Noticed in

https://dx.doi.org/10.22161/ijaems.5.2.1 *ISSN: 2454-1311*

Reconstituted Freeze-Dried Reference Materials Used in Clinical Chemistry as Calibrators and/or Controls, Klin. Biochem. Metab, Checzh Republic-2016

[5] Chromy V., Vinklarkova B., Šprongl L., Bittova M.: The Kjeldahl method as a primary reference procedurefor the determination of total protein in certified reference materials used in clinical chemistry. I. A Review of Kjeldahl Methods Adopted by Laboratory Medicine. Crit Rev Anal Chem, 45: p. 106–111. , Checzh Republic ,-2015

[6] Dessureault-Rompré J., Zebarth B.J., Burton D.L., Sharifi M., Cooper J., Grant C.A., Drury C.F. Relationships among mineralizable soil nitrogen, soil properties, and climatic indices. Soil Sci. Soc. Amer. J. ;74:1218–1227.-2010

[7] Fan X.H., Li Y.C. Nitrogen release from slow-release fertilizers as affected by soil type and temperature. Soil Sci. Soc. Amer. J. ; 74:1635–1641 -2010

[8] Gaskell, M. and R. Smith., Nitrogen sources for organic vegetable production. HortTechnology 17:431–441.- 2007

[9] Griffin T.S. Nitrogen Availability. In: Schepers J., Raun W.R., editors. Nitrogen in Agricultural Systems.SSSA Inc. and ASA Inc.; Madison, WI, USA. pp. 613–646-2008.

[10] ISO 11261:1995: Soil quality – Determination of total nitrogen – Modified Kjeldahl method, [online]. [cit 10. 7. 2016]

[11] Johnston, AM, Janzen, HH, & Smith, EG.,Long-term spring wheat response to summerfallow frequency and organic amendment in southern Alberta. Canadian Journal of Plant Science, 75(2), 347-354-1995

[12] Lejskova B., Optimization of the determination of total protein in biological samples and reference materials used in clinical chemistry, Phd Thesis, MAsaryk University,Departmenf of Chemistry , Czech Republic-2016

[13] Mantovi, Paolo, Baldoni, Guido, & Toderi, Giovanni. Reuse of liquid, dewatered, and composted sewage sludge on agricultural land: effects of long-term- application on soil and crop. Water research, 39(2), 289-296. -2005

[14] Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers (Text with EEA relevance), [online]. [cit 10. 7. 2016] http://eur-lex.europa.eu/homepage.htm

[15] Operation manual SpeedDigester K-425 / K-436

[16] Lobell D.B. The cost of uncertainty for nitrogen fertilizer management: A sensitivity analysis. Field Crop. Res. 2007;100:210–217 -2007

[17] Pascual, JA, Garcia, C, Hernandez, T, & Ayuso, M.,. Changes in the microbial activity of an arid soil amended with urban organic wastes. Biology and Fertility of soils, 24(4), 429- 434. -1997

[18] Sarker, Ashoka, Kashem, Md Abul, & Osman, Khan Towhid. Comparative Effect of City Finished Compost and NPK Fertilizer on Growth and Availability of Phosphorus to Radish (Raphanus sativus L.). Open Journal of Soil Science, 2(02), 146.-2012

[19] Wiens J.T , Agronomic and Enviromental Effectsof Phosphorus Fertilizer Application Methods, Msc Thesis, University of Saskatchewan, Saskatoon-2017

[20] Vinklarkova B., Chromy V., Sprongl L., Bittova M., rikanova M., rikanova M., Ohnutkova I., Zaludova L., The Kjeldahl Method as a Primary Reference Procedure for Total Protein in Certified Reference Materials Used in Clinical Chemistry. II. Selection of Direct Kjeldahl Analysis and Its Preliminary Performance Parameters. Critical Reviews in Analytical Chemistry, Checzh Republic – 2015

[21] Vinklarkova B., Chromy V., Bittova M., Sprongl L., Zaludova L., Simplified direct Kjeldahl method suitable as a primary reference procedure for the determination of total protein in reference materials used in clinical chemistry, Klin. Biochem. Metab., Checzh Republic -2015

[22] YoderN., Organic Fertilizer Comparison on Kale (Brassica spp.) Varietal Growth and Nutrient Content, Msc Thesis, Department of Horticulture, Colorodo-2014

https://dx.doi.org/10.22161/ijaems.5.2.2 ISSN: 2454-1311

Fluctuation of NO_3-N and PO_4 Elements in The Traditional Pond Area at Tides

Abdul Malik[1,2,*], Kadarwan Soewardi[3], Ridwan Affandi[3], Sigid Hariyadi[3], Majariana Krisanti[3]

[1]Study Program of Aquaculture, Makassar Muhammadiyah University, Indonesia
[2]Study Program of Aquatic Resources Management, Postgraduate School, Bogor Agricultural University, Indonesia
*email : akademik.malik@gmail.com
[3]Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University, Indonesia

Abstract**—** *Traditional pond technology depends on nature in management, such as filling and disposal of pond water utilizing the time of low and high tides. The food for traditional pond technology comes from nature. The availability of nutrients such as N and P greatly determines the productivity of pond. The study was aimed to determine the fluctuations of N and P elements in traditional pond areas at tides. This research was conducted with purposive sampling method and laboratory analysis for several water parameters. The results showed that pH ranged from 7 to 8 both at low tide and high tide. The average value of nitrate (NO_3) from five locations was extended from 0.106 to 1.495 mg/l. The value of silica (Si) ranged from 5,287 to 10,876 mg/l in low tide. Orthophosphate at low tide ranged from 0.027 to 0.090 mg/l, the highest value was in the coast station and the lowest was in the sea station. Whereas the value of nitrate (NO_3) and orthophosphate in high tide ranged from 0.830 to 1.495 mg/l and 0.039 to 0.090 mg/l. Nutrients were abundant enough to support the growth and development of primary producers. So, the waters in this region include fertile waters.*

Keywords**— high tide, low tide, nitrate, phosphate, traditional pond.**

I. INTRODUCTION

Indonesia is the country with high potential of marine and fisheries resources. One of the potential is aquaculture sector with shrimp commodity in the coastal area. The area of shrimp farms in Indonesia is currently 344,759 ha or 39.78% from the total of potential land which is spread throughout Indonesia (Arifin et al. 2012). Currently, the various technologies of shrimp cultivation have developed rapidly from the simplest to the most modern technology.

One of the technology in pond cultivation is traditional pond that is widely used by Indonesian people. The traditional pond technology is largely dependent on nature, such as filling and disposal of pond water utilizing the time of low and high tides. Water quality plays a major role as a medium of cultivation. The cultivation requires sea water as a medium that is highly dependent on the quality of optimal water supply. Changes of water quality are closely related to potential waters in the availability of N and P elements.

The nitrate and phosphate content of coastal waters is used as a benchmark for aquatic fertility. When the content was optimal, the phytoplankton is more abundant (Mustofa 2015). Risamasu and Prayitno (2011) also state that nitrogen (N) and phosphorus (P) play an important role in the growth and metabolism of phytoplankton including plants autotrophs. Nutrient enrichment in the aquatic environment has a positive impact, but it can also have a negative impact in certain level. The positive impact was an increase in phytoplankton production and total fish production (Jones-Lee and Lee 2005; Gypens et al. 2009). While the negative impact is a decrease in oxygen content in the waters, decreasing biodiversity, and sometimes increasing the potential appearance and development of dangerous phytoplankton species commonly known as Harmful Alga Blooms or HABs. Therefore, environmental preservation around traditional pond areas needs to be considered. According to Abraham and Sasmal (1995), traditional pond productivity depends on the quality of coastal resources around it.

Coastal areas with river estuaries have their own characteristics. The hydrodynamic process such as currents and tides causes the distribution pattern and concentration of organic matter to vary in different location. The result study from Lihan et al. (2008) find that strong currents expand the distribution of nutrients, which can move elsewhere.

Traditional farms are generally still adjacent with mangrove forests. The mangrove forests are thought to provide or contribute to fertilizing the surrounding waters. Mangrove ecosystems serve as a place to nurture larvae, breeding sites and food sources for various aquatic species, especially shrimp and milkfish (Sikong 1978). Mangrove litter as a source of organic matter is very important in the

https://dx.doi.org/10.22161/ijaems.5.2.2 *ISSN: 2454-1311*

supply of nutrients through decomposition process by active organisms. Litter decomposition is a very important process in nutrient dynamics in ecosystem (Regina and Tarazona 2001). The study was aimed to determine the fluctuations of N and P elements in traditional fishpond area in Soppeng Riaja Subdistrict, Barru District, South Sulawesi.

II. MATERIALS AND METHODS

Location and Time of Research

The study was conducted in the mangrove forest area of Soppeng Riaja Subdistrict, Barru District, South Sulawesi. This area was partly used for the cultivation of shrimp ponds with traditional technology. Sampling was carried out in May 2017 until February 2018. This research was conducted with post facto survey methods and laboratory analysis for several water parameters. Sampling, preservation, transportation, and water quality analysis were carried out based on Standard Methods for The Examination of Water and Wastewater (APHA 2012). Determination of sampling locations was established with purposive sampling method and the station as follows:

1. Freshwater area (river), this is intended to measure nutrient content from land.
2. Sea area, this is intended to measure the nutrient content in the sea
3. The coastal area is intended to measure nutrient content in the coast
4. The mangrove area is intended to measure the nutrient content in the mangrove ecosystem
5. The pond area is intended to measure the nutrient content in the pond area.

Data analysis

The fluctuations of each variable nitrate and phosphate at different locations were using correlation and regression. The analysis employed SPSS version 22.

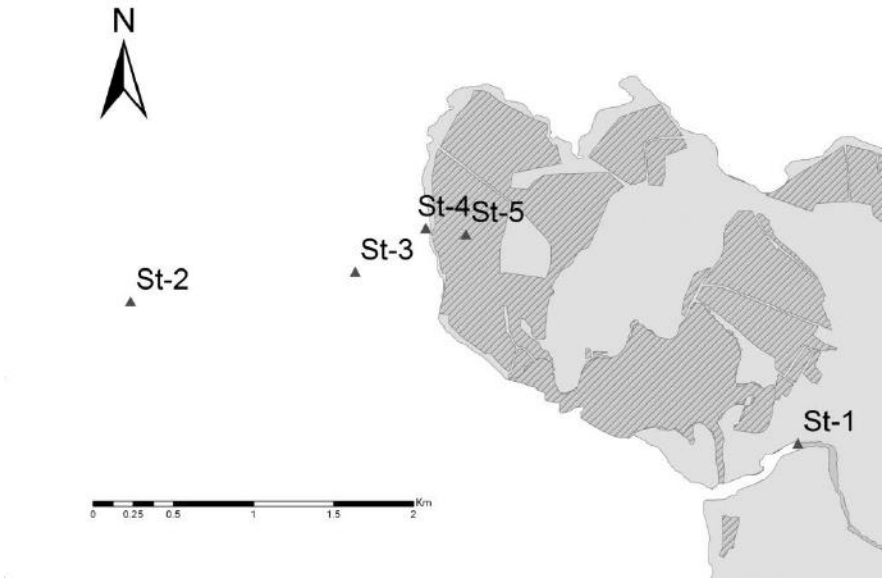


Fig.1: Location of water sampling station in Soppeng Riaja Sub district, Barru District, South Sulawesi, the sampling location st 1 (4°15'19.08'S, 119°36'58.32'E), st 2 (4°14'50.28'S, 119°34'43.32'E), st 3 (4°14'44.52'S, 119°35'28.68'E), st 4 (4°14'35.52'S, 119°35'43.08'E), and the st 5 (4°14'36.96'S, 119°35'51'E).

The sampling used purposive sampling method that could represent the overall state of the research area. Water sampling at each station was carried out in three replications and carried out during high and low tides with a one-month interval. Taking water samples used Nansen bottles, then water samples were stored in the cool box, and analyzed in the laboratory of the Brackish Aquaculture Research Institute (BPPAP) in Maros, South Sulawesi. Dissolved oxygen levels were measured by DO meter, the degree of acidity (pH) was measured by a pH meter and salinity was measured by refractometer.

Table.1: The parameters of water quality

No	Parameters	Unit	Tools	Methods	Description
Physics					
1.	Temperature	˚C	Thermometer	Expansion	*In-situ*
2.	Brightness	meter	*Secchi disk*	Visual	*In-situ*
3.	Rainfall	mm/day	Secondary data	-	
4.	Tides		Tides bar	Visual	*In-situ*

https://dx.doi.org/10.22161/ijaems.5.2.2 *ISSN: 2454-1311*

Chemistry					
5	pH	-	pH meter	Electrode	*In-situ*
6	Salinity	‰	Refractometer	Light refraction	*In-situ*
7	Nitrate (NO_3^-)	µmol/L	Spectrophotometer	Ultraviolet light	*Ex-situ*
8	Silicate (SiO_2)	mg/L	Spectrophotometer	Ultraviolet light	*Ex-situ*
9	DO	mg/L	DO meter	Electrode	*In-situ*
10	Orthophosphate	mg/L	Spectrophotometer	Ultraviolet light	*Ex-situ*

III. RESULTS AND DISCUSSION

The results of measurements and laboratory analysis of the physical and chemical parameters were presented in Tables 2 and 3. Based on the results, water temperature at low tide ranged from 27-29°C with the highest value in the sea station and the lowest value in the mangrove station. The temperature at high tide ranged from 27-30°C with the highest value in the sea station and the lowest value in the mangrove station. Temperature influenced the biological and chemical processes of aquatic organisms. In the tropical area, temperature range was very reasonable and the difference between the lowest and highest temperatures was not far. It did not have much effect on the metabolic process in waters. When light penetration entering into the waters decreased, it would reduce phytoplankton activity to photosynthesis (Abida 2010).

The results of salinity measurements at low tide ranged from 27-32 ppt, whereas in rivers the salinity value at low tide was 0 ppt. In high tide, salinity ranged from 30-33 ppt and salinity in the river rose to 11 ppt. This condition indicated that the flow or strength of entering fresh water is greater than the entering tide. According Wisha et al. (2015), currents made the main transport of waters that weak currents created weaker transport. The main parameter in studying seawater mass was salinity, salinity was greatly affected by high salinity at high tide and the amount of freshwater concentration in the waters.

The pH ranged from 7–8 at low tide and high tide. The degree of acidity (pH) of water indicated the presence of hydrogen ions in water. This was caused hydrogen ions acidic. Most aquatic biota was sensitive to changes in pH and like around 7–8.5 (Effendi 2003). Referring to this opinion, the pH of the water could still support the life of aquatic biota and could live well.

Table.2: Average range of several water quality parameters in the mangrove forest in Soppeng Riaja Subdistrict, Barru District, South Sulawesi, during low tide

Station	Parameter						
	Temperature	pH	Salinity	Nitrate	Si	DO	Orthophosphate
Sea	29.98	8.110	32.906	0.524	6.439	6.986	0.027
Coastal	29.26	7.933	30.450	0.818	10.876	7.072	0.086
Mangrove	27.96	7.941	29.863	0.402	7.977	6.633	0.062
River	29.71	8.067	0.000	0.106	9.627	7.228	0.049
Pond	29.66	7.493	27.896	0.231	7.038	6.867	0.044

Table.3: Average range of several water quality parameters in the mangrove forest in Soppeng Riaja Subdistrict, Barru District, South Sulawesi, during high tide

Station	Parameter						
	Temperature	pH	Salinity	Nitrate	Si	DO	Orthophosphate
Sea	30.51	8.113	33.039	0.830	5.287	6.956	0.049
Coastal	28.67	8.033	32.339	0.980	6.512	7.078	0.039
Mangrove	27.88	7.859	31.359	1.495	7.433	6.411	0.090
River	29.93	8.106	11.272	0.970	6.676	7.089	0.039
Pond	29.41	7.356	30.281	1.063	6.850	6.633	0.047

The results of temperature around the mangrove ecosystem at low tide showed that the water temperature ranged from 27.96–29.98°C, while the temperature at high tide ranged from 27.88–30.51°C. The temperature conditions were still within the water quality standard of Government Regulations Number 82 in 2001. High and low water temperature was influenced by the temperature in surrounding air, the exposure intensity of sunlight entering water body, and the surrounding vegetation. The intensity of sunlight was influenced by cloud cover, season, and time of day. The more intensity of sunlight would make the water temperature higher. Likewise, more close vegetation around it would make the surrounding air

https://dx.doi.org/10.22161/ijaems.5.2.2 *ISSN: 2454-1311*

temperature lower so that the water temperature also got lower.

An increase in temperature would cause a rise in the metabolism and respiration speed of aquatic organisms resulting in improved oxygen consumption. The increase in temperature also caused an increase in the composition of organic matter by microbes. This condition was impacted to increase the BOD levels in water. The optimum temperature for phytoplankton growth in waters ranged from 20–30°C (Effendi 2003). This showed that the water temperature conditions around the mangrove area did not interfere to phytoplankton growth. Water temperature could affect to dissolved oxides (DO) in these waters (Aprianti et al. 2015). Dissolved oxygen (DO) at low and high tide in five stations ranged from 6.4 to 7 mg/l. DO levels that safe for marine biota based on Decree of the State Minister of the Environment Number 51 of 2004 were > 5 mg/l, DO concentrations in this study were safe for marine biota.

Test Result of Chemical Parameters

Nitrate (NO_3)

Nitrate was the main form of nitrogen in the waters and the main nutrient for plant growth and algae. Nitrate nitrogen was very easy to dissolve and stable in water (Effendi 2003). Results of nitrate in the mangrove area during low tide and tide were showed in Figure 2.

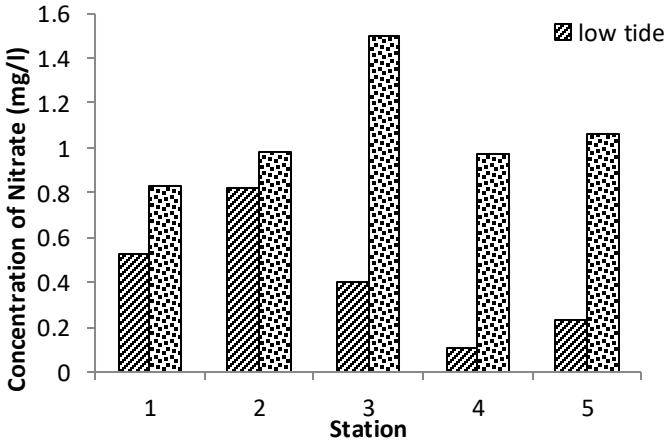


Fig.2: Nitrate levels at low and high tide in five stations

The average value of nitrate (NO_3) at low tide from five locations ranged from 0.106-0.818 mg/l with the highest value in the coastal station. While, the value at high tide ranged from 0.970-1.495 mg/l with the highest value at the pond station followed by mangrove station. The coastal stations at low and high tide have high nitrate levels, while mangrove stations were high concentration at high tide. Mustofa (2015) suggested that nitrate (NO_3) was highest in locations near mangroves. The waters that have mangrove vegetation supported the fertility of the waters with abundant elements from the mangrove litter. The distribution of nitrate concentrations was influenced by the season which affected to the tides (Ahmad et al., 2012). Nitrate concentration in general was still high in coastal areas and mangrove areas compared to marine waters (Patty et al. 2015). Suprapto et al. (2014) stated that river flows contributed to the process of nutrient availability in the waters.

Based on the quality standards (Decree of the State Minister of the Environment Number 51 of 2004), the nitrate levels in waters were 0.008 mg/l. Nitrate concentrations in this study were exceed quality standards. From these data indicated that the traditional pond waters of Soppeng Riaja Subdistrict, Barru District, South Sulawesi, were under pressure in the form of nitrate enrichment and potentially caused algal bloom. The fertility level of waters was strongly influenced by the nutrient content. The amount of NO_3 content would affect to marine population that required nutrients as the main ingredient in their life process. Isnaeni et al. (2015) suggested that the nitrate content was getting lower towards the sea. Based on Table 4, nitrate correlation analysis at low tide and pairs with a correlation coefficient of 0, 754, with a Sig (0.019) <α, it can be concluded that nitrates at low and high tide have a significant. Regression analysis with Sig (0.051), linear model at low and high tide variables with significant.

Silica (Si)

Silica (Si) was one of the essential elements for living things. Some algae, especially diatoms (Bacillariophyta), required silica to form a frustule (cell wall) (Effendi 2003).

https://dx.doi.org/10.22161/ijaems.5.2.2 *ISSN: 2454-1311*

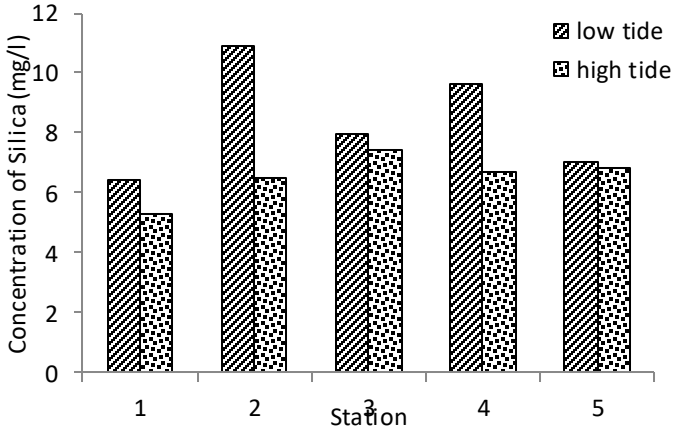


Fig.3: Silica levels at low and high tide in five stations

The measurement results of silica (Si) at low tide from the five locations ranged from 6.439-10.876 mg/l. The highest value was at the coastal station and the lowest at the sea station. The silica value at high tide ranged from 5.287-7.433 mg/l with the highest value at the mangrove station. Marling (2016) stated that the highest silica (Si) was found in coastal areas and river estuaries. Silica (Si) was an element other than nitrogen and phosphorus which was also important for primary productivity (Papush & Danielsson, 2006). Silica was also a nutrient that acted as a regulator for phytoplankton competition, where diatoms always dominated phytoplankton populations in high silica concentrations (Egge and Aksnes, 1992).

Phosphate (PO_4)

Phosphate in waters was not found in free form as an element, but in the form of dissolved inorganic compounds (orthophosphate and polyphosphate). Inorganic phosphorus compounds found in the mangrove ecosystem area were shown in Figure 4. The average orthophosphate concentration at low tide in five stations ranged from 0.027 to 0.086 mg/l with the highest in the coastal station and the lowest in the sea station. The average orthophosphate at high tide ranged from 0.039-0.090 mg/l with the largest in the mangrove station and the lowest in the coast and river station. At low tide, the current movement tended towards the sea and carries phosphate from river to ocean waters. Maslukah et al (2014) stated that the current movement played a role in nutrient spread. Costa et al (2008) indicated that higher phosphate concentrations near land, were affected by water waste. According to Endiger et al (1998), phosphate in coastal waters was very possible originating from land. Crossland (1983) suggested that seasonal variations didn't hardly affect to phosphate concentrations in waters, but phosphate concentration was more influenced by phosphate use activities such as fertilization and detergents.

Based on the Decree of the State Minister of the Environment Number 51 of 2004 in attachment III, the threshold of phosphate content was 0.015 mg/l. According to Mustofa (2015), the highest concentration of phosphate (PO_4) was in locations near mangroves. The waters that have mangrove vegetation support the abundant fertility of the elements, because the mangrove litter is falling. Marlian (2016) stated that the phosphate (PO_4) element was highest in coastal areas. According to Ulqodry et al. (2010), phosphate compounds naturally originated from the waters themselves through decomposition processes of weathering or plants, residual dead organisms, and waste from livestock or leftover feed with bacteria decomposes into nutrients.

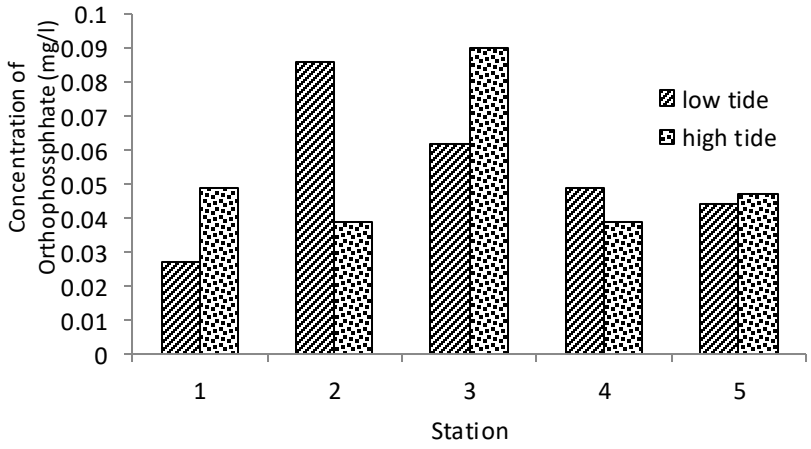


Fig.4: Orthophosphate levels at low tide and high tide

https://dx.doi.org/10.22161/ijaems.5.2.2 *ISSN: 2454-1311*

Based on the concentration of nitrate, phosphate, and silica, the water quality in the traditional pond area of Soppeng Riaja Subdistrict, Barru District, South Sulawesi in general was still relatively good. In addition, high nitrate concentrations illustrated the availability of nitrogen sources for phytoplankton growth. The main inorganic nutrients needed by phytoplankton to grow and multiply in the form of nitrate. The factors that distinguish the productivity of the coastal ecosystem from the open sea were; 1). Coastal waters received a large number of critical elements, namely N and P in the form of NO_3 and PO_4 through runoff from land where the content was more than the water, 2). Shallow, so phytoplankton production could continue, 3). There was rarely a permanent thermocline, so no nutrients were trapped in the bottom of water, 4). There were litter debris originating from land (Nybakken 1998). Phosphate distribution was not different at high and low tide (Budiasih et al. 2015). Phosphorus correlation analysis at low tide and tide shows a small correlation coefficient of 0.410. Sig (0.273)> α. it can be concluded that phosphorus at low and high tide is not significant. Regression analysis with the Sig value (0.161), a linear model between the tide and low tide with insignificant phosphorus values.

IV. CONCLUSION

Nutrient fluctuations in the traditional pond area of Soppeng Riaja Subdistrict, Barru District, South Sulawesi were generally still good. Nutrients were abundant enough to support the growth and development of primary producers. So, the waters in this region include fertile waters. The highest nitrate at low tides was 0.818 mg/l in the coastal station and the lowest was 0.231 mg/l in the pond station. While, the highest and the lowest nitrate at high tides were 1.495 mg/l in the mangrove station and 0.830 mg/l in the sea station. The highest and the lowest phosphorus at low tides were 0.086 mg/l in the coastal station and 0.027 mg/l in the sea station. While, the highest and the lowest phosphorus at high tide were 0.090 mg/l in the mangrove station and 0.039 mg/l in the coastal and river stations.

ACKNOWLEDGEMENT

The authors are thankful to Ministry of Research and Technology of Higher Education, Indonesia for providing BPPDN fellowship for pursuing PhD.

REFERENCES

[1] Abida IW. 2010. Community structure and abundance of phytoplankton in the waters of the Porong River in Sidoarjo. Marine Journal 3 (1): 36-40. [Indonesian]

[2] Ahmad F, Jompa J, Nessa N, Rani C. 2012. Spatio-temporal dynamics of aquatic fertility levels in the Spermonde Islands, South Sulawesi. IX Annual National Seminar on Fisheries and Marine Research Results, 14 Juli 2012. [Indonesian]

[3] American Public Health Association (APHA). 2012. Standard methods for the examination of water and wastewater. 22st Edition. Washington: American Public Health Association.

[4] Aprianti NS, Sulardiono B, Nitisupardjo M. 2015. Study of phytoplankton that potential as HABs (Harmful Algal Blooms). Diponegoro Journal of Maquares 4 (3): 132-138. [Indonesian]

[5] Arifin T, Amri SN, Yulius, Gunawan D. 2012. Research in the ecological-economic approach to increase the productivity of shrimp farms in the straits of Makassar, South Sulawesi Province. Increased Ability of Researchers and Engineers of the Ministry of Maritime Affairs and Fisheries. Jakarta: Research Report and Engineer of the Jakarta Ministry of Maritime Affairs and Fisheries. [Indonesian]

[6] Boyd CE. 1990. Water quality in ponds for aquaculture. Alabama: Birmingham Publishing Co.

[7] Budiasih R, Supriharyono, Muskananfola MR. 2015. Analysis of Organic Ingredients, Nitrates, Phosphates in Sediments in Rhizophora and Avicennia Mangrove Areas in Timbulsloko Demak Village. Diponegoro Journal of Maquares, 4 (3): 66-75. [Indonesian]

[8] Costa Jr OS, Nimmo MJ, Cordier E. 2008. Coastal nutrification in Brazil; A review of the role of nutrients excess on coral reef demise. Journal of South American Earth Science 25 (2): 257-270.

[9] Crossland CJ. 1983. Dissolved nutrients in coral reef waters. In: J D Barnes (ed) Perspectivesin coral reefs. Townsville: Australian Institute of Marine Sciences. pp. 56-68.

[10] Decree of the State Minister of the Environment No 51/2004 regarding standard quality of seawater. [Indonesian]

[11] Edinger EN, Jompa J, Limmon GV, Widjatmoko W, Risk MJ. 1998. Reef degradation and coral biodiversity in Indonesian: Effects of land-based pollution, destructive fishing practices and changes over time. Marine Pollution Bulletin 36 (8): 617-630.

[12] Effendi H. 2003. Review of water quality: for management of aquatic resources and environment. Yogyakarta: Kanisius Publisher. [Indonesian]

[13] Egge JK, Aksnes DL. 1992. Silicate as regulating nutrient in phytoplankton competition. Mar. Ecol. Prog. Ser. 83: 281-289.

[14] Government Regulation No. 82/2001 on management of water quality and control over water pollution. [Indonesian]

https://dx.doi.org/10.22161/ijaems.5.2.2 *ISSN: 2454-1311*

[15] Isnaeni N, Suryanti, Purnomo PW. 2015. Aquatic fertility based on nitrate, phosphate and chlorophyll-a in the Waters of Karimunjawa Island Coral Reef Ecosystem. Diponegoro Journal of Maquares 4 (2): 75-81. [Indonesian]

[16] Jones-Lee A, Lee GF. 2005. Eutrophication (excess fertilization). Water encyclopedia: surface and agricultural water. New Jersey: Wiley. pp. 107-114.

[17] Lihan T, Saitoh SI. 2008. The measured measured temporal and spatial variability of the Tokachi River plume. Estuarine, Coastal and Shelf Science 78 (2): 237-249.

[18] Marling N. 2016. Abundance variation analysis of nitrogen nutrients, phosphate, silicate (N, P and Si) in Waters of Meulaboh Bay, West Aceh. Acta Aquatica 3 (1): 1-6

[19] Maslukah L, Indrayanti E, Rifai A. 2014. Distribution of organic material and nutrients by tidal flow in the estuary river of the Jepara River. Journal of Marine Sciences 19 (4): 189-194. [Indonesian]

[20] Mustofa A. 2015. The content of nitrate and phosphate as a factor for coastal water fertility. Disprotek Journal 6 (1): 13-19. [Indonesian]

[21] Nybakken JW. 1988. Marine Bilogy, An Ecological Approach. Language switching by Eidman M, Koesoebiono, Bengen DG, Hutomo M, Sukarjo S. Jakarta: Gramedia. [Indonesian]

[22] Patty SI, Arfah H, Malik AS. 2015. Nutrient (phosphate, nitrate), dissolved oxygen and ph associated with fertility in the Jikumerasa Waters, Buru Island. Journal of Coastal and Tropical Seas 1 (1): 43-50. [Indonesian]

[23] Papush L, Danielsson A. 2006. Silicon in the marine environment: dissolved silica trends in the Baltic Sea. Estuarine, Coastal and Shelf Science 67: 53-66

[24] Regina IS, Tarazona T. 2001. Nutrient pools for organic matter and throughfall under a Scot pine plantation in the Sierra de la Demanda, Spain. European Journal of Soil Biology 37: 125-133

[25] Richtel M. 2007. Recruiting plankton to fight global warming. New York: New York Times.

[26] Risamasu FJL, Prayitno HB. 2011. Study of phosphate, nitrite, nitrate and silicate nutrients in Matasiri waters, South Kalimantan. Journal of Marine Sciences 16 (3): 135-142. [Indonesian]

[27] Sikong M. 1978. The role of mangrove forests as a place to care for various types of fish and crustaceans. Proceedings of the seminar on mangrove ecosystems. Jakarta 27 February - 1 March 1978. pp. 106-108. [Indonesian]

[28] Suprapto D, Purnomo PW, Sulardiono B. 2014. Analysis of aquatic fertility based on the chemical physics relationship of basic sediments with NO_3-N and PO_4-P at the Tuntang River Demak Estuary. Saintek Perikanan Journal 10 (1): 56-61. [Indonesian]

[29] Ulqodry TZ, Yulisman M, Syahdan, Santoso. 2010. Characteristics and distribution of nitrates, phosphates and oxygen dissolved in Karimunjawa Waters of Central Java. Journal of Science Research 13 (1): 35-41. [Indonesian]

[30] Wisha UJ, Heriati A. 2016. Analysis of tidal range and its effect on distribution of total suspended solid (TSS) in the Pare Bay Waters. Marine Journal 9 (1): 23-31. [Indonesian]

https://dx.doi.org/10.22161/ijaems.5.2.3 *ISSN: 2454-1311*

The Use of Two Media of Instruction in Biology: A Quasi-Experimental Study

Jomell M. Santiago MSc.[1]*, Eden S. David Ph.D.[2]

[1]Faculty member, Department of Laboratory High School, College of Education, Nueva Ecija University of Science and Technology San Isidro Campus, San Isidro, Nueva Ecija, 3106 Philippines
email: jomellsantiago8854@gmail.com
[2]Faculty member, Department of Biological Science, College of Arts and Science, Central Luzon State University, Science City of Muñoz, Nueva Ecija, 3120 Philippines

***Abstract*—** *This paper determined the effectiveness of the two media of instruction, English and Filipino, in selected topics in Biology using quasi-experimental research. Two sections of Grade 8 students were the respondents of this study. The researchers found that the difference in scores of the two groups was statistically significant. Students who were subjected to English as a medium of instruction recorded a significantly higher posttest score than those students who were taught using Filipino. Thus, English as a medium of instruction is more effective in teaching selected topics in Biology.*

Keywords*— *Academic performance, Biology, English, Filipino, medium of instruction.

I. INTRODUCTION

In the field of education, one of the important factors that should be given attention is the language or medium of instruction because it is one way to ensure the efficient and effective transmission of information during the learning process. The authors in [1] state that" language of instruction is a vehicle through which education is delivered. Through language, the process of teaching-learning process is possible."

The study conducted by the International Studies of Educational Achievements (ISEA) on science achievements among 10-year old students throughout the world cited by the author [2] showed that the Hungarians, Swedes, Japanese, Koreans, and Norwegians who were taught and learn Mathematics and Science in their national language, got the highest scores in the International Education Assessment Test. Unfortunately, the Philippines obtained the lowest mean score in Mathematics and Science achievements. The result of the study shows that Filipino children, who were taught Mathematics and Science in a foreign language, perform far below than the students of other countries.

The researchers in[3] "documented that teachers believe English-medium instruction to be a setback to students' academic success and students stated that they could not understand the subject matter when the lectures are in English." The authors in [4] found that "English-medium instruction had considerable negative effects on geography, science, and world history."In the same manner, reference [5]"found similar differences in economics, geography, history, physics, chemistry, biology, and mathematics." In addition, the result of the study by [6] "suggests that instruction in English significantly and negatively affects the academic success of the students."

According to[7], "the use of mother tongue, which refers to the Filipino language in the Philippines, by the teachers plays a crucial role in the learning of subjects which contributed immensely to the understanding of the students in their lesson." In addition, [8] said that "mother tongue education should be given importance in educational policies and children should be taught in a language they understand and the same language should be used in the classroom in the early six years of education."

In contrast, the disadvantage of using mother tongue in teaching science particularly Biology are it contains many technical terms in describing its concepts, principles and theories, and is, therefore, more susceptible to reading difficulties than other natural sciences [9]. The author in [10] state that "learners in private schools perform much better in Biology as compared with learners in public schools because learners in private schools had a better English proficiency."

It was observed that the preferred language use as a medium of instruction is also a factor since students often have a difficult time to understand the language used by the teacher as well as the language used in the learning material and examination [11 and 12].

Because of these reasons, the researchers ventured on quasi-experimental research to compare and find out the

https://dx.doi.org/10.22161/ijaems.5.2.3 *ISSN: 2454-1311*

effectiveness of English and Filipino as media of instruction in teaching Grade 8 students of selected topics in Biology. The result may serve as a benchmark for the researchers to develop a plan of action that will help Grade 8 students with their existing problem in Biology.It is in this regard that this study finds meaning and significance.

II. MATERIALS AND METHODS

The study utilized Campbell and Stanley's quasi-experimental design of the non-equivalent pretest-posttest control group design [13 and 14]. According to the author [15], "quasi-experimental design was used to evaluate the effectiveness of an intervention when the intervention has been implemented."

The two sections of Grade 8 students were selected using purposive sampling. "Purposive sampling is a non-probability sampling method and it occurs when elements selected for the sample are chosen by the judgment of the researcher" [16].

The researchers conducted the study in March 2018 at Juan R. Liwag Memorial High School, located at Barangay Bayanihan, Gapan City, Nueva Ecija, Philippines. Informed consent from parents and assent from the respondents were secured by the researchers before doing the experimental process for ethical considerations. The research instruments used were the pretest and posttest questionnaires. The statistical tools utilized in this study were frequency, percentage, weighted mean and independent sample t-test.

III. RESULTS AND DISCUSSION

3.1 Academic Performance of the Respondents

Before the experimentation, student respondents were given a pretest in Biology about Cell Division and Genetics.

Table.1: Pretest Results

Score	Verbal Description	English Group		Filipino Group	
		Frequency	Percent	Frequency	Percent
0 to 8	Beginning (Did not Meet Expectations)	1	1.6	10	15.2
9 to 16	Developing (Fairly Satisfactory)	28	44.4	34	51.5
17 to 24	Approaching Proficiency (Satisfactory)	20	31.8	21	31.8
25 to 32	Proficient (Very Satisfactory)	13	20.6	1	1.5
33 to 40	Advanced (Outstanding)	1	1.6	0	0.0
Total		**63**	**100.0**	**66**	**100.0**

Table (1) showed the academic performance of the two groups of respondents in their pretest. In the group who were taught in English, 28 (44.4%) got scores ranging from 9 to 16 with a verbal description of Developing or Fairly Satisfactory. There were 20 (31.8%) who got scores ranging from 17 to 24 with a verbal description of Approaching Proficiency or Satisfactory and 13 (20.6%) got scores ranging from 25 to 32 with a verbal description Proficient or Very Satisfactory. Only 1 (1.6%) got a score ranging from 33 to 40 with a verbal description of Advanced or Outstanding and was under Beginning or Did not Meet Expectations whose score ranged from 0 to 8.

Meanwhile, in the group who were exposed to Filipino as a medium of instruction, 34 (51.5%) got scores ranging from 9 to 16 with a verbal description of Developing or Fairly Satisfactory. There were 21 (31.8%) who got scores ranging from 17 to 24 with a verbal description of Approaching Proficiency or Satisfactory and 10 (15.2%) got scores ranging from 0 to 8 with a verbal description Beginning or Did not Meet Expectations. Only 1 (1.5%) student was under Proficient or Very Satisfactory whose score ranged from 25 to 32 and nobody reached the Advances or Outstanding level.

The result on both groups is related to the findings in [17], that Filipino students' academic performance in Biology which is under the subject of Science and Technology is weak.

Table.2: Posttest Results

Score	Verbal Description	English Group		Filipino Group	
		Frequency	Percent	Frequency	Percent
0 to 8	Beginning (Did not Meet Expectations)	0	0.0	4	6.1
9 to 16	Developing (Fairly Satisfactory)	18	28.6	25	37.9
17 to 24	Approaching Proficiency (Satisfactory)	13	20.6	18	27.3
25 to 32	Proficient (Very Satisfactory)	10	15.9	17	25.7

https://dx.doi.org/10.22161/ijaems.5.2.3 *ISSN: 2454-1311*

33 to 40	Advanced (Outstanding)	22	34.9	2	3.0
Total		**63**	**100.0**	**66**	**100.0**

Table (2) showed the academic performance of the two groups in their posttest. In the English group, there were 22 (34.9%) respondents who earned scores ranging from 33 to 40 with a verbal description of Advanced or Outstanding. Eighteen (28.6%) got scores ranging from 9 to 16 with a verbal description of Developing or Fairly Satisfactory, 13 (20.6%) got scores ranging from 17 to 24 with a verbal description of Approaching Proficiency or Satisfactory and 10 (15.9%) got scores ranging from 25 to 32 with a verbal description of Proficient or Very Satisfactory. Nobody was under Beginning or Did not Meet Expectation level.

On the other hand, in the Filipino group, 25 (37.9%) got scores ranging from 9 to 16 with a verbal description of Developing or Fairly Satisfactory. There were 18 (27.3%) who got scores ranging from 17 to 24 with a verbal description of Approaching Proficiency or Satisfactory and 17 (25.7%) got scores ranging from 25 to 32 with a verbal description Proficient or Very Satisfactory. Four students were under Beginning or Did not Meet Expectations whore scores ranged from 0 to 8 and only two students were under Advanced or Outstanding level whose scores ranged from 33 to 40. This shows that the respondents in the English group after the use of English language as a medium of instruction in teaching Biology to learn betterthan of the respondents in the group where the Filipino language was used as a medium of instruction in teaching Biology.

The finding of the study contradicts the findings of the following authors [18], [19] and[20], [21] and [22]. According to them, the use of the English language would seriously affect and become a limiting factor for student learning, and learners encounter enormous problem learning Biology. However, according to the following authors [23] and [24], "science and mathematics are dynamic areas of knowledge in which all sorts of new discoveries and a large portion of information related to them are found in English and should be taught in English."

Table.3: t-test of the Pretest and Posttest Performances of the Two groups

Group	**Pretest**		**Posttest**	
	Mean	t-value	Mean	t-value
English	18.34	2.01	25.03	3.02
Filipino	13.93		18.72	

Table (3) showed that the English group had higher pretest and posttest score. The statistical analysis revealed that the pretest and posttest scores between the two groups have significant differences. This meant that the performance of the respondents in the English group after the use of English language as a medium of instruction is greater than the performance of the respondents in the experimental group where the Filipino language was used as a medium of instruction.

The result of the study implies that the use of the English language as a medium of instruction is more effective than the Filipino language in teaching science. The author in [25] stated that it is based on the fact that the language of instruction plays a significant role in students' academic performance. The reason why the control group had a higher posttest score was that the medium of instruction use was English and the language used in Biology which is under the subject of science was English. Since scientific and technological development is mostly recorded in English language, according to authors [26] and [27], "one advantage of using English as a medium of instruction is the higher quality of support materials compared to those in local languages.""Textbooks, articles, support websites, practice questions are better in both quality and quantity in English than in any other language. "Therefore, it is a disadvantage for all who do not use the English language because they may not have access to the world's known scientific and technological discoveries that are predominantly written in English" [28].

According to [29], "teachers and students prefer the use of English as the medium of instruction. The teachers find English as a more comfortable language for explaining ideas and concept and a valuable tool to source information technology."The findings of the author in [30] showed that the students had better learning performances when English was used as a medium of instruction than Filipino in teaching Social Sciences. Because of this, it is more advantageous to use the English language in teaching Biology than any language.

IV. CONCLUSIONS AND RECOMMENDATIONS

Innovative and successful teachers should have the knowledge and the sense of purpose that allows them to rise

https://dx.doi.org/10.22161/ijaems.5.2.3 *ISSN: 2454-1311*

above casual or conventional approaches and to do things others cannot [31] as cited by [32].

The researchers, being innovative teachers ventured on different approaches in teaching selected Biology and found out that the academic performance of the respondents under the group who were taught in English had statistically higher mean posttest score from those students under the group who were taught in Filipino. Language then appeared to have an effect on the students' academic performance. Hence, English as a medium of instruction was more effective in teaching selected topics in Biology. However, since the study is only limited to five topics in Biology, this study must be replicated on a larger scale over a longer span of time in order to attain more defined results. The researchers suggested taking the whole grading period which means more topics will be added. The same study may be undertaken for the Grade 8 students of private schools, which this study fails to include. Likewise, teachers and professors may consider a game-based teaching-learning process [33] in Biology which was proven to help the students be engaged in lessons regardless of the language of instruction. Lastly, the use of English and Filipino language as media in constructing modules should be conducted in order to determine if the language will have an effect in the performance of the students if it used as supplementary material.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to the Grade 8 students who served as their respondents and to Dr. Sofronio P. Kalaw, Dr. Leila M. Collantes, Dr. Regidor G. Gaboy, Dr. Angeles M. De Leon, Dr. Arneil G. Gabriel, Dr. Gener S. Subia, Dr. Lily G. Salangsang and Ms. Luisa P. Reyes for their significant suggestions and comments for the improvement of this study.

REFERENCES

[1] Zorro, I. and Baracaldo, D. A. (2006). Cross-Curricular and a Cross-Cultural Bridge in a Teacher Preparation program (Handouts). [Online] Available: in http://nation/ teleconference, org/resources/2006/Imelda_Zorro_Deisy_Baracaldo_A_ CrossCurricular_ant (May 23rd, 2016)

[2] Cortes, J.C. (2005). Basic Education: The Foundation of People Empowerment. Educators Congress: Baguio City.

[3] Kinyaduka, B. D., & Kiwara, J. F. (2014). Language of instruction and its impact on quality of education in secondary schools: Experiences from Morogoro Region, Tanzania. Journal of Education and Practice, 4(9), 90–95.

[4] Marsh, H. W., Hau, K. T., & Kong, C. K. (2000). Late immersion and language of instruction in Hong Kong high schools: Achievement growth in language and non-language subjects. Harvard Educational Review, 70, 302–346.

[5] Education Bureau. (2006). Further evaluation on the implementation of the MOI guidance for secondary schools, 2002–2004. Hong Kong: Government Printer.

[6] Civan, A., & Coşkun, A. (2016). The effect of the medium of instruction language on the academic success of university students. Educational Sciences: Theory & Practice, 16, 1981–2004.

[7] Acquah, S.,Eshun, S. E., &Afful-Broni, A. (2014). Towards a more Effective Education in Ghana: Teachers Coping Strategies in Teaching Natural Science. Journal of Education and Curriculum Development Research, 2 (1), 81-92.

[8] UNESCO, Global Education Monitoring Report 2016.

[9] Lock, R & Richardson, J 1995, 'The readability of selected A-level Biology examination papers,' Journal of Biological Education, vol. 27, no. 3, pp. 205-2012.

[10] Mohidiu, BHN 2008, Students achievement and language problems in learning Biology in English in Public and private schools, MED Thesis, University of Brunei Danssalam. Monsod, Wennie. English versus Mother Tongue as a Medium of Instruction. GMA News. March 2, 2009

[11] Dresher, R., (2005). Training in Mathematics Vocabulary Educational Research Bulletin. No. 13, pp. 201 – 204

[12] Johnson, H.G., (2010). The effects of instruction in mathematical vocabulary upon problem-solving in mathematics. Journal at Educational Research.4:38(July 2010) 97– 10.

[13] Campbell, D. T., and Stanley, J. C. (1966). Experimental and Quasi-experimental Designs for Research, Chicago: Rand McNally.

[14] Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental design for research. Hopewell, NJ: Houghton Mifflin Company.

[15] Shadish, W., Cook, T., & Campbell, D. (2002). Experimental and quasi-experimental designs for generalized causal inference. Boston: Houghton Mifflin Company.

[16] Black, S. E., Devereux, P. J. and Salvanes, K. G. (2005), "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education", Quarterly Journal of Economics, 120(2), 669-700.

[17] TIMMS, International Report on Achievement, Tims s.be.edu/tims s.html. 2008

https://dx.doi.org/10.22161/ijaems.5.2.3 *ISSN: 2454-1311*

[18] Gatmaitan, R. S., (2012). The Comprehensibility of Chemistry reading materials in English and Filipino. Unpublished Master's Thesis, UP, Diliman, Quezon City

[19] Mohidiu, BHN 2008, Students achievement and language problems in learning Biology in English in Public and private schools, MED Thesis, University of Brunei Danssalam.

[20] Yong, BCS 2003, 'Language problems in the learning of Biology through the medium of English,' Journal of Applied Research in Education, Vol. 7, no. 1, pp. 97-104.

[21] Dresher, R., (2005). Training in Mathematics Vocabulary Educational Research Bulletin. No. 13, pp. 201 – 204

[22] Johnson, H.G.,(2010). The effects of instruction in mathematical vocabulary upon problem-solving in mathematics. Journal at Educational Research.4:38(July 2010)97–110.

[23] Che Wan Jasimah Wan Mohamed Radzi & Norazmi Noor. (2005). The use of English in Science and Mathematics: Implementation and Challenges. Jurnal Pendidikan. 25:27-38.

[24] Pembina. (2009). Teacher Competence in Teaching and Learning Science and Mathematics use English language and its implications on the performance of the Students Human Capital Development. Executive Report of Pembina Study: End PPSMI. http:/arkibppsmi. blogspot.com/2009/05/Laporan-eksekutif-kajian-pembina.html [20 Oktober 2010].

[25] Kagwesage, A. M. (2012). Higher education students' reflection on learning in times of academic language shift. International Journal for the Scholarship of Teaching and Learning, 6(2), 1-15.

[26] Ministry of Education. (2002a). English for Teaching Mathematics and Science (ETeMS) Facilitator's Notes. English Language Teaching Centre, Teacher Education Division

[27] Pembina. (2009). Teacher Competence in Teaching and Learning Science and Mathematics use English language and its implications on the performance of the Students Human Capital Development. Executive Report of Pembina Study: End PPSMI. http:/arkibppsmi. blogspot.com/2009/05/Laporan-eksekutif-kajian-pembina.html[20 Oktober 2010].

[28] Fakeye, D. and Ogunsiji, Y. "English language proficiency as a predictor of academic achievement among ELF students in Nigeria," Journal of Science Research, vol. 37, pp. 490-495, March 2009

[29] Amamio, L. (2000). Attitudes of students, teachers and parents of RVM schools in Metro Manila toward English and Filipino as media of instruction, (Unpublished Thesis) presented to the UST Graduate School, Manila, Philippines

[30] Gorgonio, John Paul R. (2011). Use of Filipino and English in Social Studies Learning. A Master thesis from Cebu Normal University, Cebu City, Philippines presented by the researcher during 2nd International Conference on Multidisciplinary Research last October 21-22, 2011 at Bacolod City, Occidental Negros

[31] Boiser, D. (2000) Strategies for Teaching: A Modular Approach. Rex Book Store: C.M. Recto Avenue, Manila.

[32] Subia, G.S. (2018) Comprehensible Technique in Solving Consecutive Number Problems in Algebra. Journal of Applied Mathematics and Physics, 6, 447-457. https://doi.org/10.4236/jamp.2018.63041

[33] Subia, G.S., Amaranto, J.L., Amaranto, J.C., Bustamante, J.Y. and Damaso, I.C. (2019) Chess and Mathematics Performance of College Players: An Exploratory Analysis. Open Access Library Journal, 6: e5195. https://doi.org/10.4236/oalib.1105195

https://dx.doi.org/10.22161/ijaems.5.2.4 *ISSN: 2454-1311*

Volatility Diagnostics for Stock Price of Sharia-Compliant Companies listed in Malaysia Composite Index

Nashirah Abu Bakar[1], Sofian Rosbi[2]

[1]Islamic Business School, College of Business, Universiti Utara Malaysia, Kedah, Malaysia
[2]School of Mechatronic Engineering, Universiti Malaysia Perlis, Malaysia

Abstract*—The objective of this study is to evaluate the volatility of sharia-compliant companies that listed on Malaysia Stock Exchange. Data of return for each of the companies are collected from Thomson Reuters Datastream. The number of selected companies is 19 that selected from 30 companies composing Kuala Lumpur Composite Index (KLCI). This study calculated average monthly return and volatility rate for each of the companies. Next, normality statistical test is performed using Shapiro-Wilk normality test. Result indicates the mean value of average monthly return is 0.442 % with standard deviation 1.28%. Then, the mean value for volatility rate is 4.85% and standard deviation is 2.23%. Result from Shapiro-Wilk normality test indicates data distribution for average monthly return and volatility follow normal data distribution. The significant of these findings is it will help investors to understand the behavior of stock price in Malaysia Stock Exchange particularly sharia-compliant companies in Kuala Lumpur Composite Index. In addition, the findings of this study will help investors to develop investment portfolio that can maximize return and reducing loss.*

Keywords*—*Volatility, Sharia-compliant companies, Malaysia Stock Exchange, Kuala Lumpur Composite Index, Islamic Finance.

I. INTRODUCTION

There has been an increasing body of literature on sharia-complaint companies' performance worldwide (Abu Bakar and Rosbi, 2018a; Che Azmi, et al., 2016). The main objective of sharia compliant companies is to provide Islamic investment that free from any prohibited elements in Islamic rules. Islamic-based investments are obligated to follow sharia rules, which means that they must not only be free from elements of riba' (interest) and gharar (uncertainty) but also from activities related to maysir (gambling), alcohol, tobacco, drugs or any form of activity that could pose potential harm to the society or nation (Abu Bakar and Rosbi, 2017(a); Che Azmi, et al., 2016; Ullah et al., 2014; Abdul Rahim and Yong, 2010). Lusyana and Sherif, (2017) explained that Islamic investment principles emphasize ethical investing that comply with the principles of sharia, which is the Islamic law that governs every facet of each Muslim's life. While, Che Azmi et al., (2016) emphasize that investors are not only concerned with environmental, social, governance issues (Hamza, 2013) and ethical issues as a part of their investment decisions but they also must monitor their activities in order to achieve the motivations and objectives of the social responsibility investing.

Bursa Malaysia has authority in select top 30 largest listed companies. The main function in selecting top 30 largest listed company is to enhance trading and appreciation of the Malaysian market. Out of 19 companies from 30 largest companies listed on Bursa Malaysia was sharia compliant company that was composing the Malaysian composite index. This number shows that sharia-compliant companies were attracting not only Muslim investors but also non-Muslim investors who are interested in investing in Islamic investment. Thus, top 30 largest companies must have a good performance in term of operation and financial. However, with the current economic condition in Malaysia is always change, sharia-compliant companies must monitor their performance especially on the volatility of shares prices in order to be positive, stable and maintain listed as the top 30 largest listed companies of Bursa Malaysia. Therefore, forecasting volatility of shares price plays important roles in investment market (Abu Bakar and Rosbi, 2017b).

Stock market is one of the most important indicators on how the economic are moving up. Positive increment of dynamic movement for the share price indicates good performance of stock market in Malaysia (Abu Bakar, et al., 2018b).Thus, this study was evaluating the volatility of sharia-compliant companies that listed on Malaysia Stock Exchange. The number of selected companies is 19 that selected from 30 companies composing Kuala Lumpur Composite Index (KLCI).

https://dx.doi.org/10.22161/ijaems.5.2.4 *ISSN: 2454-1311*

II. LITERATURE REVIEW

Companies that are classified under the sharia-compliant category in Malaysia increased rapidly since the inception of this classification in 1999 in the Malaysian market (Ahmed Haji and Mohd Ghazali, 2013; Ousama and Fatima, 2010). As reported by Securities Commission of Malaysia out of 689 companies from 902 companies are sharia compliant companies (Securities Commission of Malaysia, 2018).

Therefore sharia compliant companies are looking as a good platform in promoting Islamic capital market. Study by Wan Ismail, et al., (2015) regarding quality of earnings in sharia-compliant companies finds robust evidence that sharia-compliant companies have significantly higher earnings quality compared to other firms. The results also provide that sharia-compliant companies supply a higher quality of reported earnings to attract foreign investment, have greater demand for high-quality financial reporting because of their sharia status and are subject to greater scrutiny by regulators and institutional investors. Therefore sharia-compliant companies must show a good reputation in promoting Islamic capital market.

Hence, study that focus on the volatility of the share price found varies findings. For example, Sankaran et al., (2012) investigate the extreme returns in a variety of financial markets found the correlation positive extreme returns within overlapping clusters significantly increases with volatility between Dow Jones Industrial Average and S&P 500. Then Kongsilp and Mateus, (2017) investigate the role of volatility risk on stock return found a clear and robust empirical evidence. Fowowe (2017) examine the return and volatility spillovers between oil and the stock markets of Nigeria and South Africa. The results for volatility spillovers show independence of volatilities between Nigeria stock markets and oil markets, while weak bi-directional spillovers were found between South African equity volatilities and oil volatilities.

Lee (2009) examines the housing price volatility for eight capital cities in Australia. The volatility clustering effects were found in many Australian capital cities. Coskun, et al., (2016) analyze volatility properties of the house price returns of Turkey, Istanbul, Ankara and Izmir. Empirical findings suggest several points. The important finding are; the city/country-level house price return volatility series display volatility clustering pattern and therefore volatilities in house price returns are time varying; house price return volatilities differ across geographic areas, volatility series may show some co-movement pattern. Thus, volatility is important to investigate in order to monitor the performance of share prices.

III. RESEARCH METHODOLOGY

This study analyzed the stock prices of 19 sharia-compliant companies to detect volatility rate. Therefore, this study implemented mathematical calculation to find return rate including volatility rate. The data distribution evaluation for both variables is performed using Shapiro-Wilk normality test.

3.1 Data selection and return calculation

This study collected daily stock prices from Thomson Reuters Datastream. Table 1 shows selected 19 sharia-compliant companies listed on Malaysia Stock Exchange. These companies are selected among 30 companies that composing Kuala Lumpur Composite Index (KLCI).

Table.1: List of companies

No.	Company Name
1	Axiata Group Berhad
2	Dialog Group Berhad
3	DiGi.Com Berhad
4	Hartalega Holdings Berhad
5	IHH Healthcare Berhad
6	IOI Corporation Berhad
7	Kuala Lumpur Kepong Berhad
8	Maxis Berhad
9	MISC Behad
10	Nestle (Malaysia) Berhad
11	Petronas Chemicals Group Berhad
12	Petronas Dagangan Bhd
13	Petronas Gas Berhad
14	PPB Group Berhad
15	Press Metal Aluminium Holdings Berhad
16	Sime Darby Berhad
17	Sime Darby Plantation Berhad
18	Tenaga Nasional Berhad
19	Top Glove Corporation Berhad

Then, the stock prices are averaged to find monthly stock price. Next, this study calculated the return rate using using Equation (1).

$$\mathrm{Re}_{i,t} = \left(\frac{P_t - P_{t-1}}{P_{t-1}} \right) \times 100\% \quad \text{..... (1)}$$

In Equation (1), the parameters are described as below:

$\mathrm{Re}_{i,t}$: Return rate for company *i* at monthly observation period *t*,

P_t : Stock prices of company *i* at monthly observation period *t*, and

P_{t-1} : Stock prices of company *i* at monthly observation period *t-1*.

Next, the volatility rate is measured using standard deviation of data distribution. Therefore, the volatility is described using Equation (2).

https://dx.doi.org/10.22161/ijaems.5.2.4 ISSN: 2454-1311

$$\sigma_i = \sqrt{\frac{\left(r_{i,t} - \bar{r}_i\right)}{n-1}} \quad \text{..... (2)}$$

In Equation (2), the parameters are described as follows:

σ_i : Volatility rate for company *i*,

$r_{i,t}$: Observed variable for return of company *i* at monthly period *t*,

$\bar{r}_i$: Mean value of return for company *i*, and

n : Number of observation.

3.2 Shapiro-Wilk normality test

An assessment of the normality of data is a prerequisite for many statistical tests because normal data is an underlying assumption in parametric testing. In this study, Shapiro-Wilk normality test is selected for data distribution analysis. The Shapiro-Wilk normality test is more appropriate for small sample sizes (< 50 samples), but can also handle sample sizes as large as 2000.

Suppose that a random variable X is observed and this study interested in testing the hypothesis of normality of data distribution. The null-hypothesis of Shapiro-Wilk test is that the population is normally distributed.

$$H_0 : X \approx N\left(\mu, \sigma^2\right)$$

Shapiro-Wilk normality testing is represented by W-statistics. The *W*-test statistics is indicated by Equation (3).

$$W = \frac{\left(\sum_{i=1}^{n} a_i X_{(i)}\right)^2}{\sum_{i=1}^{n}\left(X_i - \bar{X}\right)^2} \quad \text{.....(3)}$$

where $X_{(1)} \le X_{(2)} \le ... \le X_{(n)}$ are the ordered values of a sample of $X_1, X_2, ..., X_n$. A lower tail of W indicates non-normality. The tabulated coefficients a_i are described as Equation (4).

$$\left(a_1, a_2, ..., a_n\right) = \frac{m^{\mathrm{T}} V^{-1}}{C} \quad \text{..... (4)}$$

In Equation (4), the parameters are described as follows:

C : Vector norm is a function that assigns a strictly positive length or size to each vector in a vector space,

$$C = \left\| V^{-1} m \right\| = \sqrt{\left(m^{\mathrm{T}} V^{-1} V^{-1} m\right)}$$

m : Vector *m* is made of the expected values of the order statistics of independent and identically distributed random variables sampled from the standard normal distribution.

$$m = \left(m_1, m_2, ..., m_n\right)^{\mathrm{T}}$$

V : Covariance matrix for normal order statistics.

Next, assume the expected value of mean μ is known as μ_0 .Therefore, the null hypothesis of Shapiro-Wilk normality test can be expressed as below.

$$H_0 : X \approx N\left(\mu_0, \sigma^2\right)$$

Next, the W-test statistics can be re-arranged as below:

$$W_0 = \frac{\left(\sum_{i=1}^{n} a_i X_{(i)}\right)^2}{\sum_{i=1}^{n}\left(X_i - \mu_0\right)^2} \quad \text{..... (5)}$$

The null hypothesis is rejected at condition of $W_0 < W_0(\alpha, n)$. The parameter $W_0(\alpha, n)$ is critical value at significant level α .

The statistics W_0 has identical properties to W statistics. The parameter W_0 is scale invariant and maximum value of W_0 is set to one. Meanwhile, the minimum value of W is decided with value in below equation.

$$\varepsilon = \frac{n a_1^2}{n-1} \quad \text{..... (6)}$$

IV. RESULT AND DISCUSSION

The objective of this study is to evaluate level of volatility among sharia-compliant companies listed on Malaysia Stock Exchange. The selected 19 companies are listed as companies in FTSE Bursa Malaysia KLCI. This study evaluated the data distribution for return rate and volatility rate to examine financial environment in Malaysia Stock Exchange.

4.1 Data analysis for return rate

This section describes data distribution for return rate of 19 companies of sharia-compliant companies that selected among 30 companies for Kuala Lumpur Composite Index (KLCI). Figure 1 shows the return rate distribution for 19 companies. The maximum value of average monthly return is 3.16% for Nestle (Malaysia) Berhad (Company No. is 10). Meanwhile, the minimum value of average monthly return is -2.01 % for Axiata Group Berhad (Company No. is 1).

Next, this study performed normality analysis for data distribution of return rate. Figure 2 indicates data distribution of average monthly return rate using normal

https://dx.doi.org/10.22161/ijaems.5.2.4 *ISSN: 2454-1311*

Q-Q (quantile-quantile) plot. Figure 2 concluded the distribution of average return rate is follow normal distribution because all of data is close to normal distribution line (red line). The average value for return is 0.442 % and standard deviation is 1.285%.

After that, the graphical finding is validated using statistical test of normal distribution. This study selected Shapiro-Wilk normality for data distribution analysis. This statistical test is selected because number of observation is less than 2000. Table 1 shows Shapiro-Wilk normality test for return rate. Table 1 indicates the probability value (p-value) is 0.497 that is larger than 0.05. Therefore, data distribution of return rate is follows normal distribution.

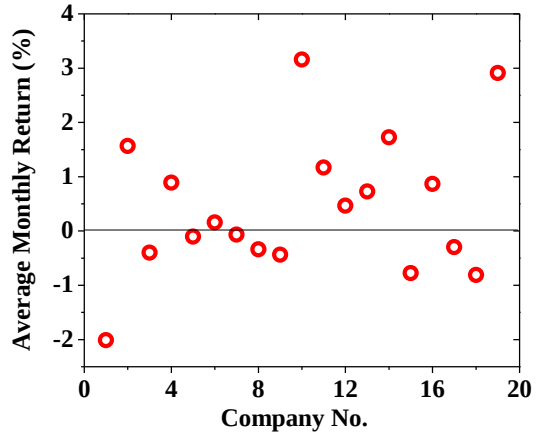


Fig. 1: Return rate distribution for company

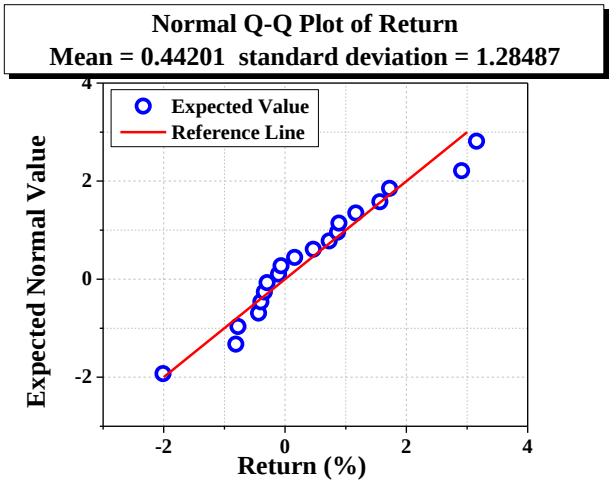


Fig. 2: Normal Q-Q plot for return rate

Table.1: Normality test for return rate

Shapiro-Wilk normality test		
Statistics	Degree of freedom, df	Probability value (p-value)
0.956	19	0.497

4.2 Data analysis for volatility rate

This study analyzed rate of volatility for 19 companies listed in Malaysia Stock Exchange that selected in 30 companies of Kuala Lumpur Composite Index (KLCI). Figure 3 shows the volatility rate distribution for 19 companies. The maximum value of volatility rate is 9.00 % for Top Glove Corporation Berhad (Company No. is 19). Meanwhile, the minimum value of volatility rate is 1.47 % for Kuala Lumpur Kepong Berhad (Company No. is 7)

Next, this study performed normality analysis for data distribution of return rate. Figure 4 indicates data distribution of volatility rate using normal Q-Q (quantile-quantile) plot. Figure 4 concluded the distribution of volatility rate is follow normal distribution because all of data is close to normal distribution line (red line). The average value for volatility is 4.85 % and standard deviation is 2.23%.

After that, the graphical finding is validated using statistical test of normal distribution. This study selected Shapiro-Wilk normality for data distribution analysis. This statistical test is selected because number of observation is less than 2000. Table 2 shows Shapiro-Wilk normality test for volatility rate. Table 2 indicates the probability value (p-value) is 0.562 that is larger than 0.05. Therefore, data distribution of return rate is follows normal distribution.

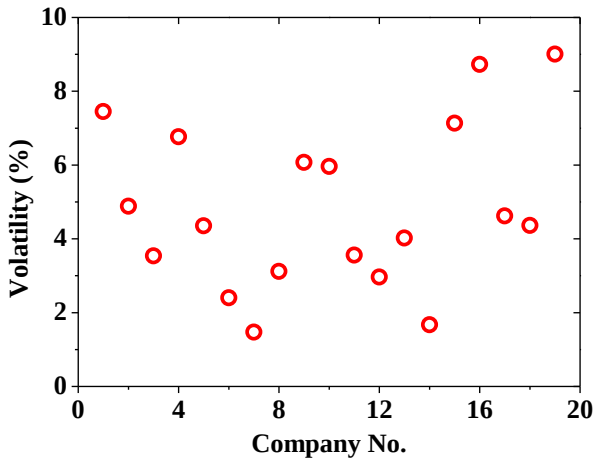


Fig. 3: Volatility rate for company

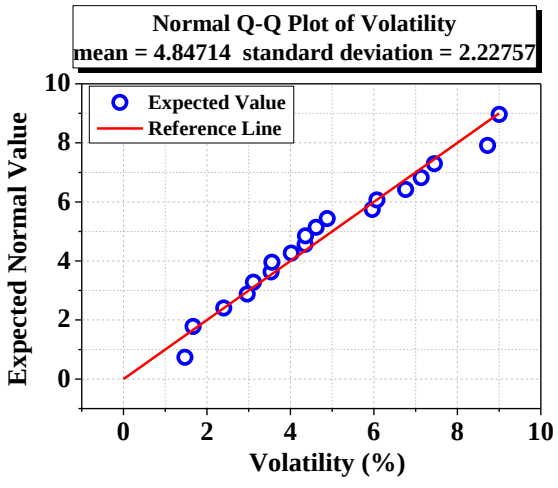


Fig. 4: Normal Q-Q plot for volatility rate

https://dx.doi.org/10.22161/ijaems.5.2.4 *ISSN: 2454-1311*

Table.2: Normality test for volatility rate

Shapiro-Wilk normality test		
Statistics	Degree of freedom, df	Probability value (p-value)
0.959	19	0.562

V. CONCLUSION

Main purpose of this study is to evaluate the volatility rate for companies listed on Malaysia Stock Exchange. The companies selected in this analysis are 19 companies that sharia-compliant. The selected companies are categorized in 30 companies that determine Kuala Lumpur Composite Index (KLCI).

Main findings of this study are:

(a) The distribution of average return rate is follow normal distribution because all of data is close to normal distribution line. The average value for return is 0.442 % and standard deviation is 1.285%.

(b) Shapiro-Wilk normality test for return rate indicates the probability value (p-value) is 0.497 that is larger than 0.05. Therefore, data distribution of return rate is follows normal distribution.

(c) The maximum value of average monthly return is 3.16% for Nestle (Malaysia) Berhad. Meanwhile, the minimum value of average monthly return is -2.01 % for Axiata Group Berhad.

(d) The distribution of volatility rate is follow normal distribution because all of data is close to normal distribution line. The average value for volatility is 4.85 % and standard deviation is 2.23%.

(e) Shapiro-Wilk normality test for volatility rate. Table 2 indicates the probability value (p-value) is 0.562 that is larger than 0.05. Therefore, data distribution of return rate is follows normal distribution.

(f) The maximum value of volatility rate is 9.00 % for Top Glove Corporation Berhad. Meanwhile, the minimum value of volatility rate is 1.47 % for Kuala Lumpur Kepong Berhad.

The significant of these findings is it will help investors to understand the behavior of stock price in Malaysia Stock Exchange particularly sharia-compliant companies in Kuala Lumpur Composite Index. In addition, the findings of this study will help investors to develop investment portfolio that can maximize return and reducing loss.

REFERENCES

[1] Abdul Rahim, R. and Yong, O. (2010). Initial returns of Malaysian IPOs and Shari'a-compliant status. *Journal of Islamic Accounting and Business Research, 1*(1), 60-74.

[2] Abu Bakar, N. and Rosbi, S. (2017a). Data modeling diagnostics for share price performance of Islamic Bank in Malaysia using Computational Islamic Finance approach. *International Journal of Advanced Engineering Research and Science, 4* (7), 174-179.

[3] Abu Bakar, N and Rosbi, S. (2017b). Dynamic Forecasting method for Shariah-compliant Share Price of Healthcare sector in Malaysian Stock Exchange. *International Journal of Advanced Engineering, Management and Science, 3* (8), 855-863.

[4] Abu Bakar, N. and Rosbi, S. (2018a). Evaluation of Risk Reduction for Portfolio in Islamic Investment Using Modern Portfolio Theory. *International Journal of Advanced Engineering Research and Science, 5* (11), 27-34.

[5] Abu Bakar, N., Rosbi, S. and Uzaki, K. (2018b). Evaluating Forecasting Method Using Autoregressive Integrated Moving Average (ARIMA) Approach for Shariah Compliant Oil and Gas Sector in Malaysia. *Journal of Mathematics and Computing Science, 1* (1), 19-33.

[6] Ahmed Haji, A., Mohd Ghazali, N.A. (2013). The quality and determinants of voluntary disclosures in annual reports of Shari'ah compliant companies in Malaysia. Humanomics, 29(1), 24-42.

[7] Che Azmi, A., Ab Aziz, N., Non, N. and Muhamad, R. (2016). Sharia disclosures: An exploratory study from the perspective of Sharia-compliant companies and professional users. *Journal of Islamic Accounting and Business Research, 7*(3), 237.

[8] Che Azmi, A., Ab Aziz, N., Non, N. and Muhamad, R. (2016). Sharia disclosures: An exploratory study from the perspective of Sharia-compliant companies and professional users. *Journal of Islamic Accounting and Business Research, 7*(3), 237-252.

[9] Che Azmi, A., Ab Aziz, N., Non, N. and Muhamad, R. (2016). Sharia disclosures: An exploratory study from the perspective of Sharia-compliant companies and professional users. *Journal of Islamic Accounting and Business Research, 7* (3), 237-252.

[10] Coskun, Y. and Ertugrul, H.M. (2016). House price return volatility patterns in Turkey, Istanbul, Ankara and Izmir. *Journal of European Real Estate Research, 9* (1), 26-51.

[11] Fowowe, B. (2017). Return and volatility spillovers between oil and stock markets in South Africa and Nigeria. African *Journal of Economic and Management Studies, 8*(4), 484-497.

[12] Hamza, H. (2013). Sharia governance in Islamic banks: effectiveness and supervision model. *International Journal of Islamic and Middle Eastern Finance and Management, 6* (3), 226-237.

[13] Kongsilp,W. and Mateus, C. (2017). Volatility risk and stock return predictability on global financial

https://dx.doi.org/10.22161/ijaems.5.2.4 *ISSN: 2454-1311*

crises. *China Finance Review International, 7* (1), 33-66.

[14] Lee, C.L. (2009). Housing price volatility and its determinants. *International Journal of Housing Markets and Analysis, 2*(3), 293-308.

[15] Lusyana, D. and Sherif, M. (2017). Shariah-compliant investments and stock returns: evidence from the Indonesian stock market. Journal of Islamic Accounting and Business Research, 8 (2), 143-160.

[16] Ousama, A.A. and Fatima, A.H. (2010). Voluntary disclosure by Shari'ah approved companies: an exploratory study. *Journal of Financial Reporting and Accounting, 8* (1), 35-49.

[17] Sankaran, H., Nguyen, A. and Harikumar, J. (2012). Extreme return correlation and volatility: a two-threshold approach. *American Journal of Business, 27*(2), 154-173.

[18] Securities Commission of Malaysia, (2018). Available at: https://www.sc.com.my/api/documentms/download.ashx?id=f325b375-67e9-49c3-a45d-4864c8a6be7f

[19] Shaik, M. and Maheswaran S., (2018). Evidence of excess volatility based on a new robust volatility ratio. *Journal of Economic Studies, 45* (4), 855-875.

[20] Ullah, S., Jamali, D. and Harwood, I.A. (2014). Socially responsible investment: insights from Shari'a departments in Islamic financial institutions. *Business Ethics: A European Review, 23* (2), 218-233.

[21] Wan Ismail, W.A. Kamarudin, K.A. and Sarman, S.R. (2015). The quality of earnings in Shariah-compliant companies: evidence from Malaysia. *Journal of Islamic Accounting and Business Research, 6* (1),19-41.

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

Variability in Silver Fir Growth in the Tuscan Apennine Alps in the 20th Century

Fabrizio D'Aprile[1,2, *]

[1] CREA – Research Centre for Forestry and Wood. Viale S. Margherita, n.80. 52100 Arezzo, Italy.
[2] Research Affiliate. School of Earth, Atmosphere & Environment. Monash University, Wellington Road, Clayton VIC 3800, Australia.
* Corresponding author. Tel. +39 340 603 9604
E-mail address: fabrizio.daprile@monash.edu

***Abstract*—** *Climate variables have shown that monthly mean temperature (MT) and monthly rainfall (MR) are non-stationary in the Tuscan Apennine Alps during the 20th century; similarity between trends in monthly climate variables varies irregularly through time at the seasonal and monthly scales, and site. High variability and anomalies in silver fir (Abies alba Mill.) growth have been observed in various regions of Europe and Italy. This scenario has suggested to investigate if tree-ring chronologies in silver fir vary among sites during the 20th century in the Tuscan Apennine Alps, if there are differences in tree-ring growth at upper and lower elevation within silver fir forests, and if there are anomalous or unexpected growth patterns in tree-ring chronologies of silver fir. Results shows that similarity in Residual Tree-rings series (RTRs) varies highly, frequently, and irregularly during the 20th century among sites and, to a lesser extent, within silver fir forest sites in the Tuscan Apennine Alps. Unexpected patterns of growth occur in silver fir in the last decades of the 20th century; and similarity between RTRs of the silver fir study stands tends to reduce with increasing distance among sites. Results recommend monitoring and extend this and similar investigations in the view of the climate change scenarios recently provided by research where the impacts on the viability and possibly shift of silver fir populations – and other species - in their southern European range rise serious concerns.*

Keywords*— *silver fir, tree-rings, dendrochronology, forest management, climate change.

I. INTRODUCTION

Analysis of trends in climate variables in the Tuscan Apennine Alps have shown that monthly mean temperature (MT) and monthly rainfall (MR) are non-stationary during the 20th century. In particular, similarity between trends in monthly climate variables varies irregularly through time at the seasonal and monthly scales, and site (Brunetti et al, 2006; D'Aprile et al., 2010; D'Aprile et al., 2011). In this contest, it can be pointed out that variations in trends and/or in values of climate variables that may occur at different elevation within forests would not be detected by meteorological stations although different growth response can take place in stands at the upper and lower margins of forests.

High variability and anomalies in silver fir (*Abies alba* Mill.) growth have been observed in various regions of Europe and Italy. Actually, changes in the climate-growth relationships have been verified during the 20th century in Europe(Pretzsch et al., 2014; Linder et Calama, 2013; Bertini et al, 2011).For example, silver fir forests show a strong decrease in radial growth from the late 1950s to the 1970s in Slovenia (Torelli et al., 1999) and from the 1970s to the 1990s in Poland (Podlaski, 2002). Moreover, non-stationary responses of tree-ring chronologies to climate have been identified in the European Alps (Leonelli et al., 2011), and anomalous growth trends in silver fir have been identified since the 1960s in the Lower Bavarian region of Germany (Wilson et Elling, 2004) and in the Central Apennine Alps of Italy (Gallucci et Urbinati, 2009). And, changes in tree-growth response to climate changes are expected to occur in the 21st century (Walther et al, 2005; Battipaglia et al., 2009).Thus, influence of MT and MR on silver fir growth was expected to occur in the Tuscan range of silver fir, which is mainly located in the Apennine Alps; non-stationary similarity in trends of monthly climate variables could have different influence on tree-ring growth among silver fir stands in the study area.

This scenario would suggest three main questions:

a) do tree-ring chronologies in silver fir vary among sites during the 20th century in the Tuscan Apennine Alps?
b) are there differences in tree-ring growth at upper and lower elevation within forests?
c) are there anomalous or unexpected growth patterns in tree-ring chronologies of silver fir in the study area in the 20th century?

In this study, I describe the tree-ring chronologies sampled at all sites in the study area and verify the presence of trends, test the level of association in tree-ring

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

chronologies within and between forest sites, and analyse whether the association between tree-ring chronologies during the 20th century among the study stands are stationary.

II. THE STUDY AREA

2.1 The meteorological stations

The climate pattern in the Tuscan Apennine Alps is classified as a Mediterranean montane with relatively mild summer, and rainfall tends to provide moisture enough to not cause drought. Winter is cold and frequently snowy; the permanence of snow varies from weeks to months. The meteorological stations that are located at the silver fir forests of Abetone, Camaldoli, La Verna, and Vallombrosa in the Tuscan Apennine Alps are shown in Fig. 1.1; distances between the meteorological stations and their elevation, and periods of climate data available are shown in Table 1.1. The site names are abbreviated respectively as ABE, CAM, LAV, and VAL.

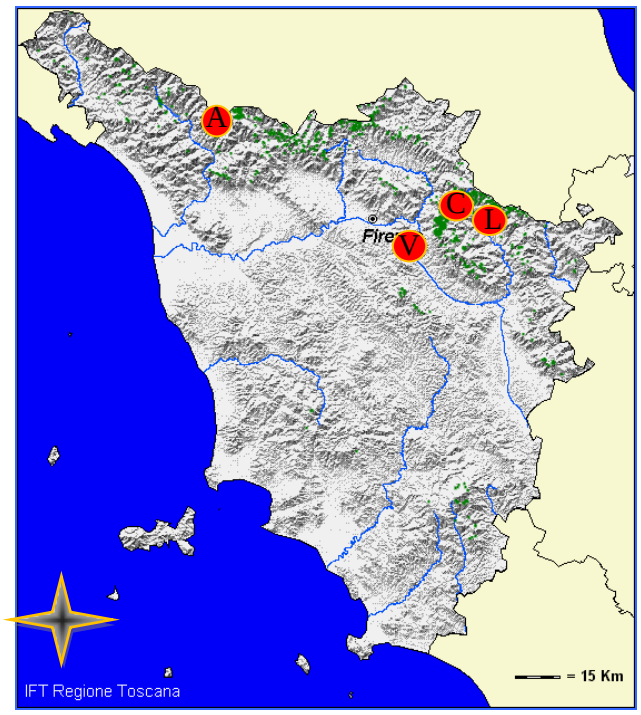


Fig.1.1: Location of the meteorological stations on tops of the Tuscan Apennine Alps. A is Abetone, C is Camaldoli, L is La Verna, and V is Vallombrosa.

Table.1.1: UTM coordinates, elevation, distance, and periods of climate data available of the meteorological stations in the Tuscan Apennine Alps. The climate data series cover different time periods. Notation (1) is for CREA- Research centre for Forestry and Wood, notation (2) is for the 'Annals' (ex-Hydrography Office of Pisa, Ministero dei Lavori Pubblici, Italy)

Meteo Station	*Coordinates UTM*	*Elevation of meteo station (m. asl)*	*Distance between meteo stations (km)*			*Periods of data available*	
			LAV	*CAM*	*VAL*	*Temperature*	*Precipitation*
ABE	4889150.00N 633615.00E	1340	112.3	100.1	84.6	1934-1996	1931-2000
LAV	4843695.00N 736295.00E	1120		13.2	30.4	1956-1990	1924-2006
CAM	4853040.00N 727035.00E	1111			22.3	1885-1993(1) 1925-1996(2)	1885-1993(1) 1931-1996(2)
VAL	4845450.00N 706000.00E	955				1872-1989(1) 1933-2006(2)	1872-1989(1) 1932-2006(2)

2.2 The silver fir stands

Silver fir in the Apennine Alps is at its southern range limit, where most of the silver fir forests are restricted to the tops of the mountains. In these sites, silver fir forests are likely to provide a particularly sensitive record of climate variation. Within the region, only a few silver fir

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

forests have a relatively long history of continuous management and regeneration, where a suitable number of stands with old firs can be found and where management and climate data have been regularly recorded and collected. Based on the distribution and availability of meteorological stations and suitable silver fir forests, I identified four main study sites: ABE (north-western Tuscany), CAM and LAV (south-eastern Tuscany), and VAL (central-south-eastern Tuscany) (Fig. 1.1). Their respective climate patterns are similar among sites, although the values of climate variables vary with site.

The meteorological stations are located within the borders of each forest, and therefore the distances between meteorological stations correspond to the distances between sites (Table 1.1).

Among the suitable silver fir forests in the Apennine Alps, there is variation in site quality, species composition, stand age and structure, and management history. In addition to meteorological data, I used the following criteria to select stands at the study sites:

a) primarily silver fir;
b) stand surface >2 ha;
c) age >100 years;
d) similar silviculture and management within each forest;
e) availability of stand management records;
f) within each forest, similarity in site characteristics (i.e., exposure, drainage, geology) within the bound of highest potential elevation gradient;
g) between forests, highest potential elevation and latitudinal gradients.

2.2.1 Elevation of the forest stands

The elevation of the selected forests shows an average span of 385m (Table 1.2), with a difference of 542m between the upper stand at ABE (ABE-Upper) and the lower stand at VAL (Table 1.2); the elevation gradient between study stands within forest differs among forests. CAM and LAV are relatively close (about 13 km) and the meteorological stations have similar elevation (Table 1.1) but they differ in site characteristics, topography, geology, composition, and silviculture, and especially in the elevation gradient of the study stands between the two forests, whereas the difference between the lower at CAM (CAM-Lower) and the upper at LAV (LAV-Upper) is 144m.

Table.1.2: Upper and lower elevation and relative gradient of elevation within forest site, prevailing aspect, mean slope, topography, and age of the study stands in the study area. The age refers to the year 2007.

Forest stand	Elevation of stand (m asl)	Elevation gradient (m)	Aspect	Mean slope	Topography	Age (years)
ABE-Upper	1445	165	SE	32%	Ridge	>180
ABE-Lower	1280		SE	17%	Along ridge	116
LAV-Upper	1204	46	SES	50%	Close to peak	>150
LAV-Lower	1158		SES	40%	Along slope	>150
CAM-Upper	1130	70	S	20%	Along ridge	109
CAM-Lower	1060		S	58%	Along slope	106
VAL-Upper	1113	210	N	40%	Along ridge	117
VAL-Lower	903		N	30%	Ridge	105

2.2.2 Tree sampling

Within each stand 14 trees were selected by applying these criteria:

a) social position (dominant and co-dominant trees were selected; suppressed trees were excluded) (Pinto et al, 2008);
b) stem condition (trees with external evidence of damage were excluded); and
c) crown shape and development (strongly asymmetric trees were excluded).

In each tree, two tree core samples perpendicular to the main slope were extracted with a tree corer ~1.3 m above the ground; stem diameters perpendicular to the slope were measured; and crown class and position were taken along the transect elevation gradient.

III. METHODS

I used matrix correlation (MC) to test the average level of association in residual tree-ring chronologies (RTRs) within and between forest sites, and agglomerative hierarchical clustering (AHC) to verify how RTRs tend to group among sites (Piovesan et al., 2005; Leal et al., 2008; Oberhuber et al., 2007). MC and AHC show the level of similarity within forest sites and among sites and its variability with distance among sites. However, these statistics do not show if similarity between tree-ring growth series is stationary during the 20th century within and/or among forests sites.

The presence of periods or cycles 3.9, 5.0, 6.0, 8.3 and 13.3 years has previously been observed in silver fir tree-ring growth in Italy (Schirone, 1992). So, I verified if any cycle in RTRs is present at the study sites also. The

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

presence of cycles in RTRs could be used to verify whether any period in RTRs relates to periods in MT and/or MR in order to provide a lag for moving averages. In fact, moving averages are frequently used in the analysis of climate-tree-ring growth relationships. Thus, I used spectral (Fourier) analysis to investigate the presence of peak periods common to all the RTRs chronologies. I tested the variability in similarity of RTRs during the 20th century within and among the study stands by applying the Pearson's correlation to moving averages between paired series of RTRs, where the time lags shown by spectral analysis were implemented.

3.1 Tree-ring sample preparation for dating

I prepared 224 core samples extracted from the eight-silver fir stands at four study sites to observe variation in growth ring widths and wood anatomical features and ensure accurate dating for climate analysis by using standard dendrochronological techniques (Stokes and Smiley, 1996; Fritts, 1976; Cook and Kairiukstis, 1990). Cores were mounted and glued onto grooved boards and sanded to a mirror finish using progressively finer grade sandpaper (120, 280, 400, 600, 800 grit) to produce flat surfaces where the ring boundaries are clearly defined under magnification. Then, I scanned the cores with a high-resolution digital scanner at 1600-2400 dpi; ring width was measured to 0.01mm precision.

3.2 Cross-dating of tree-ring chronologies

Cross-dating is key to the development of robust chronologies for climate analyses. In this research, I cross-dated the tree-ring series by using a digital image analysis system (WinDENDRO, Regent Instruments Inc., Canada). Then, I analyzed statistically the visual cross-dating by using COFECHA (Holmes, 1983) under the protocols described by Grissino-Mayer (2001). Core samples that could not be reliably cross-dated were excluded from further analyses.

3.3 The statistics in cross dating

Various statistics were calculated to describe each chronology of the silver fir stands sampled:

- mean sensitivity (MS), a measure of the mean relative change between adjacent ring widths calculated over the whole tree-ring series (Fritts, 1976);
- tree-ring standard deviation (SD): MS and SD assess the high-frequency variation of the series;
- first-order serial autocorrelation (AC) detects the persistence retained before and after the standardization;
- mean correlation between trees (Rbar);
- common variance among the individual tree-ring series explained by the 'Expressed Population Signal" (EPS) (Wigley et al., 1984).

The quality of cross-dating was assessed with the EPS and the running Rbar. When some tree-ring chronologies did not cross-date well in the same individual or between trees, I excluded it from further analyses to select the best subset of tree-ring series in each silver fir stand in the study area. To do this, I compared each individual tree-ring series with the mean correlation of all the tree-ring series of the respective stand and removed those chronologies that would reduce the higher correlation of the master series and lower the EPS chronology.

3.4 Standardization of tree-ring chronologies

Growth trends partially depend on the biological development of the tree and their screening may enhance the variability in tree-ring growth related to the influence of climate factors (Fritts, 1976). For example, sharp changes in tree growth could be due to cultural interventions such as thinning, local disturbances caused by wind storms, heavy snow, or insect attack. Among the numerous factors likely to influence ring width, age has the primary role (Fritts, 1976). This precludes the direct comparison of trees and stands of varied ages and the identification of the influence of the other factors. The commonest way to circumvent this difficulty is to transform each measured ring width into a growth index which is most frequently expressed in percent, the ratio of each actual width versus a reference values previously established for the corresponding current ring age (cambial age).To reduce the effects of similar disturbing factors, standardization of tree-ring chronologies aims to highlight the variability in tree-ring growth due to climate variability by building curves that are meaningful to dendrochronological analysis.

I used the computer program ARSTAN (Cookand Holmes, 1984) to standardize the tree-ring series by applying a multi-step approach that accounts for both the age-related growth trend and other factors such as past disturbances to further reduce the influence of non-climatic factors. All tree-ring series were initially transformed to series of dimensionless indices with a mean of one and stabilized variances using an adaptive power transformation (Cook and Kairiukstis, 1990; Druckenbrod and Shugart, 2004). This enabled the tree-ring series to meet the assumptions of normality and equal variance required for subsequent regression analyses with the climate variables (Cookand Holmes, 1984). Then, first-detrending was applied to all the sets of tree-ring chronologies by using Hugerhoff polynomial curves to standardize each individual tree-ring series with a 50-year spline. A 50-year spline curve was adopted to amplify the climate signal (high frequency) by removing the effects of

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

non-climate factors (low frequency) (Fritts, 1976; Cook and Peters, 1997, Chhin and Wang, 2005). Each series was modelled through a self-regression process where the order was selected on the basis of the minimum AIC (*Akaike Information Criterion*). So, the variance due to width measures distant from mean values was stabilised.

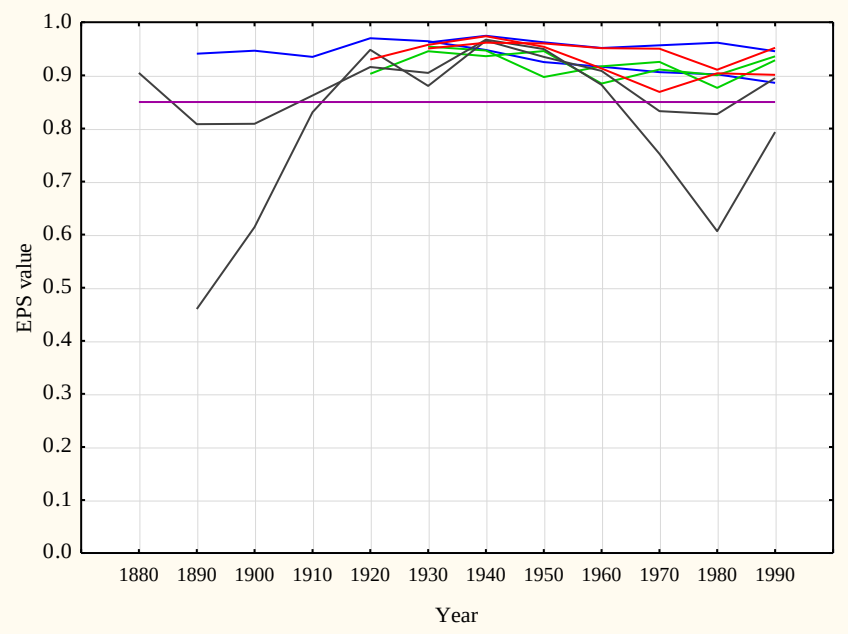
Because a smoothing spline is a moving average of localized regressions, the choice of window size is important - a long window gives a stiff spline that removes low frequency variation, while a short window gives a flexible spline that may remove low and high frequency variation (Cookand Holmes, R. L., 1984). Therefore, I repeated this procedure by using a 20-year smoothing spline, but results did not substantially differ.

Non-climatic factors that influence tree growth may result in autocorrelated growth trends in the series, where trees show a lagged growth response to growing conditions in previous years. Since environmental conditions in year *t* may influence growth in years *t + 1*, *t + 2*, to *t + n* (i.e., autocorrelation) and correlation analysis with climate variables assumes that all observations are independent, an autoregressive modelling procedure was used to remove autocorrelation from individual tree-ring series and identify patterns of autocorrelation common to the sample population. To account for autocorrelations, the detrended tree-ring series were pre-whitened using autoregressive modeling (AR). Autocorrelations were determined for each series and then removed. Then, all series were compared to identify any common autocorrelation components, which were then added back into the detrended series. To do this, all of these series were detrended and corrected for autocorrelated growth trends; I used a bi-weight robust mean to combine them into a final autoregressively standardized (ARSTAN) chronology. In this research, I used the residual chronologies to assess the variability between tree-ring chronologies and site related factors.

IV. RESULTS

4.1 Expressed Population Signal (EPS)

Both the EPS and Rbar were calculated by 50-year lags and 20-year lags with overlaps of 25 years and 10 years, respectively. Figure 1.2 shows EPS and Rbar of the tree-ring chronologies from each silver fir stand at the study area and their years of occurrence. In all cases, the EPS value is greater than the threshold value of 0.8 during the 20th century.



https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

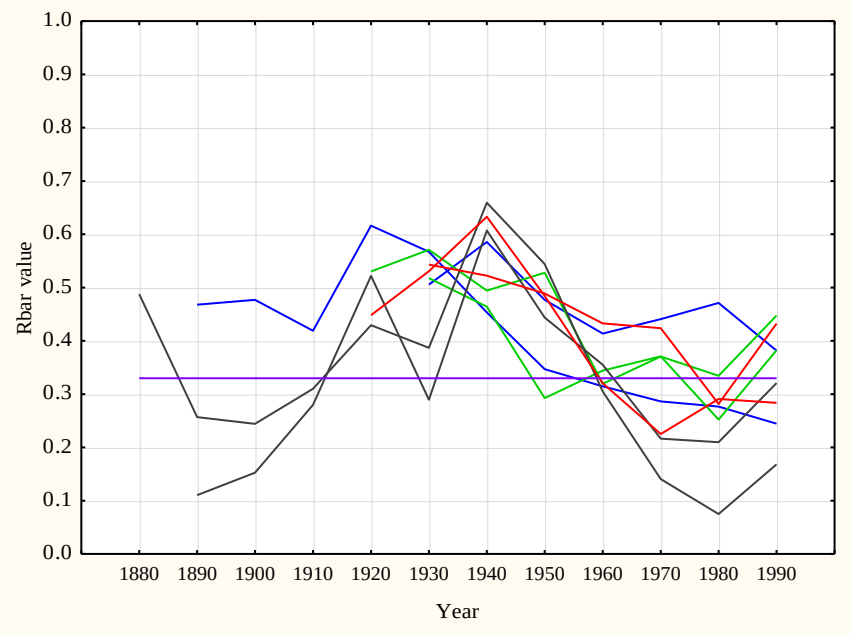


Fig.1.2: EPS (above) and detrended Rbar (below) in all the silver fir stands selected at the study site are calculated with20-year lags and overlaps of 10 years. The magenta horizontal lines are respectively EPS equal 0.85 in the EPS graph (above) and mean interseries correlation equal 0.33 at the significance level 99% in the Rbar graph (below). Upper and lower ABE is blue, upper and lower CAM is green, upper and lower LAV is black and upper and lower VAL is red.

4.2 Master series of tree-ring chronologies of the silver fir stands in the Tuscan Apennine Alps

Descriptive statistics of tree-ring series for all the silver fir stands in the study area are shown in Table 1.3.

In this analysis, a cubic smoothing spline with 50% wavelength cut-off for filtering 32 years was used; segments examined are 50 years lagged successively by 25 years. Autoregressive modelling as applied and residuals were used in master dating series and testing. Absent rings were omitted from master series and segment correlations.

Normally, a coefficient of mean series intercorrelation >0.33 is conventionally used to accept a master series of tree-ring chronologies (Holmes, 1983; Grissino-Mayer, 2001). However, I increased this critical value to >0.50 to improve the quality of the master series from the silver fir stands in the study area. Results show (Table 7.1) that this coefficient is normally >0.6 in all the stands in the study area except LAV-Lower (0.575).

Therefore, the quality of cross-dating and the subsequent representativeness of tree-ring growth appear high at the study sites selected in the Tuscan Apennine Alps.

Table.1.3: Characteristics of the mean tree-ring chronologies of the silver fir stands in the study area. N is 'number of ring-width series',MRW is 'mean ring width', RW is 'ring width', 'standard deviation' is SD, 'first-order autocorrelation' is AC, 'mean sensitivity' is MS.

Stand	N	Mean series length	Mean series intercorrelation	MRW	Max RW	SD	AC	MS
ABE-Upper	2892	117	0.668	1.60	7.39	1.012	0.893	0.225
ABE-Lower	2517	107	0.699	2.18	6.32	0.898	0.821	0.171
CAM-Upper	1997	82	0.651	2.53	16.39	1.403	0.785	0.260
CAM-Lower	1490	61	0.665	2.56	7.71	1.273	0.784	0.245
LAV-Upper	2019	83	0.617	2.18	8.87	1.199	0.834	0.265
LAV-Lower	2175	89	0.575	2.58	11.43	1.465	0.822	0.268
VAL-Upper	2139	88	0.680	2.36	8.25	1.017	0.723	0.237
VAL-Lower	2149	89	0.619	2.04	7.48	0.846	0.769	0.205

4.2.1 Abetone: Silver fir stands ABE-Upper and ABE-Lower

Stand ABE-Upper (m1445 asl) is the upper site at Abetone and the higher in elevation among the silver fir stands in this study. ABE-Lower (m1280 asl) is the lower stand at Abetone but is at a higher elevation than all the other stands except ABE-Upper (Table 1.4).

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

Table.1.4: Characteristics of master series of tree-ring chronologies in the stands ABE-Upper and ABE-Lower.

Silver fir stand	ABE-Upper	ABE-Lower
Number of dated series	24	28
Master series	1864–2007, 144yrs	1901–2007,107 yrs
Total rings in all series	2892	2517
Total dated rings checked	2891	2508
Mean length of series	120.5	89.9
Portion with two or more series	1865/2007, 143yrs	1910/2007, 98yrs

4.2.2 Camaldoli: Silver fir stands CAM-Upper and CAM-Lower

At Camaldoli, stand CAM-Upper (m1130asl) is the upper and CAM-Lower (m 1060 asl) is the lower one. Both these stands (Table 1.5) are at lower elevation than the stands at La Verna. This reduction in the number of tree-ring series was caused by decayed rings in intermediate traits of the core samples that made crossdating ineffective. Missing rings were not found in CAM-Upper and CAM-Lower.

Table.1.5: Characteristics of master series of tree-ring chronologies in the upper and lower stands at CAM.

Silver fir stand	CAM-Upper	CAM-Lower
Number of dated series	21	18
Master series	1901-2007, 107 years	1909-2007, 99 years
Total rings in all series	1997	1490
Total dated rings checked	1994	1490
Mean length of series	95.1	82.8
Portion with two or more series	1904–2007, 104 years	1909–2007, 99 years

4.2.3 La Verna: Silver fir stands LAV-Upper and LAV-Lower

The tree-ring chronologies from La Verna are (Table 3.4) the longest after ABE-Upper (Table 1.6). Silver fir at LAV appears much older than 150 years; however, longer chronologies could not be extracted because of the internal decay that affects many trees from the inner trunk outward. Decayed wood caused also some cores to be discarded as unsuitable for crossdating and some cores to not crossdate at an acceptable quality level for this analysis

Table.1.6: Characteristics of master series of tree-ring chronologies in the stands LAV-Upper and LAV-Lower.

Silver fir stand	LAV-Upper	LAV-Lower
Number of dated series	18	19
Master series	1864-2007, 144 yrs	1859-2007, 149 yrs
Total rings in all series	2019	2175
Total dated rings checked	2016	2171
Mean length of series	112.2	114.5
Portion with two or more series	1867–2007, 141 yrs	1863–2007, 145 yrs

4.2.4 Vallombrosa: Silver fir stands VAL-Upper and VAL-Lower

The lower stand at Vallombrosa shows longer continuous time span and mean length of tree ring chronologies than the upper stand (Table 1.7).

Table.1.7: Characteristics of master series of tree-ring chronologies in the stands VAL521 (upper) and VAL460 (lower).

Silver fir stand	VAL-Upper	VAL-Lower
Number of dated series	26	23
Master series	1909–2007, 99 yrs	1895–2007, 113 yrs
Total rings in all series	2139	2149
Total dated rings checked	2138	2146
Mean length of series	82.3	93.4
Portion with two or more series	1910–2007, 98 yrs	1898–2007, 110 yrs

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

4.3 Trends in master tree-ring chronologies at all study sites

The raw ring–width chronologies, standardized chronologies, residual chronologies, and autoregressively standardized chronologies of silver fir from the sites in the Tuscan Apennine Alps during the 20th century show the patterns of growth (Figures 1.3–1.6).

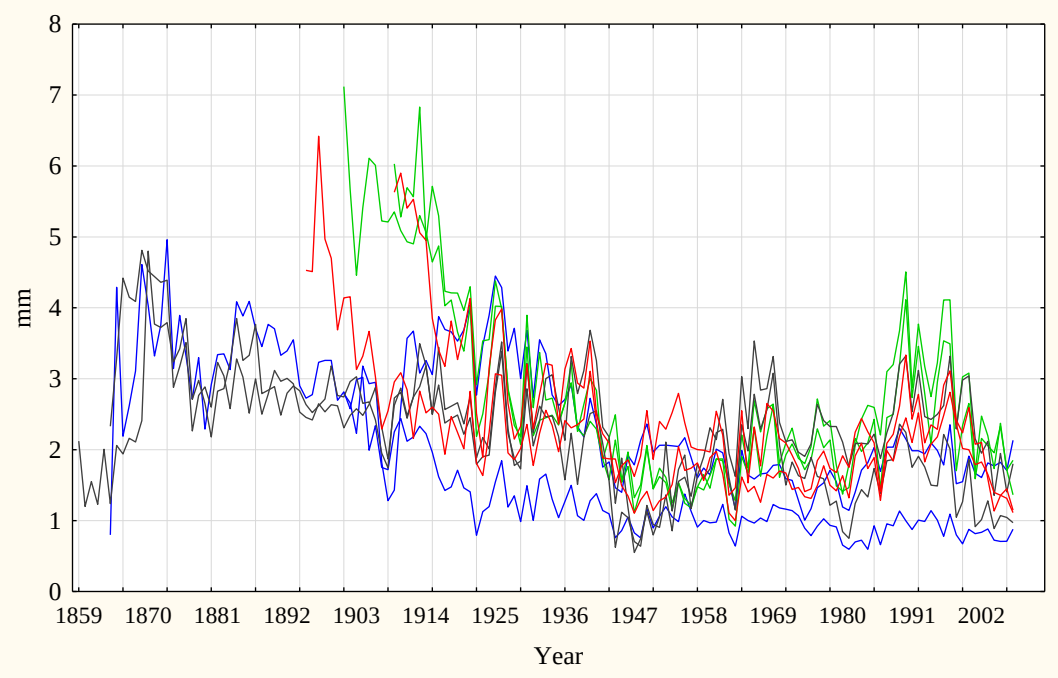


Fig.1.3: Raw tree-ring width chronologies from the late 1850s to the year 2007 in all the silver fir stands in the study area. Upper and lower ABE is blue, upper and lower CAM is green, upper and lower LAV is black and upper and lower VAL is red.

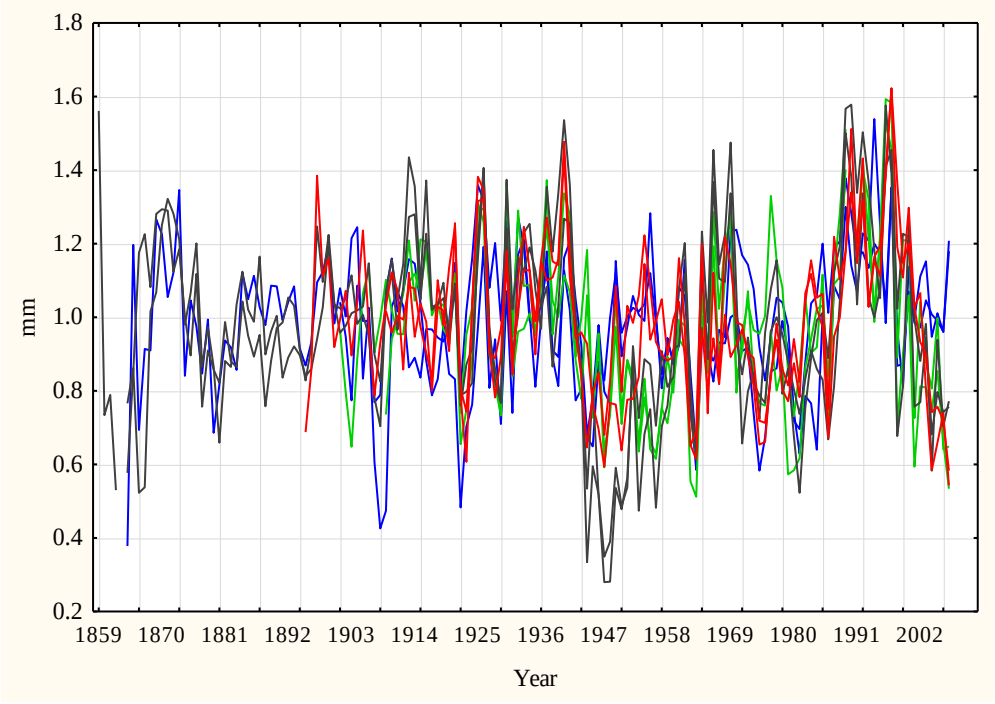


Fig.1.4: Standardized tree-ring width chronologies from the late 1850s to the year 2007 in all the silver fir stands at the study area. Upper and lower ABE is blue, upper and lower CAM is green, upper and lower LAV is black and upper and lower VAL is red.

https://dx.doi.org/10.22161/ijaems.5.2.5 ISSN: 2454-1311

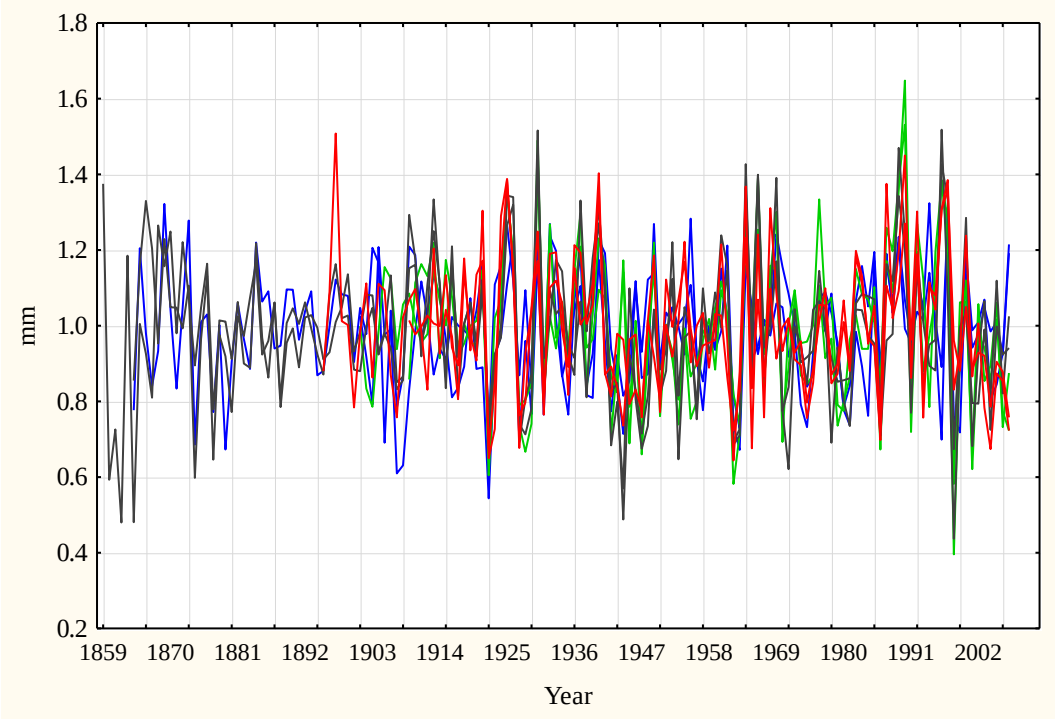


Fig.1.5: Residual tree-ring width chronologies from the late 1850s to the year 2007 in all the silver fir stands at the study area. Upper and lower ABE is blue, upper and lower CAM is green, upper and lower LAV is black and upper and lower VAL is red.

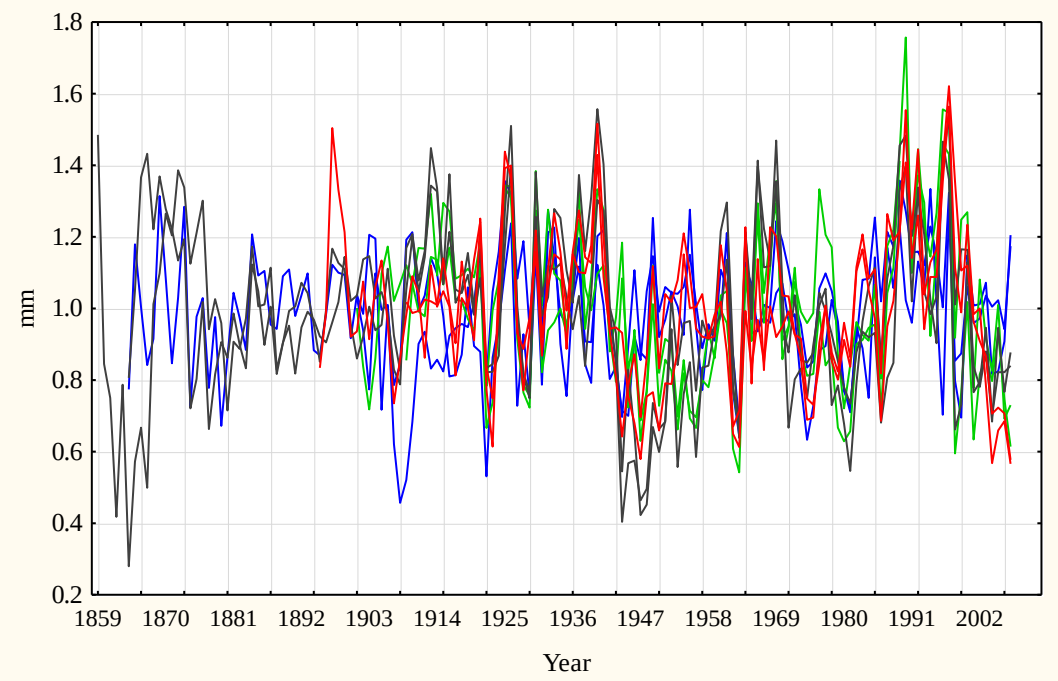


Fig.1.6: ARSTAN tree-ring width chronologies from the late 1850s to the year 2007 in all the silver fir stands at the study area. Upper and lower ABE is blue, upper and lower CAM is green, upper and lower LAV is black and upper and lower VAL is red.

The growth curves that underlie the *raw ring width chronologies* show that a negative exponential curve is appropriate for standardisation in all the silver fir stands sampled in this study; this growth pattern is typical of pure, even-aged conifer stands (Speer, 2010; Bernetti, 1998; Fritts, 1976). The curves show a markedly different slope until the 1930's, which is more pronounced in the younger stands (CAM and VAL) with respect to the older ones (ABE and VAL). The silver fir stands at LAV, especially LAV-Lower, could not show the first years - or decades - of growth because of the decay in the inner trunk. Although silver fir at LAV is currently managed as

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

an uneven-aged stand mixed with broad-leaved tree species (e.g., *Fagus sylvatica* L.); historical records suggest that these forests were probably even-aged during the previous centuries.

4.4 Periods in residual tree-ring chronologies in the Tuscan Apennine Alps

The presence of cycles or periodicity in the RTRs was tested by spectral (Fourier) analysis. Results show periods that occur more frequently in all the silver fir stands. Principal periods are3.00, 3.96, 4.95, 5.82, 7.07, 12.38-14.14 (average 13.26), 19.80, 24.75, and 33.0 years of length (Table 1.8). They appear to differ little from those found in silver fir radial growth in southern Italy (province of Isernia) by Schirone et al. (1992) where cycles 3.93, 5.00, 6.00, 8.28, and 13.33 years were detected; the 8.28-years and 3.93-years periods would show higher frequency. It can be noted that the 13.3-years period in southern Italy is the average between the 12.4-years and 14.1-years period in the Tuscan sites, and the 8.28-years period observed in southern Italy occurs also in the study area (8.25-years).

I noted that:

- the periods 14.1, 49.5, and 99.0 years are multiples of the period 7.1 years, which is a common sub-dividend among the various periods; and, the periods 49.5 years and 99.0 years are nothing but multiples of the period 24.75 years (Table 1.8);
- the periods 7.07-years and 33.0-years, which are detected in the RTRs in the study area, differ little from submultiples of the Atlantic Multidecadal Oscillation (AMO), which has a cycle of 70 years;
- the 11.0-year period (Table 1.8) corresponds to the Hale hemi-cycle (solar sunspots);
- the 18-19 years period has length similar to the North Atlantic Oscillation (18 years) or the lunar node cycle; and
- the periods 9.00 years (secondary peak) and 19.8 years are also present in the RTRs during the study period observed.

Although these potential coincidences – or similarities - do not prove the existence of a direct influence of solar-terrestrial physical factors on silver fir growth in the study area, still spectral (Fourier) analysis of RTRs would suggest the presence of regular cycles or periods where length is a multiple of approximately 7-years periods.

Table.1.8: Periods (years) that occur most frequently in the RTRs as shown by spectral (Fourier) analysis. Peak periods are shown by yellow cells; secondary peaks are shown by grey cells.

ABE Upper	ABE Low	CAM Upper	CAM Low	LAV Upper	LAV Low	VAL Upper	VAL Low
99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5
33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0
24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8
19.80	19.8	19.8	19.8	19.8	19.8	19.8	19.8
16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1
12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
7.1	7.1	7.1	7.07	7.1	7.1	7.1	7.1
6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30
4.13	4.13	4.13	4.13	4.13	4.13	4.13	4.13
3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96
3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81
3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54
3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41
3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19
3.09	3.09	3.09	3.09	3.09	3.09	3.09	3.09
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91
2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83
2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
2.68	2.68	2.68	2.68	2.68	2.68	2.68	2.68
2.61	2.61	2.61	2.61	2.61	2.61	2.61	2.61
2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
2.48	2.48	2.48	2.48	2.48	2.48	2.48	2.48
2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41
2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36
2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11
2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02

4.5 Association between tree-ring chronologies within and among sites in the Tuscan Apennine Alps

4.5.1 Matrix correlation tests of tree-ring chronologies from the study sites

Matrix correlation tests provide a first insight into the overall level of association between tree-ring series within and among forest sites (Table 1.9). However, this statistic does not show if similarity is stationary over time in tree-ring series between upper or lower stands either within forests and among sites.

Table.1.9: Pearson's r matrix correlation of RTRs among the silver fir stands in the study area. The period 1909-2007 is common to all the tree-ring chronologies. All the correlations are significant at p-value <0.0001 and significance level alpha 0.05.

	ABE Upper	ABE Lower	CAM Upper	CAM Lower	LAV Upper	LAV Lower	VAL Upper	VAL Lower
ABE-Upper	1.00	0.67	0.43	0.39	0.47	0.48	0.44	0.39
ABE-Lower	0.67	1.00	0.52	0.57	0.52	0.45	0.55	0.49
CAM-Upper	0.43	0.52	1.00	0.86	0.73	0.72	0.69	0.60
CAM-Lower	0.39	0.57	0.86	1.00	0.72	0.73	0.71	0.64
LAV-Upper	0.47	0.52	0.73	0.72	1.00	0.86	0.65	0.56
LAV-Lower	0.48	0.45	0.72	0.73	0.86	1.00	0.64	0.57
VAL-Upper	0.44	0.55	0.69	0.71	0.65	0.64	1.00	0.82
VAL-Lower	0.39	0.49	0.60	0.64	0.56	0.57	0.82	1.00

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

Results show that the association between RTRs from upper and lower silver fir stands at the same site is always higher than among sites (Table 1.9).Within the study sites, the Pearson's *r* coefficient is >0.83 at CAM, LAV, and VAL except at ABE where *r* is 0.67. Instead, the level of association among the study sites appears to weaken with increasing distance; in fact, *r* is >0.57 and <0.73 at CAM, LAV, and VAL and <0.57 at ABE.

4.5.2 Agglomerative hierarchical clustering of tree-ring chronologies in the study sites

Agglomerative hierarchical clustering (AHC) was used to show how RTRs tend to group among the silver fir stands in the study area (Fig. 1.7). Results show higher association between tree-ring growth within sites and decreasing association among sites with increasing distance. To verify if different kinds of clustering were shown by different methodological approaches to AHC, the AHC tests were performed by both the Pearson-*r* and Euclidean distance measures. The linkage rules 'single linkage', 'complete linkage', and 'unweighted pair-group average' were applied. Results differ very little from those shown in Figure 1.7.

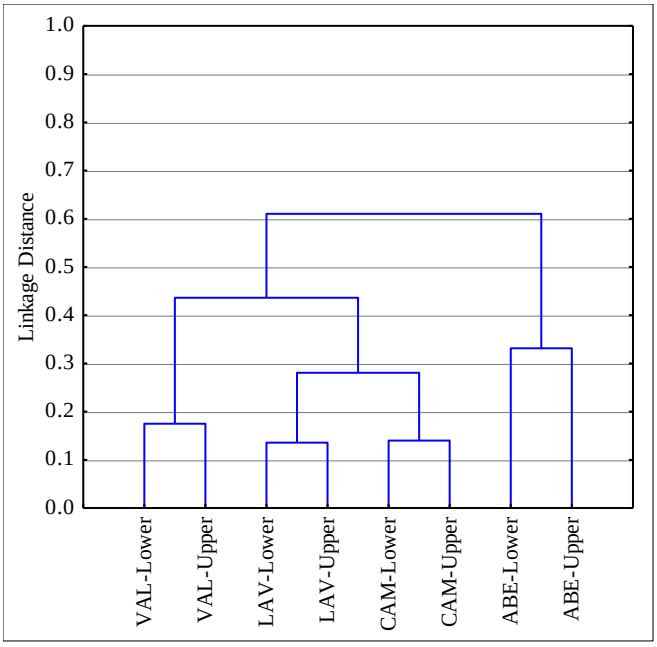


Fig.1.7: Agglomerative hierarchical clustering of RTRs in the period 1909-2007 from the silver fir study stands in the study area. The test is based on the Pearson's r coefficient, method "complete linkage".

4.5.3 Moving averages of Pearson's correlation coefficients

The presence of a sub-period about 7 years in the RTRs would suggest using it as a time-lag (temporal window) in the Pearson's *r* correlations of 7-years moving averages of paired RTRs. Results show that similarity in RTRs during the 20th century in the study area (Figures 3.7, 3.8, and 3.9) is more non-stationary among sites than within forest sites. Figure 1.8 shows that *r* between upper and lower silver fir stands within sites is normally >0.60 and <0.98 but it drops frequently to <0.60 at ABE and VAL, and at LAV in the 1970s. In particular, similarity between RTRs strongly reduces at VAL in the mid-1940s and in the late 1950s. Before the 1920s, similarity in RTRs between upper and lower stands within sites is null or very weak and correlation coefficients show even negative values at all sites. At LAV, similarity appears very strong although this may be due to little difference in elevation between the upper and lower stands, where low similarity at CAM and VAL before the 1920s might be related to the young age of silver fir. At ABE also the lower stand is younger than the upper stand.

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

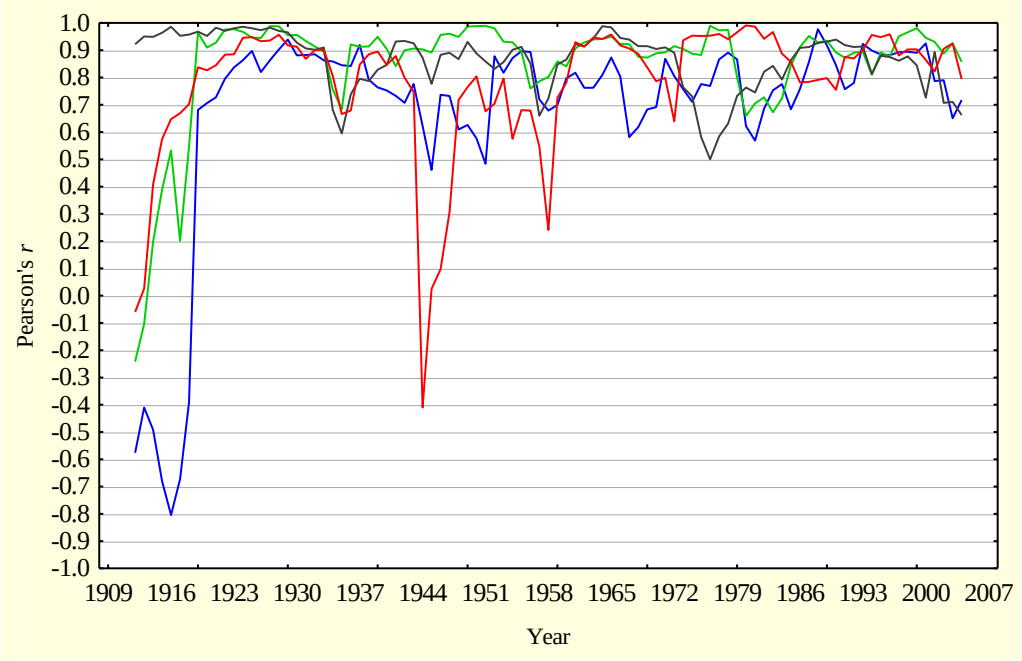


Fig.1.8: Variability in the correlation of 7-year moving averages of RTRs between upper and lower study standswithin silver fir forests in the study area; period 1909-2007. Blue is ABE, green is CAM, dark grey is LAV, and red is VAL.

Variability in similarity of trends of RTRs between sites is more pronounced and irregular than within sites (Figures1.8-1.10). The correlation coefficient frequently turns from highly positive values to negative values – and vice versa - even in short time and irregularly among sites. Moreover, fast changes in similarity among sites may not include some of them. In other words, the correlations between paired RTRs may differ in sign even in the same period among sites. For example, the level of correlation is high ($0.62<r<0.84$) between the upper stands at ABE-VAL, ABE-LAV, and LAV-VAL in the 1940s, and even negative ($0.20<r<-0.58$) at CAM-LAV, CAM-VAL, and ABE-CAM in the same period.

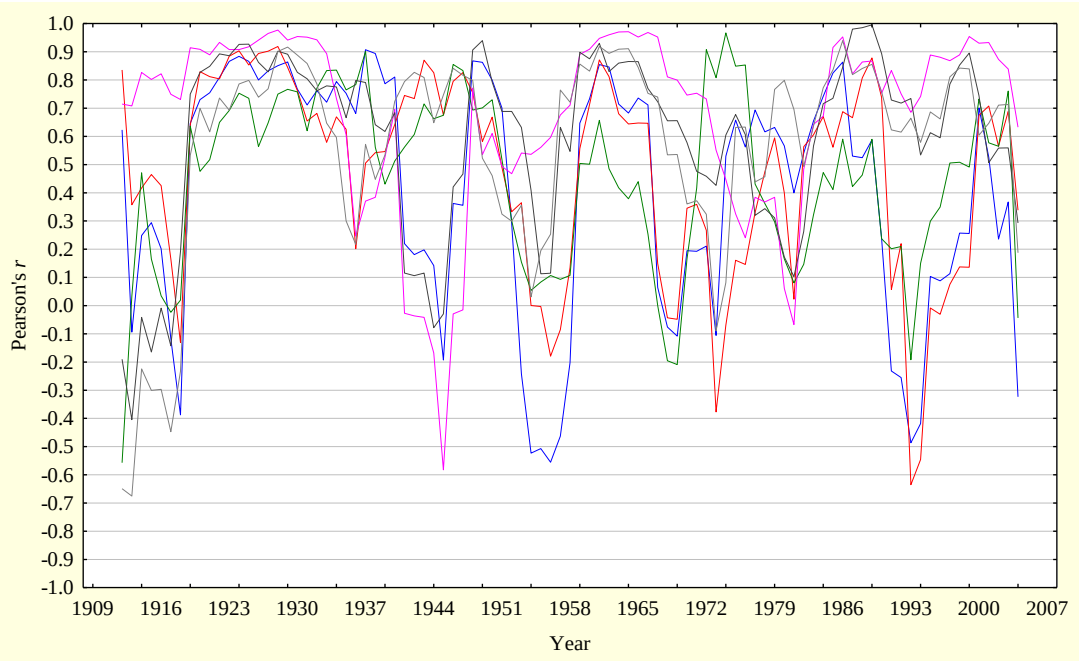


Fig.1.9: Variability in the correlation (Pearson's r) of 7-year moving averages between RTRs among the upper study stands of silver fir forests in the study area; period 1909-2007. ABE-CAM is blue, ABE-LAV is red, ABE-VAL is green, CAM-LAV is magenta, CAM-VAL is dark grey, and LAV-VAL is light grey.

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

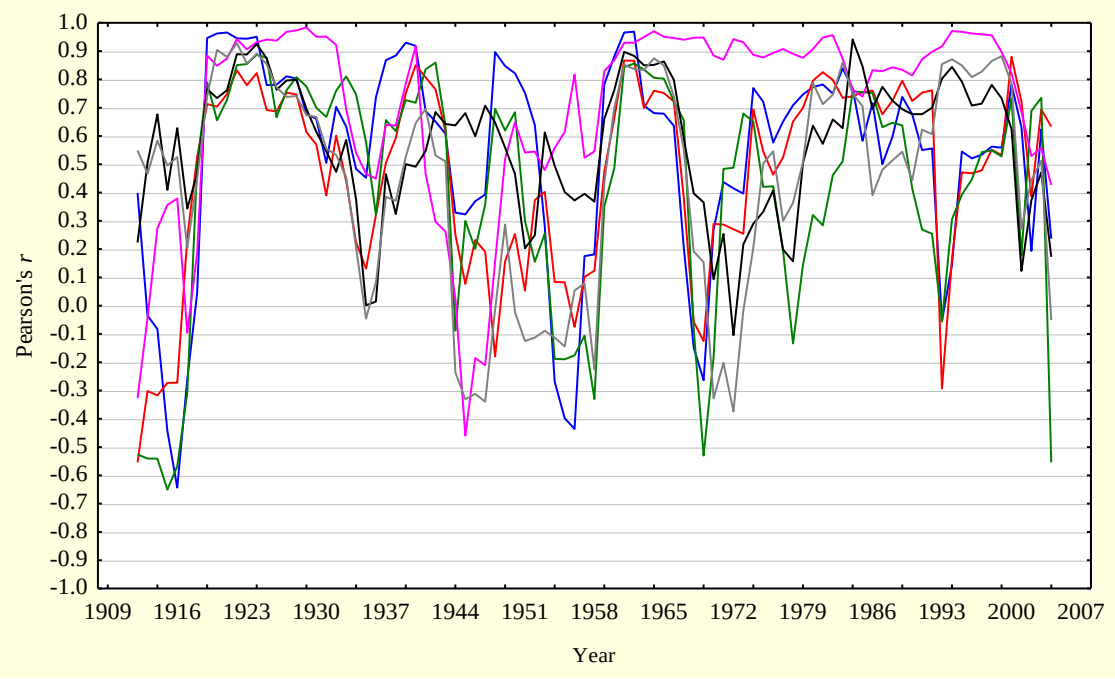


Fig.1.10: Variability in the correlation (Pearson's r) of 7-year moving averages between RTRs among the lower study stands of silver fir forests in the study area; period 1909-2007. ABE-CAM is blue, ABE-LAV is red, ABE-VAL is green, CAM-LAV is magenta, CAM-VAL is dark grey, and LAV-VAL is light grey.

V. SUMMARY OF RESULTS

The tree-ring series sampled from the silver fir stands in the study area show:

- non-stationary similarity in RTRs among sites and, at a lower extent, between upper and lower sites within silver fir forests during the 20th century; in particular:
  - similarity in RTRs between upper and lower study stands in each forest site is non-stationary. However, its variability seems to decrease from the 1980s onward (Fig. 1.8);
  - similarity in RTRs respectively between upper study stands and between lower study stands is highly variable (Fig. 1.9 and Fig. 1.10); it frequently changes from high similarity to dissimilarity during the 20th century. This would indicate that growth response of silver fir to environmental influence differs with site in the study area.
- non-stationarity is featured by strong changes in correlation values between paired series of RTRs; these changes occur irregularly during the 20th century;
- faster growth and positive trends RTRs seem to occur from the mid-1940s to the mid-late 1990s (Figures 1.3-1.6). This would suggest that climatic-environmental stimulation of growth increases after the mid-1940s;
- rapid and strong decrease of growth from the late 1990s to the mid-2000s. At ABE, the decrease appears to stop in the early 2000s in both the upper and lower silver fir stands;
- in the RTRs, pronounced troughs are shown in the periods between the mid-1940s and the mid-1950s, from the mid-1970s to the mid-1980s, and in the 2000s.The lower values are shown from the mid-1940s to the mid-1950s; a very fast reduction in growth is noted in the early 1940s (Figure1.5);
- an unprecedented peak period during the 20th century occurs in the 1990s at all the study stands (Figures 1.3-1.6); the higher values occur in this decade except at ABE-Lower in the period 1925-1935 (Table 1.10).

Table.1.10: Peaks in mean ring width (MRW) of tree-ring chronologies of the silver fir study stands in the period 1990-2000 compared with the other higher peaks of the respective entire chronologies.

	Period	MRW
ABE-Upper	1865-1875	1.06
	1990-2000	1.16
ABE-Lower	1925-1935	1.14
	1990-2000	1.14
CAM-Upper	1925-1935	1.08
	1990-2000	1.24
CAM-Lower	1931-1941	1.08
	1989-1999	1.33
LAV-Upper	1961-1970	1.04
	1989-1999	1.23

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

LAV-Lower	1930-1940 1989-1999	1.20 1.28
VAL-Upper	1930-1940 1990-2000	1.12 1.26
VAL-Lower	1930-1940 1990-2000	1.13 1.28

VI. UNEXPECTED INCREASE OF TREE-RING GROWTH IN RECENT DECADES IN THE TUSCAN APENNINE ALPS

The tree-ring chronologies show that the influence of climate on radial growth during the 1990sisunprecedented during the 20th century in the study area (Figures 1.3-1.6; Table 1.10); this occurs at all age, elevation, and site features of the silver fir study stands. In the Tuscan Apennine Alps, tree-ring growth in silver fir appears to increase from the late 1940s to the late 1990s while the average ring-width growth in the respective yield tables (Cantiani and Bernetti, 1963; Castellani et al., 1984) would decrease. In other words, the occurrence of a peak period of growth in the 1990s and a secondary peak in the 1960s appears to contrast with the expected growth curve of ring-width in pure, mono-aged silver fir stands, which is shown by ring-width curves that follow a negative exponential distribution (Boncina, 2011; Bozi˘c´ et al, 2006; Susmel, 1988; Fritts, 1976). This pattern of ring-width growth is considered typical of many conifer species, including the mono-aged silver fir stands both in the study area and in Italian sites other than the Tuscan Apennine Alps as shown by various yield tables.

VII. DISCUSSION

Tree-ring growth is expected to be non-stationary over time (Fritts, 1976); how it varies among and within sites concerns dendrochronology. In the study area, similarity in RTRs varies highly and irregularly among sites during the 20th century and, at lower extent, within sites; peaks and troughs are more pronounced from the 1940s onward. Normally, changes in the shape of curve from raw ring width to RTRs are expected. At ABE, CAM, and VAL, RTRs appear to show that variability in trends becomes more pronounced after the late 1930s (Figure 1.5).The association of RTRs between upper and lower study stands is normally high except at ABE, where it is moderate. This would suggest that biological and/or non-climatic factors progressively reduce their influence on tree-ring growth until the 1920s-1930s. In particular, a pronounced depression in tree-ring growth occurs in all the study stands in the mid-1940s and an unprecedented high tree-ring growth is observed during the 1990s.

These results would indicate that the influence of climate on silver fir growth differs among sites in the medium-long term during the 20th century; short-term variability in silver fir growth possibly due to local, short-term events and interventions (i.e., windstorms, snowfall, parasites, cuts) is minimal or at least secondary.

During the 20th century seven out of eight silver fir study stands of any age show higher RTR in the 1990s. This trend appears to contrast with the known curve of growth in pure, even-aged conifer stands where growth is expected to slowly decrease in silver fir stands >60-80 years of age. A similar increase in silver fir growth has also been detected in various regions of Europe in the last decades of the 20th century (Becker et al., 1995; Filipiak and Ufnalski, 2004; Elling et al., 2009; Toromani et al, 2011). Moreover, a change in trend of raw tree-ring chronologies occurs in the late 1930s–early 1940s in all the study stands, which is followed by more pronounced peaks and troughs.

The scenarios from the European to the Italian regional and local scales show that strong depression in silver fir radial growth occurs frequently (i.e., in the 1940s, in the 1960s-1970s, and in the 2000s) and alternates irregularly with positive trends in radial growth during the 20th century. For example, in the period 1975-1985 a severe crisis of silver fir occurs in Europe and Middle Italy. In southern Germany, silver fir growth shows a negative trend in mean radial growth between the 1880s and the mid-1970s, which turns into positive in the late 1970s-early 1980s (Elling et al., 2009). Moderate reductions in radial growth occur in the early 1920s, in the late 1930s, and in the mid-1950s.It can be noted that the intensity of these growth depressions decreases with time; however, they are smaller than the growth depression that occurs in the 1970s. From the late 1980s, silver fir growth begins to increase rapidly in many European regions; the decades are featured by rapid and continued increase of ring width. In the mid1990s-early 2000s, tree-ring width shows levels unprecedented from the late 1880s in southern Germany (Elling et al., 2009).

In the study area, presence of severe damage such as ‘silver fir decline’ was observed from the early 1970s to the late 1980s (Gellini and Clauser, 1986; Gellini et al, 1988; Bussotti and Ferretti, 1998); that is when the main growth depression occurs during the 20th century in southern Germany. In the study area, silver fir radial growth is low in this period and in the 2000s; otherwise, high tree-ring growth occurs in the periods 1965-1975 and 1990s, which would possibly indicate more favourable climate conditions. At VAL, the decline and high mortality of silver fir in the periods 1920-1940, 1945-1955, and 1975-1985 have been attributed to averaged 5-years periods of low annual rainfall preceding the crises (Moriondo and Caterini,1988). Actually, Figures1.3 and 1.4 show a reduction in radial growth in the period 1945-1955 at ABE-Upper, ABE-Lower, and VAL-Upper, which is more severe at CAM-Upper, CAM-Lower, and VAL-

https://dx.doi.org/10.22161/ijaems.5.2.5 *ISSN: 2454-1311*

Lower, and especially at LAV-Upper and LAV-Lower, and in the 1970s-mid 1980s.

VIII. CONCLUSIONS

This research provides evidence that similarity in RTRs varies highly, frequently, and irregularly during the 20th century among sites and, at a lower extent, within silver fir forest sites in the Tuscan Apennine Alps; unexpected patterns of growth occur in silver fir in the last decades of the 20th century; and similarity between RTRs of the silver fir study stands tends to reduce with increasing distance among sites. According to the results of this study, climate conditions seem to have influenced positively silver fir growth from the late 1980s through the 1990s. Then, continued climate warming may have built climate conditions progressively less favourable or adverse to silver fir growth. For example, warmer climate conditions may have initially limited silver fir growth at lower sites and advantaged it at upper elevation before creating unfavourable conditions even at upper elevation.

This scenario raises the question whether the climate/tree-ring growth relationships have changed during and after the 20th century in the Tuscan Apennine Alps and, more in general, in the southern range of silver fir. It is commonly known that relationships between seasonal and monthly climate variables and silver fir growth can change over time. At this stage, results strengthen the need of approaching silver fir management by involving climate variability as a main driver of growth where no general assumptions should be used to plan and manage silver fir forests. In particular, it is stressed that each silver fir forest needs to be analysed in view of the effects or impacts of climate change at the local level, even within forests in some cases. Although the influence of changing climate conditions is likely to be the main key to understand the effects on silver fir growth, it needs to be ascertained at what extent temperature and/or rainfall thresholds for growth are trespassed under new climate scenarios. For example, silver fir growth may:

- decrease rapidly if the effects are negative;
- grow faster and/or for a longer time if the effects are positive.

The evidence provided would recommend monitoring and extending both this and similar investigations in the view of the climate change scenarios recently provided by research (IPCC Sixth Assessment Report (AR6); https://www.ipcc.ch/sr15/; Giorgi and Lionello, 2008), where the impacts on the viability and possibly shift of silver fir populations – and other species - in their southern European range rise serious concerns.

REFERENCES

[1] Battipaglia G., Saurer, M., Cherubini, P., Siegwolf, R. T.W. and Cotrufo, M.F. (2009). Tree rings indicate different drought resistance of a native (Abies alba Mill.) and a non-native (Piceaabies (L.) Karst.) species co-occurring at a dry site in Southern Italy. Forest Ecology and Management, volume 257, Issue 3, Pages 820-828. https://doi.org/10.1016/j.foreco.2008.10.015

[2] Becker M., Bert G.D., Landmann G., Lévy G., Rameau J.C., Ulrich E. (1995). Growth and Decline Symptoms of Silver Fir and Norway Spruce in Northeastern France: Relation to Climate, Nutrition and Silviculture. In: Landmann G., Bonneau M., Kaennel M. (eds) Forest Decline and Atmospheric Deposition Effects in the French Mountains. © Springer-Verlag Berlin Heidelberg .

[3] Bertini, G., Amoriello, T., Fabbio, G., & Piovosi, M. (2011). Forest Growth and Climate Change: Evidences from the ICP Forests Intensive Monitoring in Italy. iForest, 4, 262-267. http://dx.doi.org/10.3832/ifor0596-004

[4] Bernetti, G., 1998 – Selvicoltura Speciale. UTET, Torino (Italy).

[5] Boncina, A. (2011). History, current status and future prospects of uneven-aged forest management in the Dinaric region: an overview. Forestry, Vol. 84, No. 5, 2011. doi:10.1093/forestry/cpr023

[6] Bozi˘c´ M., Antonic´ O., Pernar, R., Jelaskac, S.D., Krizan˘, J., Cavlovi˘c´, J. and Kusan˘c, V. (2006). Modelling the damage status of silver fir trees (Abies alba Mill.) on the basis of geomorphological, climatic and stand factors. EcologicalModelling, 194, pp 202-208.

[7] doi: 10.1016/j.ecolmodel.2005.10.021

[8] Brunetti, M., Maugeri, M., Monti, F. and Nanni, T. (2006). Temperature and precipitation variability in Italy in the last two centuries from homogenised instrumental time series. Int. Journal of Climatology, 26: 3. Pages 345-381. https://doi.org/10.1002/joc.1251

[9] Bussotti, F. and Ferretti, M., 1998 - Air pollution, forest condition and forest decline in Southern Europe: an overview. Environmental Pollution, 101(1): 49-65. https://doi.org/10.1016/S0269-7491(98)00039-6

[10] Cantiani, M. and Bernetti, G. (1963). Tavola alsometrica delle abetine coetanee della Toscana. Ann. Acc. Ital. Sci. For. 11 :293-332. Firenze, Italia.

[11] Castellani, C., Scrinzi, G., Tabacchi, G. and Tosi, V. (1984) – I.F.N.I. - Tavole di cubatura a doppia entrata. I.S.A.F.A., Trento (Italy), 83 p.

[12] Chhin, S. and Wang, G.G. (2005). The effect of sampling height on dendroclimatic analysis. Dendrochronologia 23(1):47-55. DOI: 10.1016/j.dendro.2005.07.003

[13] Cook, E. R. and Holmes, R. L. (1984). Program ARSTAN user's manual. Laboratory of Tree -Ring Research, University of Arizona, Tucson.

[14] Cook, E. R. and Peters, K. (1997). Calculating unbiased tree-ring indices for the study of climatic and environmental change. The Holocene, 7(3), 361–370. https://doi.org/10.1177/095968369700700314

[15] Cook, E.R. and Kairiukstis, L.A. (1990) Methods of Dendrochronology. Applications in the Environmental Sciences. International Institute for Applied Systems Analysis. Kluwer Academic Publishers, Dordrecht, 394 pp. http://dx.doi.org/10.1007/978-94-015-7879-0

[16] D'Aprile, F., Tapper, N., Baker, P., & Bartolozzi, L. (2010). Variability in Trends of Monthly Mean Temperature among Sites in the Tuscan Apennine Alps. Geophysical Research Abstracts, EGU2010-5681-3, EGU General Assembly, Vienna. http://meetingorganizer.copernicus.org/EGU2010/EGU2010-5681-3.pdf

[17] D'Aprile, F., Tapper, N., Bartolozzi, L., & Bottacci, A. (2011). Non-Stationary Similarity in Trends of Monthly Rainfall in the Tuscan Apennine Alps. Geophysical Research Abstracts, Vol. 13, EGU2011-1170-1, EGU General Assembly, Vienna. http://presentations.copernicus.org/EGU2011-1170_presentation.pdf

[18] Druckenbrod, D.L. and Shugart, H.H. (2004). Forest History of James Madison's Montpelier Plantation. The Journal of the Torrey Botanical Society, Vol. 131, No. 3, pp. 204-219. DOI: 10.2307/4126951

[19] Elling, W., Dittmar, C., Pfaffelmoser, K., Pfaffelmoser, K. and Rötzer, T. (2009). Dendroecological assessment of the complex causes of decline and recovery of the growth of silver fir (Abies alba Mill.) in Southern Germany. Forest Ecology and Management 257(4):1175-1187. DOI: 10.1016/j.foreco.2008.10.014

[20] Filipiak, M. and Ufnalski, K., 2004 - Growth Reaction of European Silver Fir (Abies alba Mill.) Associated with Air Quality Improvement in the Sudeten Mountains. Polish Journal of Environmental Studies. Vol. 13, 3: 267-273

[21] Fritts, H. (1976). Tree Rings and Climate. Academic Press. USA.

[22] Gellini, R. and Clauser, F., 1986 – Prime Indagini sul Deperimento dei Boschi (First Investigations on The Decline of Woods). In Italian, Ministero dell'Agricoltura e Foreste, Corpo Forestale dello Stato. Collana Verde. Roma, Italia.

[23] Gellini, R., Bottacci, A., Brogi, L., Bussotti, F., Cenni, E., Clauser, F., Ferretti, M., Grossoni, P., and Schiff, S. (1988). Inquinamento Ambientale e Deperimento del Bosco in Toscana (EnvironmentalPollution and ForestDecline in Tuscany). ItalianBotanical Society, Regione Toscana. Firenze.

[24] Giorgi, F. and Lionello, P. (2008). Climate change projections for the Mediterranean region. Global Planet Change, 63, 90-104. doi:10.1016/j.gloplacha.2007.09.005

[25] Grissino-Mayer, H.D. (2001). Evaluating Crossdating Accuracy: A Manual and Tutorial for the Computer Program Cofecha. Tree-Ring Research, Vol. 57(2), pp. 205-221. Department of Geography. The University of Tennessee, Knoxville, TN 37996 - 0925. USA.

[26] Holmes, R.L. (1983). Computer assisted quality control in tree-ring dating and measurement. Tree-Ring Bulletin. 43:69-78.

[27] Leal, S., Eamus, D., Grabner, D., Wimmer, R.and Cherubini, P. (2008). Tree rings of Pinus nigra from the Vienna basin region (Austria) show evidence of change in climatic sensitivity in the late 20th century. Can. J. For. Res. 38: 744–759. doi:10.1139/X07-189.

[28] Leonelli, G., Pelfini, M., Morra di Cella, U. and Garavaglia, V. (2011). Climate Warming and the Recent Treeline Shift in the European Alps: The Role of Geomorphological Factors in High-Altitude Sites. AMBIO 40: 264, pp. 264-273. https://doi.org/10.1007/s13280-010-0096-2

[29] Lindner, M. and Calama, R., (2013). Climate Change and the Need for Adaption in Mediterranean Forests. In: Forest Management of Mediterranean Forests. Editor Manuel Esteban Lucas-Borja. ISBN: 978-1-62417-868-9.

[30] Klepac, D. (2001). The development of fir forest management. In Silver Fir (Abies alba Mill.) in Croatia. B. Prpic (ed). Hrvatskesume, Zagreb, Croatia, pp. 65–89.

[31] Moriondo, F. and Caterini, F., 1988 - In margine al convegno su 'Le avversita` del bosco e delle piante arboree da legno'. L'Italia Forestale e Montana. 1: 21–26.

[32] Oberhuber, W, Kofler, W., Pfeifer, K., Seeber, A., Gruber, A., Wieser, G. (2007). Long-term changes in tree-ring - climate relationships at Mt. Patscherkofel (Tyrol, Austria) since the mid1980s. Trees, 22 (1): 31-40. DOI 10.1007/s00468-007-0166-7

[33] Pinto, P.E., Ge´gout, J.-C., Herve´ J.-C. and Dhoˆte, J.-F. (2008). Respective importance of ecological conditions and stand composition on Abies alba Mill. dominant height growth. Forest Ecology and Management 255: pp. 619–629.

[34] Piovesan, G., Biondi, F., Bernabei, M., Di Filippo, A. and Schirone, B. (2005). Spatial and altitudinal bioclimatic zones of the Italian peninsula identified from a beech (Fagus sylvatica L.) tree-ring network. Acta Oecologica, 27: pp. 197–210. doi:10.1016/j.actao.2005.01.001

[35] Podlaski, R. (2002). Radial growth trends of fir (Abies alba Mill.), beech (Fagus sylvatica L.) and pine (Pinus sylvestris L.) in the Świętokrzyski National Park (Poland). Journal of Forest Science, 48, (9): 377–387.

[36] Pretzsch, H., Biber, P., Schütze, G., Uhl, E., &Rötzer, T. (2014). Forest Stand Growth Dynamics in Central Europe Have Accelerated since 1870. Nature Communications, 5, Article ID: 4967. http://dx.doi.org/10.1038/ncomms5967

[37] Schirone, B., Romagnoli, M. and Codipietro, G. (1992). Nuove indagini dendroecologiche sull'abete bianco del bosco Abeti Soprani (Pescopennataro-IS). Annali dell'Accademia Italiana di Scienze Forestali XXXXII: 121-147.

[38] Speer, G.H. (2010). Fundamentals of Tree-ring Research. University of Arizona Press. ISBN: B00GA42F4O

[39] Stokes, M.A. and Smiley, T.L. (1996). An Introduction to TREE-RING DATING. The University of Arizona Press. @ 1996, Tucson.

[40] Susmel, L. (1988). Principi di Ecologia. Fattori Ecologici, Ecosistemica, Applicazioni. CLEUP Padova. Italia

[41] Torelli, N., Shortle, W. C., Cufar, K., Ferlin, F. and Smith, K. T. (1999). Detecting changes in tree health and productivity of silver fir in Slovenia. Forest Pathology. Vol. 29, (3), pp. 189-197. https://doi.org/10.1046/j.1439-0329.1999.00138.x

[42] Toromani, E., Sanxhaku, M. and Pasho, E. (2011). Growth responses to climate and drought in silver fir (Abies alba) along an altitudinal gradient in southern Kosovo. Can. J. For. Res. 41: 1795–1807. doi:10.1139/X11-096

[43] Walther GR., Beißner S., Pott R. (2005). Climate Change and High Mountain Vegetation Shifts. In: Broll G., Keplin B. (eds) Mountain Ecosystems. Springer, Berlin, Heidelberg. https://doi.org/10.1007/3-540-27365-4_3

[44] Wigley, T. M. L., Briffa, K. R. and Jones, P.D.F. (1984). On the Average Value of Correlated Time Series, With Applications in Dendroclimatology and Hydrometeorology. Journal of Climatology & Applied Meteorology 23(2): 201-213. DOI: 10.1175/1520-0450(1984)023<0201:OTAVOC>2.0.CO;2

[45] Wilson, R. & Elling, W. Trees (2004). Temporal instability in tree-growth/climate response in the Lower Bavarian Forest region: implications for dendroclimatic reconstruction. Trees. Vol.18: 1. pp. 19-28. https://doi.org/10.1007/s00468-003-0273-z

https://dx.doi.org/10.22161/ijaems.5.2.6 ISSN: 2454-1311

Extent of Effects and Practices on Climate Risk Management of Manufacturing Firms in the Province of Batangas

Robert S. Dipasupil, DBA

Faculty, Department of Business Administration and Information System, Arba Minch University, Sawla, Gofa Zone, Ethiopia
Polytechnic University of the Philippines
rsdipasupil@gmail.com

Abstract*— *The study aimed to identify the manufacturing companies' risk management practices towards climate change. Towards this goal, the study investigated firstly the areas of business affected by climate change and secondly, the effectiveness of their climate change risk management practices. The study looked into the significant difference on how the respondents assess the effects of climate change on their business as well as the effectiveness of climate risk management practices when compared according to their profile variables. Descriptive survey method was employed in the conduct of the study. A validated questionnaire was used to gather the needed data among 174 manufacturing companies in Batangas Province. The data were analysed with the use of frequency count, percentage and weighted mean, as well as analysis of variance (ANOVA) for the significant difference of the means. It was found that climate change has a moderate effect in the areas of production and operation, finance and accounting, and marketing. Among the areas of climate change risk management practices, only those that involve managing the risks were regarded as effective, while the rest were considered moderately effective. It is suggested that the manufacturing companies create sustainable partnerships among other companies that have successfully implemented climate change risk management initiatives to minimize the impacts brought about by the climate change.

Keywords*— *Climate change, manufacturing companies, risk management, adaptation, operations.

I. INTRODUCTION

Many businesses and entrepreneurs are seeing opportunities in the changes that are happening in the global climatic systems. However, the wide spread chaos and the damages that the impacts of climate change had brought both on the life and properties as well as on the reservoir of resources cannot be denied. Nations and countries are cooperating with each other to find solutions to the problems brought about by this situation hoping that they could find adaptation solutions if mitigation strategies are no longer feasible.

In the Philippines, the effects of a changing climate are evident. The occurrence of flash floods due to heavy rains, the landslides, the visible rise in the sea level and the warming of oceans and other bodies of water are evident indicators that the country is severely affected by the changes in the climatic systems. The increase in the cases of climate related illnesses are also on the rise such as the rise of vector borne diseases(Castello A., 2009). The government is spending so much to rehabilitate regions, provinces, cities and municipalities from the said effects which are actually getting worse as time goes on. Even though the government had actually concretized the legislation of the Climate Change Act, coupled with other legislations that support the said law, the implementation is still in the slow phase. The mitigation and adaptation actions have not taken its full gear and developments on the policies and its outcomes were very minimal. The participation and commitment of different sectors of the society are not solid, thus producing negligible results.

Among the different sectors of the society, perhaps one of the most important and highly affected by the impacts of climate change is the business sector. They command a large proportion of the resources and are considered as the primary contributor to the causes of climate change. Therefore, their commitment to the efforts of mitigating and adapting to the climate change is very important. Business sector's participation and commitment could definitely boost any national and global action towards adapting and mitigating the effects of climatic changes. For the business sector, climate change adaptation means managing the risks and discovering new opportunities to maintain a competitive edge.

In a recent report from Global Climate Risk Index(Kreft, 2015), it ranked Philippines as the number one most affected country by climate change using 2013 data. It identified the five different risk factors the country is most vulnerable to, and these are: a rise in sea levels; extreme rainfall events; extreme heating events; increased ocean temperatures; and a disturbed water budget. Tropical storms, which hit the country on average eight to nine times a year and are expected to increase in severity because of climate change, exacerbate these risks. Given the Philippines' vast shorelines and built-in geographical susceptibility, any one of these risks could be disastrous.

Batangas Province, located on the southwestern part of Luzon in the CALABARZON region, is considered as one of the most developed provinces in the Philippines. Batangas offers an alternative transport hub closest to Manila. One climate vulnerability of Batangas Province stems from the increased flooding that seems to be hampering access through the major highways during periods of heavy rainfall (Business Risk Assessment & the

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Management of Climate Impacts, 2016).

This study is specifically done in order to evaluate the risk management practices of the business sector, specifically the manufacturing industry in Batangas Province towards the impacts of climate change. This study will primarily endeavor to determine the current actions that manufacturing companies are taking in order to manage the risks brought about by the climate change. This study is done primarily to propose guidelines for implementation that could help manufacturing sector in adopting of mitigating the impacts brought about by the climate change.

II. STATEMENT OF THE PROBLEM

The study aimed to assess the climate risk management practices of manufacturing companies in Batangas Province.

Specifically, the study sought answers to the following questions:

1. What is the profile of the study in terms of:
   - 1.1 Employee respondents
     - 1.1.1 Job managerial level;
     - 1.1.2 Number of years involved in climate management; and
     - 1.1.3 Number of trainings attended related to climate risk management?
   - 1.2 Company respondents
     - 1.2.1 Form of business organization;
     - 1.2.2 Type of product manufactured;
     - 1.2.3 Capitalization;
     - 1.2.4 Number of years in operation; and
     - 1.2.5 Number of years climate risk management has been adopted?
2. How may the extent of effects of the climate change to the manufacturing companies be assessed in terms of:
   - 2.1 Production and operation;
   - 2.2 Finance and accounting; and
   - 2.3 Marketing?
3. How may the Climate Change Risks Encountered by the Manufacturing Firms be assessed by the manufacturing firms?
4. How may the effectiveness of climate risk management practices of the manufacturing companies be assessed in terms of:
   - 4.1 Building awareness;
   - 4.2 Assessment of vulnerability;
   - 4.3 Management of risks; and
   - 4.4 Review and feedback?
5. What are the factors affecting the implementations of the Climate Risk Management Practices among the manufacturing firms in Batangas Province?
6. What are the level of Preparedness of the Manufacturing Firms in Addressing the Climate Change Risks
7. Is there significant difference in the assessment of the extent of effects of climate change to the manufacturing business when grouped according to profile variables?
8. Is there significant difference in the assessment on the effectiveness of climate risk management practices of the manufacturing companies when grouped according to profile variables?
9. Based on the results of the study, what guidelines for implementation of climate risk management practices can be proposed?

III. METHODOLOGY

The study utilized the descriptive design and involved 174 manufacturing companies operating in Batangas Province which were chosen through multi-stage random sampling. A validated questionnaire used as the primary data gathering tool for the study Aside from the questionnaire, the researchers also conducted interviews to gather more insights from the respondents. Descriptive statistics was used as well analysis of variance (ANOVA) to interpret the gathered data.

IV. RESULTS AND DISCUSSIONS

The succeeding sections presents the result of this study.

1. Profile of the Respondents

1.1. Employee Respondents

Table.1: Profile of the Employee Respondents

Job Managerial Level	**F**	**%**
Top Management	54	27.98
Middle Management	81	41.97
Supervisor	36	18.65
Others	22	11.40
Total	**193**	**100.00**
Number of years involved in Climate Risk Management	**F**	**%**
5 years and less	118	61.14
6 - 10 years	57	29.53
11 - 15 years	8	4.15
16 - 20 years	4	2.07
More than 20 years	5	2.59
No response	1	0.52
Total	**193**	**100.00**
Number of trainings related to Climate Risk Management	**F**	**%**
5 and below	145	75.13
6 to 10	35	18.13
11 to 15	4	2.07

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

More than 20	3	1.55
No response	6	3.11
Total	**193**	**100.00**

Most of the respondents equivalent to 41.97% belong to the middle management, while 61.14% have been involved in climate change risk management for less than 5 years and 75.13% have attended less than 5 trainings related to climate change risk management.

1.2. Company Respondents

Table.2: Profile of the Company Respondents

Form of Business	**F**	**%**
Corporation	114	65.52
Partnership	6	3.45
Single Proprietorship	46	26.44
Cooperative	8	4.60
Total	**174**	**100.00**
Type of Product Manufactured	**F**	**%**
Non-metallic products	19	10.92
Automobile & auto parts	1	0.57
Textile, wearing apparel	34	19.54
Wood & wood products	4	2.30
Basic metals	9	5.17
Chemicals & chemical products	12	6.90
Animal feeds	45	25.86
Paper, paper products	1	0.57
Electrical % electronics	7	4.02
Food, beverages % tobacco	33	18.97
Others	9	5.17
Total	**174**	**100**
Capitalization	**F**	**%**
Less than P3 million	54	31.03
P3 million to P15 million	56	32.18
P16 million to P100 million	38	21.84
More than P100 million	25	14.37
No response	1	0.57
Total	174	100.00
Number of years in Operation	**F**	**%**
5 years and below	26	14.94
6 - 10 years	37	21.26
11 - 20 years	57	32.76
More than 20 years	54	31.03
Total	**174**	**100.00**
Number of years Climate Risk Management Practices were Adopted	**F**	**%**
Less than 5 years	108	62.07
5 to 10 years	25	14.37
11 to 15 years	25	14.37
16 to 20 years	8	4.60
More than 20 years	8	4.60
Total	**174**	**100.00**

Majority of the companies were organized as corporation equivalent to 65.52%, while 25.86% are engaged in the manufacture of animal feeds, 32.18% have capitalization of P3 million to P15 million. Furthermore, fifty seven companies equivalent to 32.76% have been operating for 11 to 20 years now and 62.07% have less than 5 years of adopting climate change risk management practices.

2. Areas of Business Affected by Climate Change.

Table.3: Areas of Business Affected by Climate Change

Areas of Business Affected by Climate Change	**WM**	**VI**

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Production and Operations		
Energy fluctuations/blackouts for companies	4.14	Moderate Effect
Resource availability such as water and raw materials	3.80	Moderate Effect
Damage on company's plant, fixed assets and infrastructure	3.76	Moderate Effect
Supply chain flow	3.33	Less Effect
Availability of workforce especially during critical periods	3.19	Less Effect
Overall Weighted Mean	3.64	Moderate Effect
Finance and Accounting		
Creation of new investment opportunities	3.57	Moderate Effect
Insurance costs of fixed assets	3.46	Less Effect
Cost of capital and operational expenditure	3.84	Moderate Effect
Liability and litigation costs	2.48	Least Effect
Cost of complying with present and future regulations related to climate change	3.80	Moderate Effect
Overall Weighted Mean	3.43	Less Effect
Marketing		
Volatility of commodity prices	3.80	Moderate Effect
Changing tastes, lifestyles and customer behaviour	3.66	Moderate Effect
Transportation and delivery of products to intended markets	3.54	Moderate Effect
Greater demand for more innovative products	3.70	Moderate Effect
Delivery of marketing communications to potential and existing consumers	2.96	Less Effect
Overall Weighted Mean	3.53	Moderate Effect

Table 3 revealed that climate change has a moderate effect on the areas of business such as production and operations, finance and accounting, and marketing.

In the area of production and operation, it was revealed that climate change has a moderate effect in terms of energy fluctuation or blackouts, resource availability such as water and raw materials, and on damage on company's plant, fixed assets and infrastructure. This runs parallel to the study of (Cruz, Harasawa, Lal, Wu, & Anokhin, 2007), which found that major power outages happened because of very high summer temperatures. However, it was assessed that climate change has a less effect on the company's supply chain flow and on the availability of workforce especially during critical periods.

In the area of finance and accounting, climate change was assessed to have a moderate effect on the creation of new investment opportunities, cost of capital and operational expenditure, and on the cost of complying with present and future regulations related to climate change. These findings are synonymous with those of (Galbreath, 2012)which stated that costs on energy, raw materials, capital expenditures and even in insurance premiums are expected to increase as a result of adapting to the impacts of climate change.

In the area of marketing, climate change was revealed to have a moderate effect in terms of volatility of commodity prices, changing tastes, lifestyles and customer behavior, transportation and delivery of products to intended markets, and greater demand for more innovative products. Owing to the nature of their operation, manufacturing companies may have firmly set their marketing designs and infrastructure, which cannot be easily changed as a response to extreme weather events brought about by climate change. Their systems and processes may be locked in for a considerable long period of time, which renders them vulnerable to sudden changes in the marketing environment as a result of the changing climate. In terms of customer loyalty as a major element of value, these findings are corollary to that findings of (Schuchard, 2010)which stated that consumer tastes and preferences may vary with increased desire for climate-compatible goods.

3. Climate Change Risks Encountered by the Manufacturing Firms

Table.4: Climate Change Risks Encountered by the Manufacturing Firms

Physical Impacts	**Weighted Mean**	**Verbal Interpretation**
Increased frequency of extreme weather events	4.04	Moderate Risk
Flooding or sea level rise	3.13	Less Risk
Drought or water scarcity	3.20	Less Risk
Change in temperature	3.85	Moderate Risk
Poor availability and quality of water	3.14	Less Risk
Coastal erosion	2.22	Least Risk
Induced changes in natural resources	3.34	Less Risk
Changing landscapes	3.06	Less Risk
Typhoons	4.50	High Risk
Overall mean	**3.25**	**Less Risk**

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Table 4 shows that with regard to the physical impacts of Climate Change encountered by the manufacturing firms, it is shown that typhoon was identified as high risk with weighted mean of 4.50. Increased frequency of extreme weather events and change in temperature was identified to have moderate risk with weighted means of 4.04 and 3.85 respectively. The other physical impacts of climate change such as induced changes in the natural resources, drought or water scarcity, poor availability and quality of water, flooding and sea level rise, changing landscapes, all got a verbal interpretation of less risk with weighted means of 3.34, 3.20. 3.14. 3.13 and 3.06 respectively. Lastly the coastal erosion as physical impact of climate change encountered by the manufacturing firms was identified to have least risk with weighted mean of 2,22. The climate change risk encountered by the manufacturing firms earned the overall weighted mean of 3.25 with verbal interpretation of less risk.

It can be gleaned from the data on table 5 that the manufacturing firm perceived typhoon to have a high risk when it comes to the physical impact of climate change that are encountered by the manufacturing firms. This can be attributed to the fact that the locations of the manufacturing firms are commonly affected by the typhoons that visit the area. The increasing strength of the typhoons increase the severity of impacts that bring about destructions on the physical infrastructure and in the operations of the manufacturing firms.

4. **Effectiveness of Climate Change Risk Management Practices**

Table.5: Effectiveness of Climate Change Risk Management Practices

Areas	WM	VI
Building Awareness	3.43	Moderately effective
Vulnerability Assessment	3.43	Moderately effective
Risk Management	3.82	Effective
Feedback and Review	3.38	Moderately effective
Overall	**3.52**	**Moderately effective**

The study revealed that among the practices of a climate change risk management program, those that are related to risk management were regarded as effective while those that relate to building awareness, vulnerability assessment, and review and feedback were considered as moderately effective.

It can be viewed that the respondents assessed most of their climate change risk management practices as moderately effective which include the areas of building awareness, vulnerability assessment and feedback and review, with weighted means of 3.43, 3.43 and 3.38 respectively. This runs parallel with the report (Climate Change Impacts and Risk Management: A Guide for Business and Government, 2006) which emphasized that the communication and consultation process will contribute towards the long term development of risk management and help to establish a foundation for its continuing maintenance. This is in line with the study of (Moran, Cohen, Swem, & Shaustyuk, 2005) Moran which stated that the companies are more vulnerable if they have more long-term capital assets, a more elaborate supply chain, and climate-sensitive resources.

On the other hand, the practices related to risk management were evaluated as effective with weighted mean of 3.82. This aspect is where the policies, programs, strategies and techniques intended to manage the risks brought about by climate change are implemented.

5. **Factors Affecting the Implementations of the Climate Risk Management Practices**

Table 6 shows the factors that affect the implementation of the climate risk management practices as perceived by the manufacturing firms

Table.6: Factors Affecting Implementation of Climate Change Risk Management Practices

Barriers to Implementation	Mean	Verbal Interpretation
Ambiguous language and terminology	3.91	Strong Effect
Lack of understanding of the costs of inaction	4.11	Strong Effect
Insufficient organizational commitment	4.16	Strong Effect
Negative framing of the climate change impacts	3.88	Strong Effect
Lack of internal buy-in	3.80	Strong Effect
Unclear performance indicators	3.97	Strong Effect
Insufficient expertise	4.15	Strong Effect
Unclear signals from government and stakeholders	4.18	Strong Effect
Lack of strong regulation	4.50	Very Strong Effect
Overall mean	4.02	Strong Effect

Legend: VSE = Very Strong Effect, SE = Strong Effect, ME = Moderate Effect, LE= Less Effect, NE = No Effect

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Table 6 shows that in terms of the factors that affect the implementation of the climate risk management practices, the respondents from the manufacturing firms disclosed that lack of strong regulation, has a very strong effect with a weighted mean of 4.50, the factors such as unclear signals from the government and stake holders, insufficient expertise, insufficient organizational commitment, lack of understanding of the cost of inaction, unclear performance indicators, ambiguous language and terminology, negative framing of the climate change impacts and lack of internal buy-in all have a strong effect on the implementationof the climate risk management practices with weighted means of 4.18, 4.16, 4.5, 4.11, 3.97, 3.91, 3.88 and 3.80 respectively.

It can be seen from the data on the table 6 that the manufacturing firms perceived that lack of strong regulation is a factor that have a very strong effect on the implementation of the climate risk management practices. This response can be explained by the fact that it is very common in the Philippines that if there is no strong regulation, then the business will not act. This is because most of the business in the Philippines still considers actions towards the mitigation of the impact of climate change as an expense and not as an investment. It must also be noted that the other factors were considered by the manufacturing firms to have a strong effect in the implementation of the climate risk management practices. These factors include unclear signals from the government and stake holders, insufficient expertise, insufficient organizational commitment, lack of understanding of the cost of inaction, unclear performance indicators, ambiguous language and terminology, negative framing of the climate change impacts and lack of internal buy-in. This indicates that the manufacturing firms are actually recognizing the factors that hinders them from implementing suitable actions towards addressing the impacts of climate change risks that they encounter in the present.

6. Level of Preparedness of the Manufacturing Firms in Addressing the Climate Change Risks

Table.7: Level of Preparedness of the Manufacturing Firms in Addressing the Climate Change Risks

Level of Preparedness	Mean	Verbal Interpretation
What is the level of preparedness of your organization in managing climate change impacts?	2.26	Somewhat Prepared

It can be gathered that when it comes to the level of preparedness of the manufacturing organizations in managing the climate change impacts, the manufacturing firms revealed that they are somewhat prepared which earned the weighted mean of 2.26.

It can be gleaned from the response of the respondents from the manufacturing firms that they "somewhat prepared". The response of the respondents on the level of preparedness is indicative that there is some uncertainty on their part on the real status in terms of managing the current and the future impacts of climate change. Some respondents even revealed that since it is hard to quantify or forecast the severity of the climate change impacts and the lack of standard measures regarding the performance indicators related to climate change risk management make it hard to confidently assess the level of preparedness regarding the management of climate change risks.

7. **Test of significant difference on assessment of the extent of effects of climate change to the business when grouped according to the following profile variables**.

7.1. Form of Business

Table.5: Significant Differences on the Extent of Effects of Climate Change to the Manufacturing Companies in Terms of Form of Business

Areas	F value	p-value	Decision
Production and Operations	0.762	0.517	Fail to reject Ho
Finance and Accounting	1.842	0.141	Fail to reject Ho
Marketing of Goods and Services	1.470	0.224	Fail to reject Ho

Since the computed F-value of 0.762 which yields a p-value of 0.517 that is greater than the critical value of 0.05 thus, there is no significant difference on the assessment of the respondents regarding the operation and production as an area of the business affected by the climate change when they are grouped according to form of ownership as company profile. Moreover, since the computed F-value of 1.842 which yields a p-value of 0.141 which in turn is less than the critical value of 0.05, thus there is no significant difference on the assessment of the respondents on the finance and accounting as area of the business affected by the climate change when they are grouped in according to form of business ownership as company profile. Lastly, since the computed F-value of 1.470 which yields a p-value of 0.224 which in turn is less than the critical value of 0.05, then there is no significant difference on the assessment of the respondents on the marketing of goods and services as area of the business affected by the climate change when they are grouped in according to form of business ownership as company profile.

7.2. Type of Product being Manufactured.

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Table.6: Significant Differences on the Extent of Effects of Climate Change to the Manufacturing Companies in Terms of Type of Product Manufactured

Areas	F value	p-value	Decision
Production and Operations	1.765	0.07	Fail to Reject Ho
Finance and Accounting	1.956	0.041	Reject Ho
Marketing of Goods and Services	2.107	0.026	Reject Ho

Table 6 shows that since the computed value of F which is 1.765, which in turn yields a p-value of 0.07, a value that is greater than the critical value of 0.05 which indicates that the null hypothesis could not be rejected. Thus, there is no significant difference on the assessment of the respondents when they are grouped according to the type of products manufactured as company profile. Furthermore, since the computed F-value which is 1.956 which in turn yield a p-value of 0.041 which is less that the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the respondent in the financial and account as an area of the business affected by the climate change when they are grouped according to the type of product manufactured as company profile. Lastly, since the computed value of F, which is 2.107 which in turn yield a p-value of 0.026 which is also less than the critical value of 0.05, then the null hypothesis is rejected, there is significant difference on the assessment of the respondents on the marketing of goods and services as area of the business affected by the climate change when they are grouped according to the type of product as company profile variable.

7.3. Capitalization.

Table.7: Significant Differences on the Extent of Effects of Climate Change to the Manufacturing Companies in Terms of Capitalization

Areas	F value	p-value	Decision
Production and Operations	1.562	0.200	Fail to reject Ho
Finance and Accounting	0.491	0.689	Fail to reject Ho
Marketing	0.405	0.749	Fail to reject Ho

The table shows that the computed F-value which is 1.562 that results to a p-value of 0.200 which is greater than the critical value of 0.05 then the null hypothesis cannot be rejected, and thus, there is no significant difference on the assessment of the respondents on the operations and production as an area of the business affected by the climate change when they are grouped according to capitalization. In addition, since the computed F-value of 0.491 which brings about a p-value of 0.689 that is greater than the critical value of 0.05, then the null hypothesis cannot be rejected, there is no significant difference on the assessment of finance and accounting as an area of business affected by the climate change when the respondents are grouped according to capitalization as profile variable. Lastly, since the computed F-value of 0.405 which brings about a p-value of 0.749 that is greater than the critical value of 0.05, then the null hypothesis cannot be rejected, there is no significant difference on the assessment of marketing of goods and services as an area of business affected by the climate change when the respondents are grouped according to capitalization.

7.4. Number of Years in Operation.

Table.8: Significant Differences on the Extent of Effects of Climate Change to the Manufacturing Companies in Terms of Number of Years in Operation

Areas	F value	p-value	Decision
Production and Operations	0.590	0.622	Fail to reject Ho
Finance and Accounting	3.721	0.012	Reject Ho
Marketing of Goods and Services	2.413	0.068	Fail to reject Ho

Since the computed valued of F is 0.590 which results to a p-value of 0.622 which is greater than the critical value of 0.05, then the null hypothesis cannot be rejected. There is no significant difference on the assessment of the respondents on operation and production as an area of the business affected by the climate change when they are grouped according to number of years in operation as profile variable. Also, since the computed F-value is 3.721 which result to a p-value of 0.012 which is less than the critical value of 0.05, then the null hypothesis is rejected, there is significant difference on the assessment of the respondents on the finance and accounting as an area of the business affected by the climate change when they are grouped according to the number of years in operation as profile variable. Lastly, since the computed valued of F is 2.41 which results to a p-value of 0.068 which is greater than the critical value of 0.05, then the null hypothesis cannot be rejected. There is no significant difference on the assessment of the respondents on marketing of goods and services as an area of the business affected by the climate change when they are grouped according to number of years in operation.

7.5. Number of Years Climate Risk Management Practices were adopted in the Company.

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Table.9: Significant Differences on the Extent of Effects of Climate Change to the Manufacturing Companies in Terms of Number of Years Climate Risk Management Practices were Adopted

Areas	F value	p-value	Decision
Production and Operations	1.142	0.338	Fail to reject Ho
Finance and Accounting	0.977	0.422	Fail to reject Ho
Marketing of Goods and Services	1.883	0.115	Fail to reject Ho

Since the computed value of F which is 1.142 which results to a p-value of 0.338 is greater than the critical value of 0.05, then the null hypothesis cannot be rejected. Moreover, since the computed value of F which is 0.977 which results to a p-value of 0.422 is greater than the critical value of 0.05, then the null hypothesis cannot be rejected. Lastly, since the computed value of F which is 1.883 which results to a p-value of 0.115 is greater than the critical value of 0.05, then the null hypothesis cannot be rejected.

8. **Result of the test of significant difference on assessment of the effectiveness of climate change risk management practices of the companies when grouped according to the following profile variables**.

8.1. Form of business.

Table.10: Significant Differences on the Assessment of the Effectiveness of Climate Change Risk Management Practices in Terms of Form of Business

Areas	F value	p-value	Decision
Building Awareness	5.507	0.001	Reject Ho
Assessment of Vulnerability	8.305	0.000	Reject Ho
Managing the Risks	1.628	0.184	Fail to reject Ho
Review & Feedback	1.843	0.141	Fail to reject Ho

It can be seen from the table that since the computed value of F which is 5.507 that results to a p-value of 0.01 which is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the respondents on the building of awareness as part of the risk management practices related to climate change implemented by the manufacturing companies in Batangas province when they are group in accordance to form of business ownership. Also, since the computed value of F which is 8.305 that results to a p-value of 0.000 which is less than the critical value of 0.05, then the hypothesis is rejected. On the other hand, since the computed value of F which is 1.628 that results to a p-value of 0.184 which is greater than the critical value of 0.05, then the hypothesis is cannot be rejected. Lastly, since the computed value of F which is 1.843 that results to a p-value of 0.141 which is greater than the critical value of 0.05, then the hypothesis is accepted.

8.2. Type of Products Manufactured.

Table.11: Significant Differences on the Assessment of the Effectiveness of Climate Change Risk Management Practices in Terms of Type of Product Manufactured

Areas	F value	p-value	Decision
Building Awareness	3.500	0.000	Reject Ho
Assessment of Vulnerability	3.272	0.001	Reject Ho
Managing the Risks	1.822	0.059	Fail to reject Ho
Review and Feedback	1.713	0.081	Fail to reject Ho

The table shows that since the computed value of F which is 3.500 which results to a p-value of 0.000 which is less than the critical value of 0.05, then the null hypothesis is rejected, there is significant difference on the assessment of the respondents on the building of awareness as part of the risk management practices related to climate change implemented by the manufacturing companies in the province of Batangas when they are grouped according to type of product manufactured as profile variable. Also, since the computed value of F which is 3.272 results to a p-value of 0.001 which is less than the critical value of 0.05, then the null hypothesis is rejected, there is significant difference on the assessment of the respondents effectiveness of the climate risk management practices implemented by the manufacturing companies when they are grouped according to type of product manufactured. In addition, since the computed value of F which is 1.882 which results to a p-value of 0.059 which is greater than the critical value of 0.05, then the null hypothesis cannot be rejected. Finally, since the computed value of F which is 1.713 which results to a p-value of 0.081 which is greater than the critical value of 0.05, then the null hypothesis cannot be rejected.

8.3. Capitalization.

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

Table.12: Significant Differences on the Assessment of the Effectiveness of Climate Change Risk Management Practices in Terms of Capitalization

Areas	F value	p-value	Decision
Building Awareness	7.197	0.000	Reject Ho
Assessment of Vulnerability	9.981	0.000	Reject Ho
Managing the Risks	4.052	0.008	Reject Ho
Review & Feedback	3.027	0.031	Reject Ho

It can be seen that since the computed value of F which is 7.197 which results to a p-value of 0.000 which is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the effectiveness of the building of awareness as climate change risk management practices of the manufacturing companies when they are grouped according to capitalization. Also, since the computed value of F which is 9.981 which results to a p-value of 0.000 which is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the effectiveness of the assessment of risks as climate change risk management practices of the manufacturing companies when they are grouped according to capitalization. Moreover, since the computed value of F which is 4.052 which results to a p-value of 0.008 which is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the effectiveness of the management of risks as climate change risk management practices of the manufacturing companies when they are grouped according to capitalization. Finally, since the computed value of F which is 3.027 which results to a p-value of 0.031 which is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the effectiveness of the feedback criteria as climate change risk management practices of the manufacturing companies when they are grouped according to capitalization.

8.4. Number of Years in Operation.

Table.13: Significant Differences on the Assessment of the Effectiveness of Climate Change Risk Management Practices in Terms of Number of Years in Operation

Areas	F value	p-value	Decision
Building Awareness	1.38	0.250	Fail to reject Ho
Assessment of Vulnerability	1.920	0.128	Fail to reject Ho
Managing the Risks	1.252	0.292	Fail to reject Ho
Review and Feedback Criteria	2.32	0.077	Fail to reject Ho

The data shows that since the computed value of F which is 1.38 which results to a p-value of 0.0.250 which is greater than the critical value of 0.05, there is no significant difference on the assessment of the effectiveness of the building of awareness as climate change risk management practices of the manufacturing companies when they are grouped according to number of years of operation. In addition, since the computed value of F which is 1.920 which results to a p-value of 0.128 which is greater than the critical value of 0.05, then there is no significant difference on the assessment of the effectiveness of the assessment of risks as climate change risk management practices of the manufacturing companies when they are grouped according to years of operations. More so, since the computed value of F which is 1.252 which results to a p-value of 0.292 which is greater than the critical value of 0.05, then there is no significant difference on the assessment of the effectiveness of the management of risks as climate change risk management practices of the manufacturing companies when they are grouped according to number of years of operation. Lastly, since the computed value of F which is 2.32 which results to a p-value of 0.077 which is greater than the critical value of 0.05, then there is no significant difference on the assessment of the effectiveness of the feedback criteria as climate change risk management practices of the manufacturing companies when they are grouped according to number of years in operation.

8.5. Number of Years Climate Risk Management Practices were adopted in the Company.

Table.14: Significant Differences on the Assessment of the Effectiveness of Climate Change Risk Management Practices in Terms of Number of Years Climate Risk Management Practices were Adopted in the Company

Areas	F value	p-value	Decision
Building Awareness	3.602	0.007	Reject Ho
Assessment of Vulnerability	4.224	0.003	Reject Ho
Managing the Risks	3.461	0.009	Reject Ho
Review and Feedback	3.787	0.006	Reject Ho

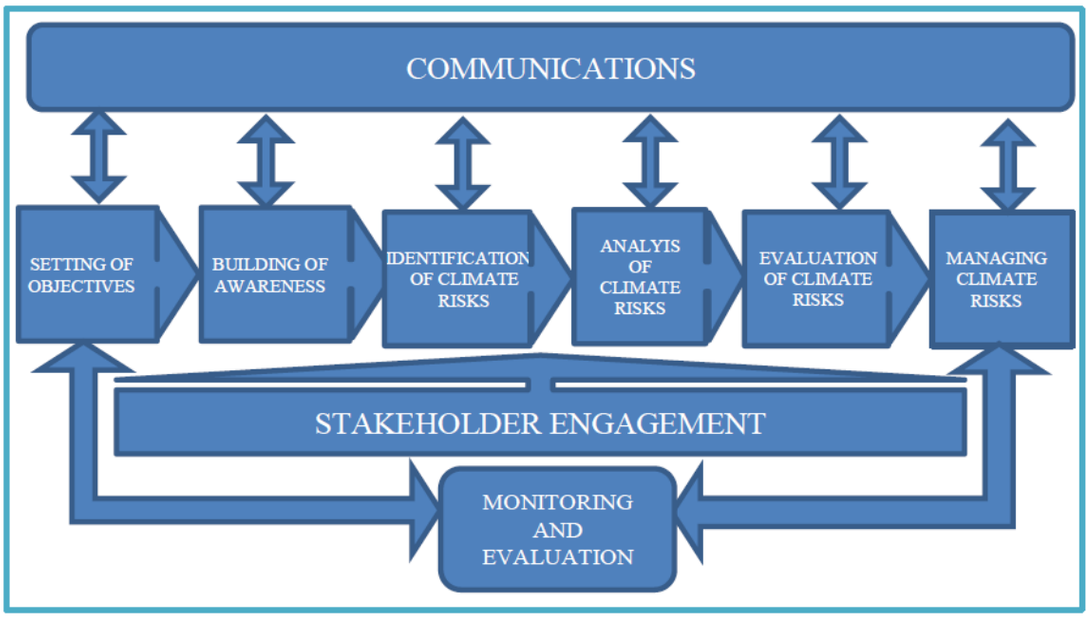
The data on the table shows that the computed value of F which is 3.602, that resulted to a p-value of 0.007 which is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the respondents regarding the effectiveness building of awareness as part of the climate change risk

https://dx.doi.org/10.22161/ijaems.5.2.6 ISSN: 2454-1311

management practices of the manufacturing firms when they are grouped according to number of years climate risk management practices is adopted or observed in the company. In addition since the completed value of F which is 4.224 which yields a p-value of 0.003 that is less than the critical value of 0.05, then the hypothesis is rejected, there is significant difference on the assessment of the respondents on the level of effectiveness of the building of awareness as part of the climate change risk management practices of the manufacturing companies when they are grouped according to the number of years climate risk management practices is adopted or observed in the company. More so, since the computed value of F which is 3.461 which results to a p-value of 0.009 which is less than the critical value of 0.05, then the hypothesis could not be rejected, there is no significant difference on the assessment of the effectiveness of the management of risks as climate change risk management practices of the manufacturing companies when they are grouped according to number of years climate change risk management practices is adopted or observed in the company. Lastly, since the computed value of F which is 3.787 which results to a p-value of 0.006 which is less than the critical value of 0.05, then the hypothesis could not be rejected, there is no significant difference on the assessment of the effectiveness of the feedback criteria as climate change risk management practices of the manufacturing companies when they are grouped according to number of years in operation.

9. Proposed Guidelines for Implementation of Climate Risk Management Practices

This guidelines is an output of the study "Extent of Effects and Practices on Climate Risk Management of Manufacturing Firms in the Province of Batangas". The guidelines is structured in accordance to the findings of the study. The figure below indicates the summary of the guidelines that will be discussed below:



Objectives:

The guidelines for implementation endeavors to propose a simple guide for implementation of climate risk management practices that the manufacturing firms could adopt in order to improve their resiliency in the face of climate change risk thereby enhancing their actions on the climate risk management that could benefit their companies in the long run.

Guidelines

The following are the steps for in implementing climate risk management:

1. Setting of Objectives
   - Establish definitive scope of the actions on climate risk management in the organization
   - Formulate clear cut objectives and integrate such objectives to the company policy and strategic plan in consideration of Company's Mission and Vision
   - Identify the stakeholders and their level of involvement
   - Establish criteria for measurement on the climate risk management effort
2. Building of Awareness
   - Conduct assessment on the level of awareness/knowledge of the stakeholder of the organization regarding climate change risk management
   - Formulate action plan for increasing the level of awareness of every stakeholder in the organization regarding the climate risk related management, general concepts and the tools and techniques in assessment and in management of risks
   - Implement the action plan, focusing on the enhancement of knowledge of every stakeholder of the organization regarding the climate change and the risks it represents
   - Monitor and evaluate the progress of the stakeholders
3. Identification of climate risks

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

- Identify and define all risk that affect the business operations in all areas
- Enumerate all the identified risk on each areas of the business operation

4. Analysis of Climate Risks
   - Reviewthe strategies and practices to mitigate the identified risk
   - Choosethe assessment, criteria, tools and techniques to be used in the proper analysis of the identified risks
   - Assessthe identified risks in consideration of the formulated goals and criteria
5. Evaluation of the Climate Risks
   - Rank the identified risks brought about by the climate change in accordance to the level of importance and its impact to the organization;
   - Ascertain the level of priority of the identified risks focusing on the most important and most severe and identify risks that needs more detailed analysis
6. Managing of the Climate Risk
   - Formulate solutions/options to manage or adapt the identified risks
   - Select the best options/solutions that could be used in managing the risks
   - Integrate the selected options and solutions and assign resources to ensure proper implementation
   - Implement the best options and solutions to manage the identified risks

Communication

Communication is a key component for every risk management endeavor and should be present in all steps of the risk management process. The creative inputs of everybody in the organization is important in the achievement of success in all areas of the climate risk management initiatives that the organization may implement. It is imperative that all that are involved in the climate management initiatives are well informed on all areas from planning, to development, to implementation, to monitoring and evaluation and also revision and changes that may happen as the initiative push thru. Thus, the following should be observed in the organization.

- The organization should endeavor to promote free flow of information regarding the climate risk management in climate risk management actions.
- All employees of the organization should be knowledgeable of the actions done by the organization regarding climate risk management activity.
- Consultative decision making is encouraged to involve everybody in the climate change risk management actions in terms of communication.

Engagement of the Stakeholders

In order to increase the chance of success of climate risk management actions, the engagement of the firm's stake holder is essential. There are two type of stakeholders (1) Internal Stakeholder which may be composed of owners, top management, middle management, supervisor, employees and (2) External Stakeholder which may be composed of government, community, suppliers, market, and competitors.

The engagement of the firm's internal and external is an important boost to the efforts in climate risk management process. Involving the stakeholders of the organization could provide leverage in managing risks brought about by the climate change. The following may be of help.

- Creation of sustainable partnership with the government agencies to improve enactment, and implementation of the laws and legislation regarding the climate risk management
- Creation of sustainable partnerships with the community to enhance community support in climate risk management endeavors.
- Creation of sustainable partnership with academic institutions to boost capability in acquiring and disseminating knowledge particularly in the area of research and trainings.
- Creation of sustainable partnership with the Non-governmental institutions that advocate climate change initiatives to further boost knowledge and capability of the organizations.
- Creation of sustainable partnership with suppliers and distributors to ensure alignment supply chain practices to the climate risk management action that will be adopted by the organization.

Monitoring and Evaluation

The monitoring and evaluation of each of the steps in the climate risk management is very important to the success of climate risk management actions. All outputs of the climate change risk management adaptation and initiatives should be reviewed in consideration with the formulated criteria and objectives. It is also important that the climate risk management initiatives/actions be monitored and evaluated so as to be updated and responsive to the ever changing dynamics of the business and physical environment. This will enable adjustments if necessary to ensure efficient and effective implementation of the climate risk management initiatives: The following should be observed in monitoring and evaluation of climate risk management activities.

- Planned and regular monitoring and evaluation of the climate risk management activity.
- Analysis and evaluation of should be updated, including climate risk management scenarios, information about climate change risks impacts, changes in vulnerability assessments, and level of effectiveness of the implementation of existing climate risk management practices.
- Complete and comprehensive documentation and paperwork should be done in the monitoring and evaluation process, this would enable the concerned personnel/employees to

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

use the documents for strategic assessment and if so, re-planning of climate risk management initiatives and actions for continuous improvement process.

V. CONCLUSIONS

After analysing and interpreting the data gathered, the following conclusions were drawn:

1. Climate change has a moderate effect on the manufacturing companies in terms of production and operations, finance and accounting, and marketing.
2. The manufacturing firm perceived typhoon to have a high risk when it comes to the physical impact of climate change that are encountered by the manufacturing firms.
3. The climate risk management practices of the manufacturing firms were moderately effective in the area of building awareness, assessment of risks, and in the area of review and feedback criteria. However, it is assessed as effective on the area of managing risks.
4. The manufacturing firms perceived that lack of strong regulation is a factor that have a very strong effect on the implementation of the climate risk management practices
5. The respondents from the manufacturing firms perceived that they "somewhat prepared" which is indicative that there is some uncertainty on their part on the real status in terms of managing the current and the future impacts of climate change
6. In terms of the significant differences of the effects of climate change, the null hypothesis is accepted in the area of production and operation in relation to form of business, capitalization, years in operation and number of years climate risk management were adopted. In the area of finance and accounting, the null hypothesis is accepted in relation to form of business, capitalization, years of operation, and number of years climate change risk management practices were adopted. Finally, in the area of marketing, the null hypothesis is accepted in relation to form of business, capitalization, years in operation, and number of years climate risk management practices were adopted.
7. There are significant differences on the assessment of the respondents on the effectiveness of climate risk management practices of the manufacturing firms in the area of building awareness when they are grouped according to form of business, type of product manufactured, capitalization and number of years climate change risk management practices were adopted or observed as profile variables.
8. Thereare significant difference on the assessment of the respondents on the effectiveness of climate risk management practices of the manufacturing firms in the area of managing risks when they are grouped according to capitalization, and number of years climate risk management practices has been observed or adopted as profile variables.
9. Finally, there are significant differences on the assessment of the respondents on the effectiveness of climate risk management practices of the manufacturing firms in the area of review and feedback criteria when they are grouped according to capitalization, and number of years climate risk management practices have been adopted or observed.

ACKNOWLEDGEMENT

This paper is an excerpt from the dissertation of the Author for the degree of Doctor in Business Administration from the Polytechnic University of the Philippines (PUP). The author wish to acknowledge the valuable contributions of his research adviser, **Dr. Guillermo C. Bungato** Jr, Faculty of the Graduate School, Polytechnic University of the Philippines, Sta Mesa, Manila.

REFERENCES

[1] (2016). *Business Risk Assessment & the Management of Climate Impacts.* Quezon City: WWF Philippines and BPI Foundation Inc.

[2] Castello A., e. a. (2009). Managing the health effects of climate change. *Lancet*, 1693-1733.

[3] (2006). *Climate Change Impacts and Risk Management: A Guide for Business and Government.* Australia: Australian Greenhouse Office.

[4] Cruz, R., Harasawa, H., Lal, M., Wu, S., & Anokhin, Y. (2007). *Asia CLimate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on CLimate Change.* Cambridge: Cambridge University Press.

[5] Galbreath, J. (2012). On the relevancy of climate change to business. *American Association of Wine Economics Working Paper No. 107*.

[6] Kreft, S. e. (2015). *Who suffers most from extreme weather events?* Berlin: GermanWatch.

[7] Moran, M., Cohen, A., Swem, N., & Shaustyuk, K. (2005). Growing interest in environmental issues is important to both socially responsible and fundamental investors. *Portfolio Strategy*.

[8] Schuchard, R. (2010). Preparing for the unpredictable: Lessons on adapting to climate change. *BSR Insight*.

[9] A Strategic Approach to Climate Change in the Philippines: An Assessment of Low Carbon Interventions in the Transport and Power Sectors. (2010) *Transport and Traffic Planners, Inc.*

[10] Asian Development Bank Report (2009). www.adb.org

[11] Amado, J. and P. Adams. (2012) Value Chain Climate Resilience: A Guide to Managing Climate Impacts in Companies and Communities. Retrieved from http://www.oxfamamerica.org/press/files/prep-value-chain.pdf

[12] An Approach to Climate Change Adaptation Research: Events, Strategies and Drivers. (2011) *Climate Change Adaptation: Finding the Appropriate Response.* Retrieved from http://www.rrcap.ait.asia/climatechangeadaptation.pdf

[13] Baglee, A., Haworth , A., & Anastasi, S. (2012). *Climate Change Risk Assessment for the Business, Industry and Services Sector* Balch, O. and S. Kenzie. (2012) The Business of Adapting to Climate Change:

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

A Call to Action. Retrieved from http://www.iblf.org/latestclimate_change_adaptation.ashx

[14] BangkoSentralngPilipinas (2009). www.bsp.gov.ph

[15] Barnett, J., & O'Neill, S. (2013). Maladaptation. *Global Environmental Change-Human and Policy Dimensions*, 211-213

[16] Bast, J.L. (2010) Seven Theories of Climate Change. Retrieved from http://www.heartland.org/sites/default/files/SevenTheories.pdf

[17] Bowyer, P., Bender, S., Rechid, D., & Schaller, M. (2014). *Adapting to Climate Change: Methods and Tools for Climate Risk Management*. Germany: Climate Service Center.

[18] Calderon, J. (2004) Methods of Research and Thesis Writing. Metro Manila. Naitonal Book Store, Inc.

[19] Casis, R. (2008) The Climate Change Crisis: Global Legal Framework, Policy Initiatives and the Philippine Responses. *Philippine Climate Change Policy: Mitigation and Adaptation Measures.* Experts Dialogue, UP Law Center, UP Diliman

[20] Climate Change Adaptation: Engaging Business in Asia (2011) *CSR Asia*. Retrieved from http://www.csr-asia.com/report/report_2011_sida.pdf

[21] *Climate Risk Analysis*. (2005). Retrieved August 2, 2015, from Climate Risk Analysis: www.climateriskanalysis.com/glossary/

[22] Consumers, Brands and Climate Change. (2007) Retrieved from http://www.theclimategroup.org/assets/files/research.pdf

[23] Crawford, M. and Seidel, S. (2013). *Weathering the Storm: Building Business Resilience to Climate Change*. Center for Climate and Energy Solutions

[24] Cruz, R., H. Harasawa, M. Lal, S. Wu, and Y. Anokhin (2007) Asia Climate Change 2007: Impacts, Adaptation and Vulnerability

[25] Dasgupta, S., B. Laplante, S. Murray, D. Wheeler. (2009) Sea Level Rise and Storm Surges: A Comparative Analysis of Impacts in Developing Countries. *Policy Research Working Paper 4901*. World Bank

[26] Evidente, M. (2008) A Philippine Response to Climate Change: Possible Strategies for Mitigation and Adaptation. *Philippine Climate Change Policy: Mitigation and Adaptation Measures.* Experts Dialogue, UP Law Center, UP Diliman

[27] Frianeza, C. (2010) The Philippine Business Community Responding to the Challenges and Opportunities of Trade Liberalization and Climate Change. *Tech Monitor*

[28] Galbreath, J. (2012) On the Relevancy of Climate Change to Business: Evidence from the Margaret River Wine Region of Australia. *American Association of Wine Economics Working Paper No. 107*

[29] Hartel, C. and G. Pearman. (2010) Understanding and Responding to the Climate Change Issue: Towards a Whole of Science Research Agenda. *Journal of Management and Organizations*. Vol.16 (1)

[30] Hoffman, A. (2007) The Coming Market Shift: Business Strategy and Climate Change. In *Cut carbon, grow profits: business strategies for managing climate change and sustainability* (7). Retrieved from http://www.webuser.bus.umich.edu/ajhoff/pub_professional.pdf

[31] Hong Kong Business Survey on Energy Efficiency and Climate Change. (2012) *Climate Change Business Forum*. Retrieved from http://www.climatechangebusinessforum.com/en-us/research

[32] Integrating Climate Change Into Business Strategy (2012) Retrieved from http://www.cdproject.net/CDPResults/CDP_Benelux-150-Report-2012.pdf

[33] Intergovernmental Panel for Climate Change (2007) Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group Ito the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon,S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H. Miller (eds.)]. Cambridge University Press, Cambridge United Kingdom and New York, New York, USA

[34] IPCC (2007) Fourth Assessment Report of the IPCC Annex B: Glossary of Terms. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA

[35] ISO 31000:2009 (2009) *Risk Management: Principles and Guidelines*

[36] Jones, C. and L. David. (2007) North American Business Strategies towards Climate Change. *European Management Journal*, 25 (6)

[37] Klein, R., S. Huq, F. Denton, T. Downing, R. Richels, J. Robinson, and F. Toth.(2007) Inter-relationships between Adaptation and Mitigation. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M. Parry, O. Canziani, J. Palutikof, P. van der Linden and C. Hanson. Eds. Cambridge University Press, Cambridge, UK

[38] KPMG (2008) Climate Changes Your Business. Retrieved from http://www.kpmg.com/EU/en/Documents/climate_changes_your_business.pdf

[39] Lasco, R., F. Pulhin, P. Jaranilla, K. Garcia and R. Gerpacio. (2008) Mainstreaming Climate Change in the Philippines. *Working Paper No. 62*. Los Banos, Philippines. World Agroforestry Centre

[40] La Vina, A. (2008) Addressing Climate Change in the Philippines: An Integrated Adaptation-Mitigation Approach. *Philippine Climate Change Policy: Mitigation and Adaptation Measures.* Experts Dialogue, UP Law Center, UP Diliman

[41] Leurig, S. (2011) Climate Risk Disclosure by Insurers: Evaluating Insurer Response to the NAIC Climate Disclosure Survey. *CERES*.

[42] Llewelyn, J and C, Chaix (2007) The Business of Climate Change II. Retrieved from

https://dx.doi.org/10.22161/ijaems.5.2.6 *ISSN: 2454-1311*

http://gei.newscorp.com/resources/files/lheman/thebusinessofclimatechange.pdf

[43] Mallari, Nelia C, (2008) "Risk Exposure and Risk Management Techniques of Bataan Economic Zone Enterprises, their Impact on Earnings per Share, Unpublished Dissertation, Polytechnic University of the Philippines, Sta Mesa Manila.

[44] Macinas-Mananghaya, Emilia L., (2011) "Risk Exposure and Coping Mechanism of Apparel Business in the Province of Bulacan" Unpublished Dissertation, Polytechnic University of the Philippines, Sta Mesa Manila.

[45] Maier, S. (2008) The State We're In: Global Corporate Response to Climate Change and the Implications for Investors. *Ethical Investment Research Services.*

[46] Majithia, S. (2009) *Preparing your business for a changing climate.* [Powerpoint Slides] Retrieved from http://www.accaglobal.com/documents/NationalGrid

[47] Merilo, M. (2008) Philippine Initiatives on Climate Change. *Philippine Climate Change Policy: Mitigation and Adaptation Measures.* Experts Dialogue, UP Law Center, UP Diliman

[48] Moran, M., A. Cohen, N. Swem and K. Shaustyuk. (2005) The Growing Interest in Environmental Issues Is Important to Both Socially Responsible and Fundamental Investors. *Portfolio Strategy,* Goldman Sachs

[49] National Statistics Office (2009). www.nso.gov.ph

[50] Nitkin, D., R. Foster, J. Medalye. (2009) Concepts and Theories: A Systematic Review of the Literature on Business Adaptation to Climate Change. *Network for Business Sustainability.* Retrieved from http://www.nbs.net/fr/files/2011/nbs_climatechangeconcepts.pdf

[51] Norrington, H. and K. Underwood. (2008) Climate Change and Small Business: How Directors are Responding to the Challenges of Climate Change. *Climate South East Research Findings*

[52] Parry, M., N. Arnell, P. Berry, D. Dodman, S. Fankhauser, C. Hope, S. KOvats, R. Nicholls, D. Satterthwaite,R. Tiffin and T. Wheeler (2009) Adaptation to Climate Change: Assessing the Costs. *Environmental Magazine.* November/December 2009

[53] Philippine Business Response to Climate Change. (2011) *PriceWaterHouse Coopers Financial Advisory, Inc.*

[54] PCCI (2010) Annual Report. www.philippinechamber.com

[55] Philippine Department of Energy. www.doe.gov.ph

[56] Porter, M. (2011). *The Competitive Advantage of Nations.* Free Press

[57] Rahmstorf S. and D. Coumou. (2011) Increase of Extreme Events In A Warming World. Retrieved from http://www.pnas.org/content/early/2011/10/18/full.pdf

[58] Sajise, A. M. Sombilla and R. Ancog. (2012) Socio Economics of Climate Change in the Philippines: A Literature Synthesis. *SEARCA, Philippines*

[59] Schuchard, R. (2010) Preparing for the Unpredictable: Lessons on Adapting to Climate Change. *BSR Insight Article.* Retrieved from http://www.bsr.org/reports/20100831_bsr_insight_53798.pdf

[60] Stufflebeam, D. (2003). The CIPP model of evaluation. In T. Kellaghan, D. Stufflebeam& L. Wingate (Eds.),Springer International Handbook of Educational Evaluation

[61] The Climate Change Guide. (2007) *Canadian Business for Social Responsibility.* http://www.cbsr.ca/sites/default/files/CBSR_climatechangeguide.pdf

[62] United Nations Development Programme [UNDP] (2006) Human Development Report 2006. Beyond Scarcity: Power, Poverty and the Global Water Crisis. Retrieved from http://hdr.undp.org/hdr2006/report.cfm

[63] United Nations Framework Convention on Climate Change. (2007) *Climate change: impacts, vulnerabilities and adaptation in developing countries.* Retrieved from http://www.unfccc.int/resource/docs/publication/impacts.pdf

[64] Walker, W. e. (2013). Adapt or Perish: A Review of Planning Approaches for Adaptation under Deep Uncertainty. *Sustainability* , 955-979

[65] Washington State Department of Ecology. (2012) *What is Climate Change.* Retrieved from http://www.ecy.wa.gov/climatechange/whatis.htm

[66] Yusuf, A. and H. Francisco. (2010) Hotspots! Mapping Climate Change Vulnerability in South East Asia. *Economy and Environment Program for South East Asia*

https://dx.doi.org/10.22161/ijaems.5.2.7 *ISSN: 2454-1311*

Experimental Study on Partial Replacement of Sugarcane Bagasse Ash in Cement

Chandru.G[1], Vignesh.V[2], Dr. Saravanan.R[3]

[1, 2]Engineer, Thanjavur, MIET Engineering College, Trichy, Tamil Nadu, India.
Professor & Head, Department of civil Engineering, MIET Engineering College, Trichy, Tamil Nadu, India.

Abstract— *This project mainly deals with the replacement of cement with Bagasse ash in fixed proportions. Bagasse ash partially replaced in the ratio of 0%, 5%, 10%, 15% and 20%by weight of cement in four different experiment to find out maximum compressive strength and tensile strength compare it with the strength of normal concrete by using grade M-20 at 7days and 28 days. The test result indicate that the strength of concrete increase up to 20% Sugar cane bagasse ash replacement with cement.*

Keywords— Ordinary Portland cement, Sugarcane bagasse ash, M-20 Conventional concrete, Compressive strength, tensile strength.

I. INTRODUCTION

A lot of hazards are done to environment in the manufacture of cement. It involves lot of carbon emission associated with other chemicals.

Sugar Cane Bagasse Ash is difficult to dispose which in return is environmental Hazard. The Bagasse ash imparts high early strength to concrete and also reduce the permeability of concrete. The Silica present in the Bagasse ash reacts with components of cement during hydration and imparts additional properties such as chloride resistance, corrosion resistance etc.

Therefore the use of Bagasse ash in concrete not only reduces the environmental pollution but also enhances the properties of concrete and also reduces the cost. It makes the concrete more durable.

II. MATERIALS

This experimentation were locally available materials are used. It includes ordinary Portland cement and sugarcane bagasse ash as a binding material, fine aggregates, and coarse aggregates. Normal water was used for mixing and curing of entire work.

2.1 SUGARCANE BAGASSE ASH (SCBA)

Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material.

Fig.1: Sugarcane Bagasse

Table .1: Physical properties of sugarcane bagasse ash

Properties	
Specific gravity	1.89
Density	2.52g/cm^3
Particle size	5140cm^2/g
Surface area	28.9µm
colour	Reddish grey

Table.2: Chemical Components of sugarcane bagasse ash

Chemical composition	**Residual bagasse ash (%)**
SiO2	65.37
Al2O3	0.22
Fe2O3	5.98
CaO	1.50
LOI	21.04

2.2 CEMENT

In this present study 53 grade Ordinary Portland Cement (OPC) is used for all concrete mixes. The cement used is fresh and without any lumps. The specific gravity, normal consistency, initial and final setting time of cement was found as per Indian standard specifications.

https://dx.doi.org/10.22161/ijaems.5.2.7 *ISSN: 2454-1311*

Table.3: Physical properties OPC and SCBA cement

Properties	OPC	SCBA cement
Specific gravity	3.15	2.97
Initial setting time	90 min	90 min
Final setting time	210 min	210 min
Consistency	31.5%	30%

Based on the comparison between OPC cement and SCBA the properties of OPC does not changes due to the addition of SCBA, and it also enhance the properties of OPC and reduce its quantity.

2.3 FINE AGGREGATE

The sand used in this present study is ordinary river sand. The sand passing through 4.75 mm size sieve is used in the preparation of concrete mix.

Table.4: Physical properties of Fine aggregate

Properties	
Specific gravity	2.63
Fines modulus	2.58
Density	1754.3kg/m^3

2.4 COARSE AGGREGATE

The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standards and results are within the permissible limit.

Table.5: Physical properties of Coarse aggregate

Properties	
Specific gravity	2.71
Density	1692.3kg/m^3

2.5 WATER

Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water is used. The pH value should not be less than 7.

III. PROCEDURE

3.1 BATCHING

Weight batching was done as per mix proportion. Weight batching facilitates simplicity flexibility and accuracy.

3.2 MIXING

Hand mixing was done as per mix proportion.

IV. MIX PROPORTION

4.1 MIX PROPORTION

The mixture proportioning was done according the Indian Standard Recommended Method IS 10262:2009. The target mean strength was 27MPa for OPC control mixture.

Table.6: Mix proportion

Water content	Cement	Fine aggregate	Coarse aggregate
191.6	383(kg)	546(kg)	1187(kg)
0.50	1	1.42	3.09

Hence cement was replaced by bagasse ash at various percentage of replacement 0%, 5%, 10%, 15%, and 20% by weight of cement and 150x150x150mm cube casting. Water content 0.50, Fine aggregate 1.42 parts, and coarse aggregate 3.09 parts.

Table .7: Mix proportion

Types	Cement (kg)	Sugarcane bagasse ash (kg)
Type I (0%)	1	0
Type II (5%)	0.95	0.05
Type III (10%)	0.90	0.10
Type IV (15%)	0.85	0.15
Type V (20%)	0.80	0.20

The mix was prepared manually. First all the dry ingredients are mixed thoroughly such as cement, sugarcane bagasse ash, fine aggregate, coarse aggregates mixed by adding water after it makes uniform mixture.

4.2 PLACING AND COMPACTING

Moulds are properly cleaned and oiled. The fresh concrete filled into the moulds in three layers each layers are damped at 25 blows. The entrapped air in concrete is removed by using vibrator. After the compaction, the excess mortar was removed from the mould within the help of trowel and the surface was levelled.

4.3 REMOULDING AND CURING

After placing it was allowed to set for 24 hours. Samples were removed and it was marked. Concrete samples now kept in curative tank for required time of 7 days, 14 days, 28 days after that time, concrete samples from curative tank.

4.4 TESTING

After curing the concrete sample were taken to remove excess water content for the sample. The samples are tested.

V. TEST ON CONCRETE

5.1 FRESH CONCRETE TEST

5.1.1 SLUMP CONE TEST

The slump test is used to measure workability of fresh concrete. More specifically, it measures the consistency of the concrete. Slump for conventional concrete 21.

Table.8: Slump cone

Types	Slump (mm)
Type I (0%)	21
Type II (5%)	25
Type III (10%)	27
Type IV (15%)	24
Type V 20%)	23

https://dx.doi.org/10.22161/ijaems.5.2.7 *ISSN: 2454-1311*

5.2 HARDENED CONCRETE TEST

5.2.1 COMPRESSIVE STRENGTH TEST

Compressive strength test of the cube was carried out universal test in machine (UTM).The load applied on specimen uniformly, without any shocks up to the specimen fails.

Table.9: Compressive strength results

Types	7 Days (N/mm^2)	28 Days (N/mm^2)
Type I (0%)	13.80	21.50
Type II (5%)	9.50	14.15
Type II (10%)	11.45	15.65
Type IV (15%)	15.12	17.83
Type V (20%)	16.03	20.03

5.2.1 SPLIT TENSILE TEST

Split tensile test of the cylinder was carried out universal test in machine (UTM).The load applied on specimen uniformly, without any shocks up to the specimen fails. A set of three cylinders are tested for each concrete mix for 7 days, 14 days, and 28 days of curing. The maximum load taken by specimen was noted for each specimen. Average strength was calculated for every set of specimens was checked for cracks and aggregate distribution.

Table.10: Flexural strength results

Types	7 Days (N/mm^2)	28 Days (N/mm^2)
Type I (0%)	1.50	3.54
Type II (5%)	0.97	1.98
Type III (10%)	1.83	2.14
Type IV (15%)	2.14	3.06
Type V (20%)	2.50	3.20

VI. CONCLUSION

The following conclusions are drawn from the study.

1) Sugarcane bagasse ash concrete performed better when compared to ordinary concrete up to 20% replacement of sugar cane bagasse ash.
2) Increase of strength is mainly to presence of high amount of Silica in sugarcane bagasse ash.
3) It also enhances the properties. It makes the concrete more durable.
4) Sugarcane bagasse ash added to the mixes rate in cement reduced.
5) Bagasse ash in concrete reduces the environmental pollution.

REFERENCES

[1] **Partial Replacement of Cement with Sugarcane Bagasse Ash in Concrete:** A Review Pragalbha Khare1, Mohd. Afaque Khan, Neeti Mishra**,** *PG Student, Department of Civil Engineering, Babu Banarsi Das University, U.P.*

[2] **Experimental Study on Bagasse Ash in Concrete** R.Srinivasan Senior Lecturer, Department of Civil Engineering, Tamilnadu College of Engineering, K. Sathiya Lecturer, Department of Civil Engineering, Avinashilingam University for Women,Coimbatore-641108.

[3] Utilization Of Sugarcane Bagasse ash(SCBA) In Concrete By Partial Replacement of Cement Dr. M. Vijaya Sekhar Reddy, K.Ashalatha, M.Madhuri, P.Sumalatha, *Head and Assistant Professor , Department of Civil Engineering , Srikalahasteeswara Institute of Technology, Srikalahasti, Andhra Pradesh, India.*

[4] **Effect of sugarcane bagasse ash on strength properties of concrete K.** Lakshmi Priya1, R. Ragupathy, *M.E., Structural Engineering, Department of Civil Engineering, PSG College of Technology, Coimbatore, India.*

[5] **Partially Replacement of Cement by Bagasse** Miss. Gadhave Kalyani , Miss. Jadhav Bhavana, Miss. Kadu Namrata4, Miss. Satav Neha, Miss. Bande Vaishali, *Civil Engineering, Pune University, Maharashtra, India.*

[6] Experimental Study On Bagasse Ash In Concrete, T. Subramani , M. Prabhakaran, *Professor & Dean, Department of Civil Engineering, VMKV Engg. College, Vinayaka Missions University, Salem, India.*

[7] **Studies on partial replacement of cement by bagasse ash in concrete** Er. Shubham Srivastra Er.puneet kumar shula *Department of Civil Engineering Madan Mohan Malviya University of Technology, Gorakhpur.India.*

[8] **Application of sugarcane bagasse ash as a partial cement replacement material** Biruk hailu *School of civil and environmental engineering Addis ababa university.*

[9] Experimental Study on Use of Sugar Cane Bagasse Ash in Concrete by Partially Replacement with Cement Jayminkumar A. Patel, Dr. D. B. Raijiwala *P. G. Student, Department of Applied Mechanics, S. V. National Institute of Technology, Surat, Gujarat, India.*

[10] A study on bagasse ash replaced plain cement concrete Shruthi H R, Dr.H Eramma,Yashwanth M K,Keerthi gowda B S, *University BDT College of Engineering, Davangere India.*