Climate Change Adaptation

The Challenging Role of Higher Education Institutions

34th AUAP Annual Conference

November 10-14, 2019

Naresuan University, Phitsanulok, Thailand

30th ANNIVERSARY NARESUAN UNIVERSITY

The Health Sciences Cluster

The Science and Technology Cluster

The Social Sciences Cluster

Climate Change Adaptation

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About Conference

Rationale

Climate change is adversely responsible for a number of unfavorable impacts on ecological systems, energy consumption, global warming to name just a few, which, unavoidably, affect the very way of life of mankind. Future global warming situation tends to dramatically spread its effects towards human, living species, and ecosystems, which required measures have to be carefully addressed and delivered. Not only biodiversity and ecological services are negatively influenced, but this eventually leads to diseases, unexpectedly long draught, food security and supply, etc. rendered by such undesirable phenomenon.

There are various types of adaptation efforts initiated to mitigate risks and alleviate difficult situations caused by climate change, ranging from individuals, communities, governments, and the private sector. Higher education institutions, serving as a major source of knowledge, research, and technology, need to play their significant roles in identifying potential issues that are threating us at global scale and addressing likeable solutions and efforts to reduce damage and impacts of climate change. Advanced medical technology and treatments, greener and cleaner technology and the use of alternative energy, and raising awareness of stakeholders may serve the purpose of how we could efficiently adapt ourselves to respond well with this controversial change.

The 34th AUAP Annual Conference 2019 on "Climate Change Adaptation - The Challenging Role of Higher Education Institutions," which will be hosted by Naresuan University, Thailand, in cooperation with the Association of Universities of Asia and the Pacific (AUAP) on November 10-14, 2019, offers a wide range of opportunities for academia, researchers, and the industry to brainstorm and come up with practical solutions to deal with climate change through the three main theme clusters; Health Sciences Cluster, Science and Technology Cluster, and Social Sciences Cluster.

Objectives

- To offers an opportunity for academia, researchers, and the industry to share experiences, know-hows, technology transfer and proposed solutions for climate change.
- To build up an academic/industry network among partners.
- To develop existing knowledge, research, and innovation on climate change through the three main theme clusters; Health Sciences Cluster, Science and Technology Cluster, and Social Sciences Cluster.

Theme

"Climate Change Adaptation - The Challenging Role of Higher Education Institutions"

Sub Themes

- The Health Sciences Cluster: Technology Advancements in Medical Treatments to Deal with Diseases Rendered by Climate Change
- The Science and Technology Cluster: Cleaner and Greener Environment for a Safer World
- The Social Sciences Cluster: Raising Realization and Awareness towards Climate Change

About Naresuan University

Naresuan University emphasizes the improvement of educational opportunity and equality for all as one of the top government universities in Thailand. A strong focus is placed upon research, innovation, partnership, and internationalization. Naresuan University aspires to be the University of Innovation. It is strategically located at the heart of the Thai Kingdom, Phitsanolok province, the major city of the lower northern region and more importantly, the birthplace of King Naresuan the Great for whom our University is named after. Though relatively new as the University was officially granted university status on July 29, 1990; the institution's history can, however, be traced back to its inception as the College of Education in 1967.

The comprehensive university lives up to the public expectations in providing diverse, cutting-edge programs through 22 faculties, colleges, and a demonstration school. Our vision statement affirms a commitment to continue proactive roles in promoting high standards in higher education both in the national and international arenas. Through ongoing review and the development of new paradigms of the best practice, the university continues to improve the quality of teaching and learning, especially highlighting the project-based, inquiry model throughout the university. All the programs are continuously enriched and informed by the rapid transfer of new knowledge used in ongoing curriculum improvements. To produce graduates of international standing, where expertise is in high demand and whose contributions and practice are of the highest caliber and integrity, the university instills in students at all levels the six "smarts":

I. Smart with ideas
II. Smart at problem solving
III. Smart at work
IV. Smart in interpersonal skills
V. Smart in life skills
VI. Smartly equipped with knowledge, skills, and attitudes as global citizens.

Vision

Naresuan University becomes one of the top 250 universities ranked by QS World University Ranking within 2021.

Mission

Naresuan University (NU) endeavors to produce well-qualified graduates transforming high-quality research to be a new innovation. The university also provides academic services beneficial for community and society, as well as preserves Thai cultures and traditions. This includes the development on administration system.

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About AUAP

The Association of the Universities of Asia and the Pacific (AUAP) is a Non-Governmental Organization (NGO), holding the highest formal consultative status with UNESCO. Its primary purpose is to be the main platform for interaction and collaboration between members, and to be the effective voice of universities in Asia and the Pacific region.

AUAP organizes regular conferences and workshops for higher education leaders and institutions in the Asia-Pacific region to discuss important issues and the challenges facing higher education today. AUAP promotes and helps enhance mutually beneficial cooperation among educational institutions, and is dedicated to render such services to its member institutions.

The Mission of AUAP

- To promote a culture of quality, innovation and research in the higher education sectors in the Asia and the Pacific region.
- To preserve and enhance the values and cultural diversity of Asia and the Pacific towards better understanding and cooperation for socio-economic development and (universal) peace.
- To engage with stakeholders of the higher educations and other organizations to further the objectives of AUAP.
- To maintain a platform for interaction and collaboration among members, and be the voice of universities in Asia and the Pacific region.
- To promote universal peace and international understanding through education.

Website: http://www3.sut.ac.th/auap/

Welcoming Remarks
Honorary Prof. Dr. Kanchana Ngourungsi
President of Naresuan University

Prof. Dr. Mahmoud Nili Ahmad Abadi, President of AUAP,
Prof. Dr. Ricardo P. Pama, Secretary General of AUAP,
Distinguished speakers and presenters,
Ladies and gentlemen…,

To begin with, it is a privilege for Naresuan University to serve as the host of the 34th AUAP Annual Conference 2019, which the main theme is solely contributed to "Climate Change Adaptation – The Challenging Roles of Higher Education Institutions." The convention is in cooperation with our decade-long relationship partner; i.e., the Association of Universities in Asia and the Pacific (AUAP) who trusts Naresuan University with the responsibility of organizing this challenging event. My particular appreciation is expressed to Assoc. Prof. Soranit Siltharm, Permanent Secretary of the Ministry of Higher Education, Science, Research and Innovation, who, not only, welcomed our cordial invitation to preside over the opening of this international conference, but who will also honor us as a keynote speaker on "Contributions of Higher Education Institutions in Research and Innovations to Alleviate Climate Change Situation." My sincere gratitude is also extended to Dr. Peter Laurel, First Vice President of AUAP, and Prof. Dr. Ricardo P. Pama, Secretary General of AUAP who continually function as mentors and facilitators whose supportive roles have enabled the establishment of this conference.

Naresuan University is committed as part of the 4Ps (Public, Private, People Partnership) intuitive. An absence of essential element of the 4Ps will certainly result in the achievement of the University's directives, which are now focus on these 4 key areas: 1) food, health, and herb; 2) logistics and supply chain; 3) historical tourism and ecotourism; and 4) alternative energy. The University has recently participated in the BCG Economy (bio- circular- green economy) project, initiated by the government, by incorporating the programs into its strategy, which emphasize Bioeconomy, Circular Economy, and Green Economy. The University will gradually apply these measures not only within the university, but it plans to expand them to 9 provinces in the lower regions of Northern of Thailand. These directives combined with the BCG Economy model will significantly facilitate the 3Is (Internationalization, Integration, and Innovation) policy of Naresuan University. Aligned with the term 'climate change adaptation,' Naresuan University, as one of the comprehensive Thai universities, is not only actively focusing on implementing the university of 3Is dimensions, but it is dedicating as much into environmental friendly approach of zero waste management, the utilization of alternative energy, and the adhere to green area administration. These persistent efforts have been witnessed not only by the local community, but the university is presently placed 141st on the UI GreenMetric World University Rankings 2018 for its green nature initiatives.

We must ensure that there are practical measures, sustainable innovations from research, and adequate environment-minded human resources to compensate the consequences from actions of previous and future decisions that impact the quality of our lives. This conference merges topics of interest and lectures from the field of science and technology, health sciences, and social sciences whereby the synergy from higher education institutions, the public, and private sectors can meet. It is timely that we take this rare opportunity to address the three dimensions of climate

change that range from preventions to mitigations and then onto adaptation; whereby we can come up with likely practical implementations to help sustain ecosystems that nurtures our planet. Every one of us is considered collaborative architect of this undesirable decay of the globe, and I am strongly convinced that 'nature could live without us, but not the other way around.'

I rest all my confidence in the productivities of this conference, and I believe that this two-day event could prove to be a major channel for discussion among participants. I wish you all a pleasant stay in Phitsanulok, the birthplace of King Naresuan the Great. I also want to hope you enjoy and have a memorable trip after the conference to the ancient city of Sukhothai, which is known as the first kingdom of Thailand, the dawn of the happiness.

Thank you.

Opening Remarks
Honorary Prof. Dr. Kanchana Ngourungsi
President of Naresuan University

Prof. Dr. Mahmoud Nili Ahmad Abadi, President of AUAP,
Prof. Dr. Ricardo P. Pama, Secretary General of AUAP,
Distinguished speakers and presenters,
Ladies and gentlemen…,

Climate change is a global problem that endangers sustainable development. Climate change imposes direct threats to people's lives and their livelihoods in Thailand and this is not something we will experience in a distant future. The effects of climate change are already happening today. In response, the Royal Thai Government has pledged to the world community in 2015 at the 21st Conference of Parties (COP) in Paris to reduce greenhouse gas emissions by 20% in 2030 from the business-as-usual (BAU) level and may increase to 25% from BAU if receiving appropriate international financial support, knowledge and technology transfer.

Addressing the UN Climate Action Summit in New York in 2019, Prime Minister Prayut Chan-o-cha said that the increased impacts of climate change have increasingly threatened the region's economic and social progress. In this regard, ASEAN has strived to strengthen resilience by implementing both climate change mitigation and adaptation measures, and is committed to be actively involved in global climate action at various levels. Thai prime minister stressed that no one country can fight climate change alone, therefore partnership is vital.

In Thailand, Ministry of Higher Education, Science, Research, and Innovation (MHESI) is one of the main Ministry to mitigate, adapt and tackle climate change.

1. Ministry of Higher Education, Science, Research, and Innovation (MHESI) is established on May 2, 2019 and set up under the concept of higher education, science, research and innovation integration. MHESI focuses on promoting research work for commercial purposes, producing human resources in response to future needs, and developing innovation on a full-cycle basis. MHESI also creates new body of knowledge and upgrade the country's manpower, so that Thai people will be equipped with higher skills and capabilities, thus enabling them to move the country forward under the "Thailand 4.0" concept, which is a value-based, innovative, and technology-driven economy.

2. There are many agencies which work for research and innovation in all fields; science, natural and social sciences, humanities, environment and so on;

- Universities and Institutions of Higher Education: Faculty of Environment, Faculty of Science, Faculty of Agriculture, Faculty of Healthcare and so on.
- Agencies under Former Ministry of Science and Technology: National Science and Technology Development Agency (NSTDA), Thailand Institute of Scientific and Technology Research (TISTR), Geo-Informatics and Space Technology Development Agency (GISTDA), Hydro and Agro Informatics Institute (HAII) and National Astronomical Research Institute of Thailand (NARIT).
- Science, Research and Innovation Fund

3. Science, Research and Innovation Fund

- According to the policy and strategy for higher education, science, research and innovation, the budget will be allocated in accordance with the policy framework and strategy of the network consisting of 4 platforms (the

development of manpower and knowledge institutes, research and innovation for society's challenges, research and innovation for increasing competitiveness and research and innovation for spatial development and inequality reduction), 16 programs and 27 important projects.

- For example, important projects such as promoting artificial intelligence as a base for driving the country in the future, genomics research, quantum research, aging society, total poverty eradication, innovation for foundation economy, etc. Budget management will be conducted through the Program Management Unit (PMU), which will have a competitive process. It will consider the proposed work plan that has been evaluated for its effectiveness and worthiness.
- MHESI also will fund for both basic research and applied research (research areas: science, social science, humanities and interdisciplinary). Funding is included environmental research; water management, PM 2.5.
- Multi-year commitment on funding for Science, Research and Innovation based on achievement.
- Funding relates to national strategic issues.
- Collaboration with Network of PMU (Program Management Unit), Universities and Research Institutes and international partners is important.

4. Consortium Frontier Research

4.1 BCG Model, a new economic development model, is based on philosophy of sufficiency economy development which accelerates the leaping growth of the economy

- BCG model consists of 3 dimensions; B - Bio Economy, C - Circular Economy and G - Green Economy
- Bio Economy is the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. The forecasted change in climatic conditions and increasing depletion of fossil fuel sources require the economy to be based preferably on renewable resources. Securing global nutrition also demands an increase in productivity with due regard to protecting resources and the environment. The transition to a sustainable bio economy means that the historically developed structures and ways of life that appear normal today need to be completely rethought. Therefore, it is crucial to align research on a broad basis to the solution of the emerging societal challenges and to increasingly integrate social and economic sciences, as well as cultural and humanities disciplines. This is a prerequisite to tackle the problems facing us as societal challenges and to realize technical innovations as part of social structures and human life.
- Circular Economy is an economic system of closed loops in which raw materials, components and products lose their value as little as possible, renewable energy sources are used and systems thinking is at the core. It focuses on resource use often follow the 3-R approach: Reduce (minimum use of raw materials), Reuse (maximum reuse of products and components) and Recycle (high quality reuse of raw materials).
- Green Economy is defined as low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced

energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services.

- Green economy is also defined as economy that aims at reducing environmental risks and ecological scarcities, and that aims for sustainable development without degrading the environment. Green Economy aims to solve the pollution problem and to reduce the impact on the world sustainably.

4.2 Space Technology; Satellites and Earth Science. The agencies under MHESI relate to space technology are National Astronomical Research Institute of Thailand (NARIT) and Synchrotron Light Research Institute (SLRI).

5. Interesting Issues

- Bio Economy
- Circular Economy
- Green Economy
- One Health is defined as a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment. One Health is not a new concept, but it has become more important in recent years. This is because many factors have changed interactions between people, animals, and our environment. These changes have led to the emergence and reemergence of many diseases.
- CO2 Footprint is defined as the total amount of greenhouse gases produced to directly and indirectly support human activities. Carbon dioxide is so called greenhouse gas causing global warming. Other greenhouse gases which might be emitted as a result of people' activities are methane and ozone. These greenhouse gases are normally also taken into account for the carbon footprint. They are converted into the amount of CO2 that would cause the same effects on global warming.
- Global Warming is the unusually rapid increase in Earth's average surface temperature over the past century primarily due to the greenhouse gases released by people who have burnt fossil fuels. The impact of global warming is far greater than just increasing temperatures. Warming modifies rainfall patterns, amplifies coastal erosion, lengthens the growing season in some regions, melts ice caps and glaciers and alters the ranges of some infectious diseases. Some of these changes are already occurring.
- Earth Science and Earth Observation is the gathering of information about the physical, chemical, and biological systems of the planet via remote-sensing technologies, supplemented by surveying techniques, which encompasses the collection, analysis, and presentation of data. Earth observation is used to monitor and assess the status of and changes in natural and built environments.
- Sustainable Tourism establishes a suitable balance between the environmental, economic and socio-cultural aspects of tourism development, plays an important role in conserving biodiversity. It attempts to minimize its impact on the environment and local culture so that it will be available for future generations, while contributing to generate income, employment, and the conservation of local ecosystems. Furthermore, sustainable tourism can be a key vehicle in raising awareness and fostering positive behavior change for biodiversity conservation among the millions of people travelling the globe every year.

6. MHESI warmly welcomes the distinguished delegates from local and international universities, research institutions and private sectors on the possibilities to further develop the cooperation. Thank you very much.

Keynote Address
"Contributions of Higher Education Institutions in Research and Innovations to Alleviate Climate Change Situation"
Assoc. Prof. Soranit Siltharm
Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation

Honorary Prof. Dr. Kanchana Ngourungsi, President of Naresuan University,
Prof. Dr. Mahmoud Nili Ahmad Abadi, President of AUAP,
Prof. Dr. Ricardo P. Pama, Secretary General of AUAP,
Distinguished speakers and presenters,
Ladies and gentlemen…,

Every interaction brings about the opportunity to inspire, to propagate, and to maintain the spirit hope.

Good Morning,

I welcome you to this momentous occasion to reflect upon "Contributions of Higher Education Institutions in Research and Innovations to Alleviate Climate Change Situation." I would also like to take this moment to offer a special embrace to our prestigious and esteemed guests and speakers who have come to share their experiences and knowledge with us. We welcome you to our campus and to Thailand.

I am honored to have this occasion to come and share with you my experiences and my thoughts on "Contributions of Higher Education Institutions in Research and Innovations to Alleviate Climate Change Situation."

On a recent trip oversea, I overheard a dialogue that I believe was a little peculiar in substance. How the subject matter came to be a topic of discussion between the two individuals, two adults I might add, I do not know, but it was about this big blue marble that we have come to know as earth. Keep in mind the reference I used in describing the earth, a BIG BLUE MARBLE, a spherical shape. Well, the statement that was so very perplexing to me was that both individuals were fixed on the idea that the earth, no matter how much the institutions tried to convince them, they strongly assumed the earth was flat.

In my head, I'm screaming, "What! The earth is flat?" It was obvious to any perceptive and reasoning mind that the Earth is round. If you drive, sail, or even walk towards something tall that is in the distance, like a mountain, you will see the top of it appearing over the horizon before the remainder of the structure comes to full baring. The earth being spherical is uncontested. This train of thought about the earth has existed as common understanding among the learned scholars, professions, and amateur space enthusiast for well over 2000 years. These two had no idea that their claim, their belief that the earth is flat could be and has been tested.

Now you are probably wondering, 'what does this belief about the earth being flat have to do with the topic that we are gather here today to discuss- "Contributions of Higher Education Institutions in Research and Innovations to Alleviate Climate Change Situation." The acquisition of knowledge is a collection of data that lead to information that provides thinkers with evidence, and evidence based discussion are what brings us here today. The idea of a spherical Earth appeared in Greek philosophy with Pythagoras over two thousand five hundred years ago. However, it was not until somewhere around 330 BC that Aristotle provided evidence for the spherical shape of the Earth on empirical grounds, and it was not until August 23, 1966 when NASA

provided the first photo of Earth taken from the moon, which supported the evidence as presented by Aristotle.

Climate change is one such belief that required the rigors of testing by scientist if we are to understand the cause, the effects and the hazards to life on earth. Prof. Ulrich Cubasch, a renowned climate model application specialist, states that scientific theories are the techniques, methods, we sometimes can apply to explain phenomena while providing insights that can be evaluated by comparison with physical reality. Through both observation of nature and exhaustive experiments; we are able to decipher ideas whereby incorrect or incomplete scientific concepts ultimately do not survive repeated testing.

As far back as the 1800s, scientist had determined the relationship that the level carbon dioxide gas (CO2) in the atmosphere and temperature has and how it impacts climate. It was the evidence, the raw data collected over the past two hundred or so years that has supplied our modern-day models, which provide us with the insight to understanding the conditions that we are faced with today. Understanding that shared data, the information, has led to a generally accepted path of actions by modern day scientists; in so, these HEIs that house our think tanks present us with guidelines to address the issues facing the survival of our planet.

Here is where my story about the earth being flat and climate change merge. Scientist, these think tanks in HEIs have provided us with an abundance amount of researcher data, supported by obvious observational events like the rising sea levels, the increasing number and strengths of storms, and region temperature shifts. Nevertheless, many individuals -scholars, scientist and politicians alike- remain skeptical, and here lies the theme of this seminar; the Challenging Role of Higher Education Institutions, regarding Climate Change Adaption. Many politician and climate experts from developed nations are supporting a consensus strategy that relies on national or international commitments of HEI's to guide the discussions and research needed to influence mitigation of climate change circumstances in which people may become exposed to these phenomena.

Observations of current phenomena have suggested that the impacts and forthcoming conclusion regarding climate changes are not abstract ideas but tangible realities. Research and policy on adaptation of climate change is just beginning to recognize the full contributions of values and governance to our behavior and actions.

Those of us here today have taken on a responsibility as global citizens to focus on the realities that impact the quality of life which affect individual on all societal levels. The diseases rendered by climate change, the impact of a greener and cleaner environments for a safer world, the effects of microplastic contamination of our food supply chain, whether it be by way of the pollution of our oceans, sea levels rising, or the unsurmountable waste, CO2, and methane generating being produced is everyone's concern. Through the use of the HEIs networks, we can bring about the strategies to facilitate learning about the issues of Climate Changes and its impact on the quality of life that is essential for happiness.

For example, over the last 50 years, human activities – particularly the burning of fossil fuels – have released sufficient quantities of carbon dioxide and other greenhouse gases. Discovering containment mechanisms, which affect the mitigation of global climate, has been delegated by a self-indulgence attitude, one that is a characteristic of scientists and academics, to discover the causations, associations, and alleviations of climate change and its detrimental impacts on life.

There has been a general lack of understanding of how the disruption of the biophysical and ecological systems might affect the longer-term wellbeing and health

of populations. While at the same time, informing the inhabitants of this planet about the forthcoming dangers that can be prevented, HEIs are tasked with not only finding answers, but burdened with the task of developing innovations that will mitigate the consequence of increased and more diverse extremes in the weather, and the illness that are created from those extreme changes in climate.

With the assistance of innovative technologies spawned by HEIs, the private, and government sector, many mechanisms; the capacity for early identification of climate change, the related issues and the response to possible emerging threats to health; will be a routine procedure for authorities who are responsible for providing protective measures to those issues brought on by Climate Change. The capacity to identify the rooted causes effecting climate change must be built if we are to mitigate the cause, events, and hazardous situation produced from climate change. Sustainable mechanisms must be developed to deal with the possibility of the rapidly emerging environmental health issues linked with climate change.

Providing a cleaner and greener environment is essential. It is fundamental idea that must be established in order for us to create an attitude of "zero carbon footprint" impede and adapt the mindsets, those habits, that have produced these conditions that have brought about climate change and the challenges we are faced with today.

Science, technology, and innovations are constantly changing and improving. However, staying one-step ahead of the fluctuating conditions brought on by climate change means implementing research projects that produce application advancements for combating and mitigating the effects of climate change. It has usually been assigned to the HEIs, who as the essential element of both the academic R&D and production teams, to disseminate the efforts, the results, and applications of needed programs and product they have been create to analysis, to identify, and to mitigate the adversities that are brought on by changes, unwanted change in the climate.

Some scientist suggests the planet's climate will change fast enough to cause widespread catastrophes. Episode that will cause great damage and suffering as a result of droughts, famines, the spread of insect-borne diseases, the displacement of populations, and a worsening of severe poverty can be intervene though programs of discovery of innovative measures that is support by the research performed via HEIs. Although the severity of these impacts of climate change will depend on how much we act now to mitigate the consequences, all HEIs program must be designed to address the true role HEIs regarding climate change and research. In addition, HEIs must understand stand their role and not only their role as the investigation but must understand their responsibility as the distributor of information to communities and countries around the world will suffer the consequences of tons of carbon dioxide pumped into the atmosphere.

The stakes are high. The consequences to life and doing nothing can be catastrophic, humanitarian assistance as a result of climate-related disasters could double by 2050.The potential, and even likely, implications of climate change for ecological and physical systems are profound and disturbing.

Too frequently, adaptation still reflects a narrow framing, which assumes that climate change is an ultimate, rather than a proximate driver of change. (Nelson, 2009: 496)

There is no plausible prediction of mass civilizational collapse from the effects of Climate Change. Despite this, the fight against climate change is a real opportunity to transition to a low carbon society, creating jobs, innovation and social justice locally and internationally.

However, as scientist, educators, and leaders, we need to not only deliberate the challenges of Climate Change but also take assertive actions to develop strategic plans to tackle the policies, beliefs, and mindsets that stymie the processes to improve the quality of life for all. HEI's role in the climate change debut is founded in their societal responsibility of providing guidance.

The idea that the earth is flat has been debunked; yet there are those who are not convinced. The idea that the climate is not changing for the worst will require the higher educational institutions to adapt their approach to the dissimulation of climate change thinking. The earth is flat. Conspiracy theory sees a horizon that extends only to the distance of sight, but a horizon is not only what we can see. It is of course, what we as educators are prepared to help foster - new creative ideas that promise and promote the alleviation of events and attitudes that create climate chaos, while promoting mechanisms that will boosting those elements that provide us with a more sustainable and health quality of life.

The spirit of hope lies in our approach to climate change. The answer to the alleviation of conditions lies in our resilience and commitment to new solutions, new tactics that we can apply to combat the consequence of years of misunderstanding the effects CO2 on temperatures and the ability for nature, along with mankind, to restore the ecosystem that impacts our climate. New ideas, innovative industrial, health science technologies, approaches to ensure a cleaner and greener environment, and the advancement of ideas which will help us with the discovery of productive and effective answers to the Challenging Role of Higher Education Institutions regarding Climate.

Change Adaptation is our message of hope, which impacts the quality of life for all global citizens.

Thank you for your attention

Keynote Address
"Extreme Climate: Education is the key!"

Assoc. Prof. Dr. Seree Supratid
Director of Climate Change and Disaster Centre, Rangsit University

Abstract

The effects of climate change are already being felt across the globe and will exacerbate, impacting people in all aspects of their lives. Current average global temperature is 0.8°C higher than the pre-industrial level and research shows that 1.5o C of warming is already locked into our world. The latest finding from the IPCC-AR5 indicates that a warming of 1-2o C above pre-industrial levels would severely impact food production, water resources, and ecosystems, in addition to posing a moderate-to high-risk to human and natural systems. However, the risk of these occurrences would be high or very high under a global temperature rise of 4o C or more. With a combination of natural variability, a warmer climate from the greenhouse effects, and a more vulnerable world in general, the risk of major societal disruption from weather and climate extremes such as floods, droughts, heat waves, and destructive storms is expected to increase. Consequently, education must play a dominant role and be part of the solution. The ability of education to inspire, engage and empower people as well as inform people of the extreme climate, including its causes and impacts, are clearly acknowledged in international climate agreements.

Addressing climate change and ensuring sustainable development are integral to the global agenda, and are crucial in achieving the Sustainable Development Goals (SDGs). Young people are one of the largest demographic in the world. Forty-two percent of the people are under the age of 25 (World Bank). Education empower all people but especially motivates the young to take action on the impact of global warming and learn how to adapt to climate change. The integration of climate change into education can be demonstrated in various examples such as curriculum-based, community-based and technology-based approaches and these approaches must be about facts and sciences. There is a need for integration of climate change education throughout the lifecycle: in early childhood, primary, secondary and post-secondary education, and beyond, and through formal, informal and non-formal education. Therefore, education is necessary foundation for not only young, but equally as important in the wider community, industry and government. Here we will share about state of global, regional, and local extreme climate, especially for Thailand.

Keynote Address
"Building a Green Economy: Low Carbon Resilient Path"

Mr. Conrado S. Heruela
Director of Climate Change Program, School of Renewable Energy and Smart Grid Technology, Naresuan University

Abstract

The presentation opens with an overview of the conclusions of the IPCC 5th Climate Change Assessment Report: "Human influence on the climate system is clear"; "The more we disrupt our climate, the more we risk severe, pervasive and irreversible impacts", and "We have the means to limit climate change and build a more prosperous, sustainable future". A discussion about what is Green Economy, based on a document published by the UN Environment Programme (UNEP) in 2011, then follows. The discussions include green economy pathways, and the enabling conditions needed to achieve these. These elements of the green economy are very much and similarly aligned with the means to limit climate change and build a more sustainable future discussed In great detail in the two other IPCC 5th Assessment Reports: the Working Group II report on "Climate Change Impacts, Adaptation and Vulnerability"; and the Working Group III report on "Mitigation of Climate Change". An overview of the conclusions and recommendations of these two reports are then discussed, focusing on how the interventions and strategies presented in the two reports forms the key comprehensive climate action options available to countries and to the world for developing and defining not only a low carbon resilient path for a green economy, but avoid catastrophic climate change. The presentation discusses next the UNFCCC COP21 Paris Agreement. Under the Paris Agreement, all countries (except a handful) have signed commitments to implement climate actions, defined under their "Nationally Determined Contributions" or NDCs, which they submitted to the UNFCCC. The presentation pointed out that included in the Paris Agreement, are provisions to support countries in training & human resource development, capacity building and finance. To provide an example, an overview of Thailand NDC is provided. The presentation points then to the challenges to universities in supporting countries achieve their NDCs and their countries' commitment to the Paris Agreement. To provide a model, the presentation concluded with a brief overview of the climate actions being undertaken at the School of Renewable Energy & Smart Grid Technology or "SGTech" of Naresuan University.

Synergy of the Science and Technology Cluster
Cleaner and Greener Environment for a Safer World

Dr. Md. Sabur Khan
Founder & Chairman of Daffodil International University

Abstract

Higher education institutes have linear relationship with Climate change, green action, and clean environment. Considering Sustainable Development Goals (SDGs) on these strata like Goal 4: Quality Education; Goal 6: Clean Water and Sanitation; Goal 7: Affordable and Goal 13: Climate Action, Goal 14: Life Below Water; Goal 15: Life on Land higher education institute may play a pivotal role to integrate all the action plans discussed at these SDGs. The paper aims to address and highlight how science and technology can be used to tackle the challenges of environment with ensuring pragmatic role of higher education institutes. This research paper also attempts to highlight how universities should design course curriculum, focusing cleaner and greener environment. Examining global models on this burning issues, the paper tries to develop a model where all these stakes were considered.

Key words: Higher education institutes, Climate change, green action, Sustainable Development Goals (SDGs), science and technology, universities

Synergy of the Social Sciences Cluster
Raising Realization and Awareness towards Climate Change

Prof. Dr. Anoop Swarup
Vice Chancellor of Jagran Lakecity University

Abstract

Humans, Human systems and Humanity will have to adapt to climate change. Understanding the importance of the adaptation challenge at a global scale, however, is incomplete, constrained by a limited understanding of how adaptation is urgent and immediate. Advances in the science and observation of climate change have provided a clearer understanding of the inherent delicate nature and variability of Earth's climate system and its likely adverse response to human and natural influences. The need to adapt to climate change is now widely recognised, as evidence of its impact on social and natural systems grows visible as drastic climate changes, and greenhouse gas emissions continue unabated. Yet efforts to adapt to climate change, as reported in the literature over the last decade and in select case studies across the globe, have not led to substantial awareness and critical mass for urgent adaptation actions in communities despite substantial investments. Moreover, implemented actions due to awareness campaign have been mostly incremental and focused on proximate causes; there are far fewer reports of more systemic or transformative actions. Recent decision-oriented approaches that aim to overcome this situation to raise awareness on climate change are framed within a metaphor to lay emphasis on the need for robust decision making within adaptive processes in the face of uncertainty and inter-temporal complexity.

Microplastics in green mussel Perna viridis from Singhanakorn District, Songkhla Province, Thailand

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Abstract

Microplastic contamination in marine environment of Thailand region has recently sustained growing heed. The ingestion of microplastic in marine organisms has become an emerging environmental issue with inference for seafood safety. Bivalves being one of the marine organisms deemed to be an important route of exposure to microplastic towards human because they tend to filter large amount of seawater while feeding and non-selectively ingested microplastic from seawater; moreover, they are consumed completely without removal of guts. This study documents a market survey in order to understand the extend of microplastic presence in domestic green mussel (*Perna viridis*) sold in fishery market in Singhanakorn District, Songkhla Province. This species selected because it is widely consumed and economically important especially in the southern Thailand region. The mean concentration of microplastic in these green mussels' samples was 21.10±0.15 n/g and 12.30±0.20 n/individual. The size of microplastics found ranged from 0.18 to 4.2 mm with 0.5 to 1mm being the most common size class. Fibres subsequently were dominant shape and represent 95.9% of total microplastics ingested, with high abundance of black and blue microplastics discovered. Our results indicated that microplastic pollution is spreading in one of Thailand's commercial bivalve and we suggest more comprehensive systematic market-based survey on other types of bivalves and marine organisms in order to justify the current condition of microplastics exposure towards human.

Keywords: Microplastics, Contamination, Ingestion, Green mussel, Market survey

Introduction

The incremental of annual plastics global demand has been growing constantly due to plastics convenient properties (versatility, durability, lightness, strength and transparency); with the increasing population in recent years (Andrady, 2017; Browne et al., 2011; Lu et al., 2016). In 2010, coastal countries estimated to have been generating almost 275 million tons of plastic waste; of which 2-5% were mismanaged and eventually ending up as marine debris upon reaching the ocean (Jambeck et al., 2015; Cho et al., 2018).

Plastic debris that enters the ocean, either through accidental release or indiscriminate discards it is fragmented sequentially into smaller piece through various environmental processes including photo-to degradation (UV radiation), physical fragmentation, chemical deposition an biological degradation (Browne et al., 2007; Andrady, 2011; Shim and Thompson, 2015). Plastic debris' entrance into the

marine ecosystem subjected to range of sizes, difference in specific density, chemical composition and morphological characteristics (size, colour and shape) (Hidalgo-Ruz et al., 2012; Duis and Coors, 2016). Microplastics are generally described as small plastic particles that have the diameter dimension of <5mm (Cole et al., 2011; GESAMP, 2015). Due to their ubiquity and small size, microplastics are accessible and have high potential to be ingested by a wide range of marine organisms with numerous feeding approaches and categorized to different trophic levels (GESAMP, 2015; Guzzetti et al., 2018).

Among these marine organisms, bivalves have been extensively used as bio indicator species for environmental monitoring from pollutants such as heavy metals and persistent organic pollutants due to their immobile nature, immense distribution, high tolerance towards contaminants and the ability to filter large volume of seawater while feeding thus can ingest microplastics during the process (Zhou et al., 2008; Li et al., 2016). Furthermore bivalves; in this study green mussels (*Perna viridis*), are on of economically and highly sought seafood in Thailand region hence can be a direct route of human exposure to microplastics as they are consumed whole, without gut removal.

A market-based survey is a suitable approach for assessment of human intake of microplastics through seafood consumption because the majority of people obtain seafood from markets, and microplastic concentrations can change during transportation from the production site to market. In this study, we investigated microplastic presence in *Perna viridis* sold in Singhanakorn District fishery market, which is one of the popular seafood market in southern Thailand. To obtain representative data, systematic random sampling was carried out. This study aimed to identify the abundance and morphological characteristics (number, shape, size and colour) of microplastics in the green mussel (*P. viridis*) widely consumed by the southern Thai people and being one of the microplastics contamination primary studies in the coastal of southern Gulf of Thailand.

Methodology

One hundred green mussel individuals bought from Muang Ngam market located in Singhanakorn district, Songhkla province, southern Thailand. Only domestic green mussels caught or harvested from the coastal areas of southern Gulf of Thailand were purchased. Samples acquirement was done in April 2019 and the mussels were frozen, transported and stored at -20°C until further laboratory analysis.

Subsequently, each mussel was defrosted and dissected to remove the tissue (body) from their shells. Special care was taken to prevent sample contamination during dissection, extraction, sorting and visual identification. Cotton laboratory coats worn and all material and working surfaces cleaned with alcohol. In order to account for background contamination, an 8 cm Petri dish with a few ml of distilled water placed next to the working zone beside the microscope and no atmospheric contamination detected.

Once dissected, the wet weight of the digestive tract recorded and listed. Subsequently, the digestive tract samples were digested following the alkaline method describe by Cole et al., 2014; Ding Jin-Feng et al., 2018 with modifications. The samples then placed in a 250-mL conical flask each. Then, 150mL of 10% KOH solution carefully added before sealing the flask using aluminium foil and left for 12 hours in room temperature for assimilation process. The conical flasks then heated on hotplate at 60°C for 12 hours with 1 minute manual shaking during every 2 hours interval, to remove all the organic matter. The digested solution then filtered

immediately over a Whatman GF/F filter (0.7 mm pore size, 47 mm diameter) using a Millipore filter set without cooling down. The filter papers individually placed into clean petri dishes to complete dryness in an electric thermostat blast-drying oven at 60 ºC and then observed under dissecting microscope.

Items photographed and maximum length, colour and shape (fibre, film, sphere or fragment) noted and measured, using a microscope Olypus SZ, lense 110AL2X-2 with camera Canon EOS 600D. Items, which presented characteristic features of synthetic polymers, identified as microplastics (mouldable items with consistent thickness and colour that do not break when pressed with forceps). In case of doubt, a hot metal tip applied on the object.

Results

Microplastics were abundantly detected in green mussel (*Perna viridis*) sold in Singhanakorn fishery market with 100% frequency (presence in all 100 samples). The total microplastics concentration in these commercial green mussels are 21.10±0.15 n/g (wet weight) and 12.30±0.20 n/individual (Table 1). The average number of items varied from 5 to 30 items per individual. The size of microplastic particles ranged from 0.18 to 4.2 mm, the most common size class was 0.5-1mm, and the lowest size class was 4-4.2 mm (Fig. 1). All items found were smaller than 5mm, fitting the definition of microplastic (Arthur et al., 2009; GESAMP, 2015).

Discovered microplastics mainly constituted by fibres (95.9%) and followed by fragments (4.1%). A great variety of colours were found, being black (34.7%) the most common, followed by blue (23.7%), red (13%) and grey (8.9%) (Fig. 2). In compliance with previous studies and documentations, detected microplastics were mostly fibres (Boerger et al., 2010; Lusher et al., 2013; Neves et al., 2015; Bellas et al;, 2016) and the most frequent colour was black. The viable sources of fibers are hygiene and cosmetics products, textiles and the fishing industry (Andrady, 2011). Most microplastics, despite being less dense than seawater and tend to float at the sea surface, one of the most common type of fibers consists of nylon that were used for fishing gears and having negative or neutral buoyancy causes them to sink into mid water column or towards the sediment (Cole et al., 2011; Andrady, 2015).

The levels of microplastic in market green mussel from southern Thailand tend to be high because most of the mussels harvested from their natural estuarine habitat. The tidal current causes fine marine debris on the tidal flat to be constantly suspended in the water column, hence increasing microplastic levels in seawater (Cho et al., 2019) causing mussels that inhabits intertidal zone with non-selective feeding strategy acquire the capacity to ingest and accumulate marine contaminated particles of low qualitative values such as microplastics (Browne et al., 2008).

Table 1
Total and concentration of microplastics in *P. viridis* from Singhanakorn fishery market.

Category	Value
No. of Individuals	100
Mean Length (cm)	7.43±1.29
Mean Width (cm)	3.23±1.14
Mean weight with shell (g)	19.1±1.6
Mean weight without shell (g)	5.82±1.4
Total no. of Microplastics	1273 items

Microplastics Concentration:	
(i) n/g wet weight	21.10±0.15
(ii) n/individual	12.30±0.20

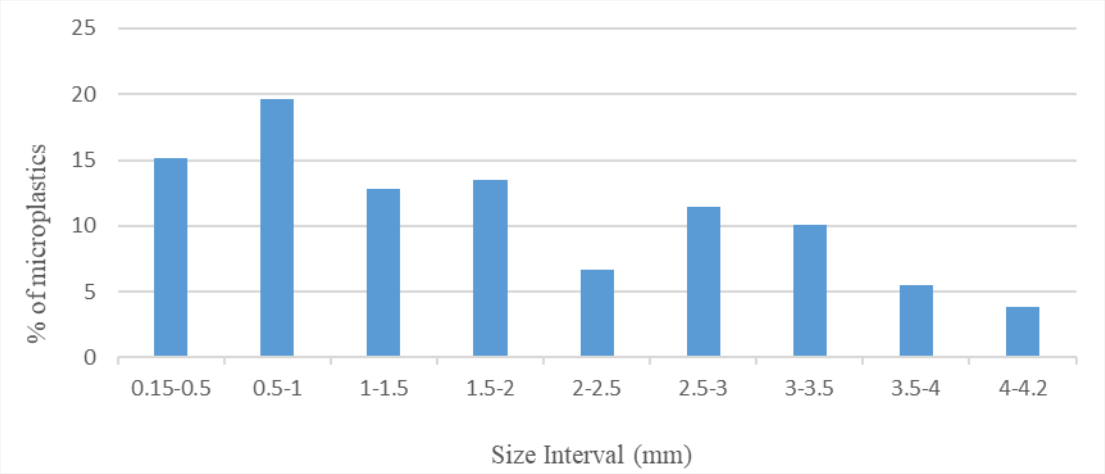

Fig. 1. Percentage of microplastics according to their size class

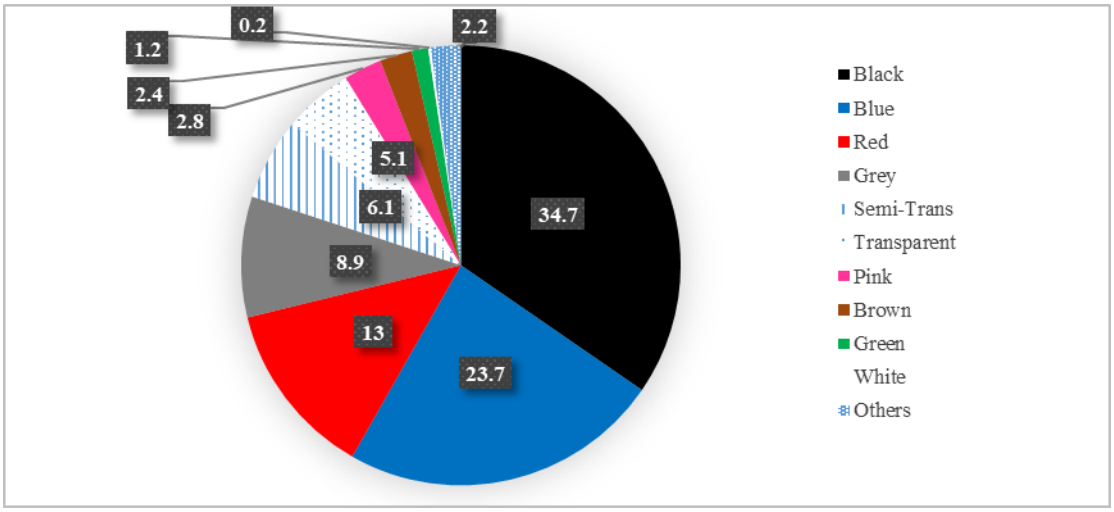

Fig. 2. Pie chart showing the plastic colours detected and their relative frequency

Conclusion

The concern about the microplastics with the combination of hazardous chemicals in mussels is growing not only for their pivotal role in the trophic chain or as component in the benthic ecosystem, but also because mussels such as *P. viridis* are highly disseminate species in the seafood industry particularly in the Thailand region. Mussels potentially being route of human exposure to microplastics because they can filter large volume of seawater and eaten completely, without gut removal. The concentration of microplastics presence in *P. viridis* in this study were high, thus more comprehensive market base surveys should be done that will cover other type of bivalves and seafood in order to understand the risk of human exposure to microplastics.

Acknowledgements

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Accumulation of Arsenic and Cadmium in a Common Species of Wing Shell)*Strombus anarium*(from Libong Island, Southern Thailand

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Abstract

This study was undertaken to assess the levels of trace metals)Arsenic and Cadmium(in a common species of wing shells)*Strombus anarium*(from Koh Libong, a small island located in Andaman Sea. A total of 35 wing shells were collected in May 2019 by hand pick sampling. Arsenic and Cadmium concentrations were determined by Inductively Coupled Plasma Mass Spectrometry)ICPMS(. The mean total concentrations of As and Cd in the tissue were found to 1.54 ± 1.10 µg/g dry weight and 0.31 ± 0.26 µg/g dry weight respectively. The biota-sediment accumulation factor)BSAF(of Cd)>1(was higher than that of As)<1(in this study. It was suggested that As could be a limiting element)BSAF < 1(of wing shells obtained in the Libong Island. In comparison with the permissible limits set by the Royal Thai Ministry of Public Health, mean values of As and Cd concentrations were within the acceptable limits. For food safety reason, regular monitoring of Arsenic and Cadmium concentrations in wing shells from Libong Island is suggested for contamination determination.

Keywords: BSAF, trace element, ICMPS, food safety

Introduction

Metal accumulation in aquatic organisms, especially filter feeders like shellfish is a serious concern, due to their capacity for bioaccumulation)Pradit et al., 2016(. Mollusks including mussels, oysters, and clams have been widely analyzed for toxic metal levels to satisfy shellfish food safety) Pradit et al., 2016(. Marine organisms could accumulate heavy metals and their metal concentrations provide a time-integrated degree of metal availability, over long periods of time depending on the metal species)Rainbow, 2002(. For example, Cd may be a carcinogen and Pb can damage blood circulation) Arnich et al. , 2013). As occurs in a wide variety of minerals, mainly as As_2O_3, and can be recovered from processing of ores containing mostly Cu, Co, Ni, Pb, Zn, Ag and Au.)Wuana & Okieimen, 2011(.As is also widely used in agriculture as pesticide and herbicides, manufacturing of glass, metal

adhesives and wood preservatives. As occurs in organic and inorganic forms. Organic As compounds)such as those found in seafood(are less harmful to health compared to inorganic As compounds)such as those found in water(that are highly toxic. Long term exposure to As can lead skin damage and increase risk of cancer as well as problems with circulatory system.

Wing shells (*Strombus anarium*) are a favorite seafood consumed by villagers in Trang Province, Thailand. They are a source of cheap protien. Since wing shells are filter-feeder organisms similar to cockles and mussels, contamination of the hightly productive mudflats with metals leads to accumulation in their whole body tissue (Hossen et al., 2014). According to concerns over this metal accumulation and their toxic effects to humans consuming these organisms, the aim of this study was to deternine accumulaton of As and Cd concentrations in the soft tissue of wing shells)*Strombus anarium*(.

Methodology

Libong Island was the selected area for this study. It is located at latitude 07°14'-07°17' N and longitude 99° 22'-09° 27' E on the western coastline of Kantang District , Trang Province, and approximately 3 km away from the mainland (Wongkamhaeng et al., 2009) (Fig. 1). Libong Island has a diverse ecosystem, including coral reefs, mangrove forests and extensive seagrass beds. The study site is situated on the east coast of the island where the large seagrass bed and mud flat can be found. A total of 35 wing shells were sampled in May 2019 by hand pick from mud flat area. They were cleaned externally before being placed in a plastic ziplock for transportation. At the laboratory, the sample were cleaned with distilled water. The total length, total weight and fresh tissue for each wing shell were measured and then recorded in a logsheet. After that soft tissue was oven dried at 60° C. The samples were ground to a fine powder with a mortar and pestle. The surface sediments were collected during the same time period from the 10 stations, using a plastic spoon to scoop about 0.5 kg of sediment and put in clean plastic bags, which were then placed in a box before transported to the laboratory. The samples were air dried until they were required for analysis

Determination of Trace Metals (As and Cd)

Strombus anarium samples were digested in a closed teflon bomb. 0.05g of sample was added with 1.5ml of HNO_3 and oven digested at 120ºC which resulted in clear solution with no residue. The metal concentrations of digested samples were determined by using Inductively Coupled Plasma-Atomic Emission Spectrometry) ICPMS(. Sediment samples were totally digested in aqua region mixture) HCl: 3HNO(and analyzed for trace metals, following the published methodologies of Loring and Rantala) 1992(, The trace metal concentrations were then measured by ICP-MS)Perkin Elmer Elan 9000(.

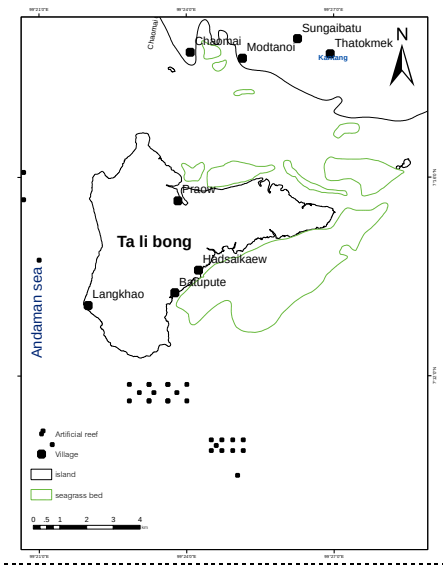

Fig. 1. Map of study area.

Data analysis

The extent of chemical bioaccumulation is usually expressed using a bioaccumulation factor) BAF(. In sediment dwelling organism, the biota-sediment accumulation factor) BSAF(is used for the relative concentration of a substance in the tissue of an organism compared to the concentration of the same substance in sediment)Baumard et al., 1999; Cortazar et al., 2008; USEPA and USACE, 1998(:

$$BSAF=Ct/Cs$$

Where Ct is the metal concentration in benthic organisms and Cs is the metal concentration in the sediment. The BSAF values which are greater than 1 (>1) indicate the occurrence of accumulation and biomagnification of that metal. The BSAF values less than 1 (<1) suggests the occurrence of trophic dilution (Burkhard, 2009)

Results

Accumulation of trace metals) As, Cd and Pb(in *Strombus anarium* was shown in Table 1 and summarized as follows; the amounts of As ranged from 0 – 5.55 µg/g dry weight (mean=1.41); the amount of Cd ranged from 0-0.53 µg/g dry weight (mean=0 . 2 1); Overall the amounts of trace metals were in order As > Cd. In comparison with the permissible limits set by the Royal Thai Ministry of Public Health, mean values of As and Cd were within acceptable limits of food safety standard.

Table 1. Descriptive data of wing shells

	N	Minimum	Maximum	Mean	Std. Deviation
Total wt (shell+tissue) (g)	35	10.44	35.60	18.27	6.38
Tissue wet wt (g)	35	0.47	8.56	2.90	1.89
Tissue dry wt (g)	35	0.14	2.53	0.79	0.63
As	35	0.00	5.55	1.41	1.14
Cd	35	0.00	0.58	0.21	0.19

Table 2 shows the correlation of As and Cd levels with tissue wet weight, total weight (shell+tissue) and tissue dry weight. Within the total weight (shell+tissue)

significant correlation was found between tissue wet weight (P<0.01), tissue dry weight (P<0.05) and Cd (P<0.05). There was no any significant correlation with As. Tissue wet weight had significant correlation with tissue dry weight (P<0.01), Cd (P<0.01) and As (P<0.05) respectively.

Table 2. Correlation between trace metals (As and Cd) in wing shells.

	Total wt. (shell+tissue) (g)	Tissue wet wt. (g)	Tissue dry wt. (g)	As	Cd
Total wt (shell+tissue) (g)	1.000				
Tissue wet wt (g)	.538**	1.000			
Tissue dry wt (g)	.406*	.821**	1.000		
As	.158	.377*	.279	1.000	
Cd	.343*	.611**	.506**	.584**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The study result revealed the BSAF >1 for Cd and the BSAF <1 for As (Fig 2). The BSAF was highest for Cd, but the concentration of Cd in the sediment of the areas was very low. A possible explanation may be that Cd accumulated in the wing shells for a long time, thus, the source of Cd may come from water and suspended particles. Since the BSAF of As was <1, As could be a limiting element for accumulation from the environment. It is well known that As is a toxic element. It could be harmful to the organisms, if they are obtained at concentrations beyond their tolerance limits or necessity. To deal with this essentiality/toxicity duality, biological systems have developed the ability to recognize a metal and deliver it to the target without allowing the metal to participate in toxic reactions (Luk et al., 2003). Relationship between concentration of As and Cd with and tissue wet weight and total weight is shown in Figs 3-6.

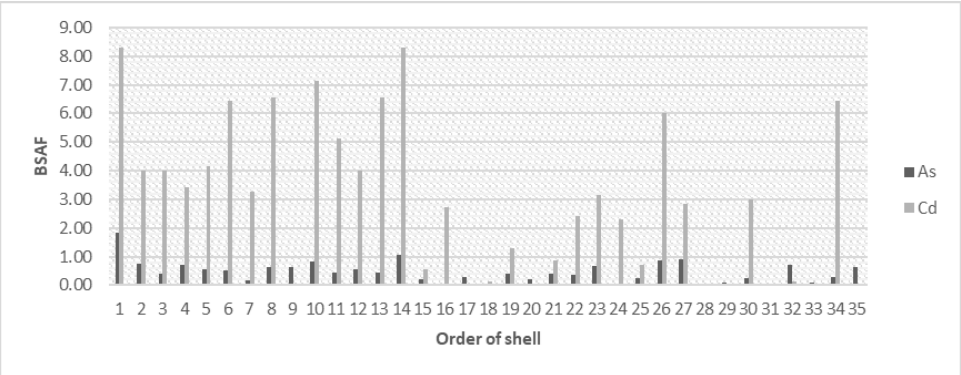

Fig. 2 The biota-sediment accumulation factor)BSAF(of As and Cd in the wing shells from Libong Island

Conclusion

The BAF results revealed that this species had restricted accumulation of non-essential elements (As and Cd). The species also demonstrated a unique property of having a capability to accumulate a specific element in their tissues and it could enter to human body by consuming the contaminated wing shells. Regular monitoring of trace metal levels in wing shells and other benthic species should be conducted for a food safty reason since most metal pollutants could easily move and disperse through aquatic ecosystems.

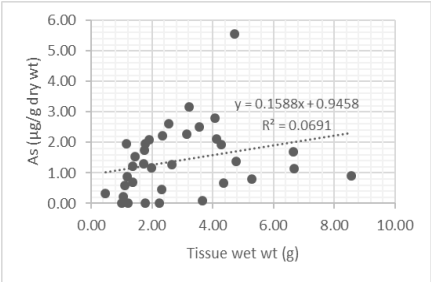

Fig.3 Relationship between concentration of As and tissue wet weight

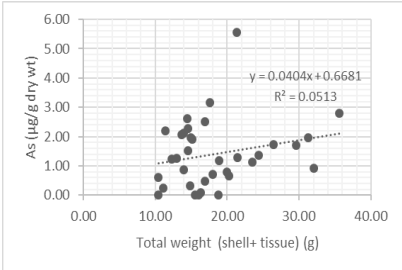

Fig.4 Relationship between concentration of As and total weight (shell+tissue)

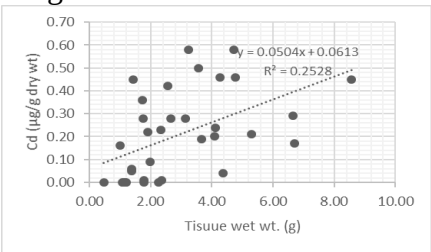

Fig.5 Relationship between concentration of Cd and tissue wet weight

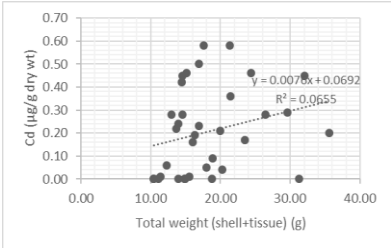

Fig.6 Relationship between concentration of Cd and total weight (shell+tissue)

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Apply Supply Chain Management to analyze Thai Para Rubber and Climate Change Crisis

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Abstract

Para rubber is one of Thai important agricultural products. Para business has started in Thailand since 1899. In 1990 Thailand has become the biggest producer and exporter of natural rubber in the world. Global demand for rubber has been driven by world population expanding and faster economic growth. Many products use natural rubber as their materials. Even, today chemical rubber can be used to replace the natural rubber, however, it is not complete replacement. Natural Para rubber still has real demand.

The research intends to study how can Para Rubber reduce the climate change crisis? by applying SCM theory to review data in each chain. The study adopts the literature review and depth interview methodology to find out the results. From analyzing throughout the Supply Chain Management (SCM) of rubber business chains found that each stream can support the world to reduce CO2. To grow Para rubber effects to carbon dioxide (CO2) absorbed. Rubber trees are an essential tree species that absorb CO2 from the atmosphere and stores it in its biomass. For this reason, rubber plantations can act as carbon sinks. Especially, there is new innovation that can create a new product as " Cement product" from natural rubber. This innovative rubber material can be applied to use for construction. To produce "Cement product" occurs co-2 and able to absorb co-2 better than normal cement products. It means if these innovation materials are practiced to be used, the high-speed co2 absorption will occur.

Therefore, Thailand has the potential for rubber plantations and mitigated greenhouse gases in the atmosphere through carbon trapping by rubber plantations. Summary, it is interesting to study how can Thailand and the world will get the benefits from growing Para rubber to reduce climate change.

Keyword: Supply Chain Management, Thai Para Rubber, Climate Change Crisis

Introduction

Para Rubber business is one kind of important business in Thailand. In 1899, the first rubber tree, was grown as the pioneer rubber plantation industry by Phraya Ratsadanupradit in Thailand in Trang province. Meanwhile, the first crop of Malaysia was established in 1896. Rubber is acknowledged as one of the important crops to the country that provides income and employment, especially to the small farmers, workers and their families. Para rubber has had an industrial crop that is significant to the Thai economy in terms of GDP, employment, and exports. In 2012 Para rubber played a role in 3.3% of Thailand's GDP, employing around one million families or up to six million people or around 15% of total employment, and 5.9% of total export value 8,745 million USD (Kaittisak Kumse (2013)) . In 2017 total world rubber production was about 12.7 million tons while Thai production was about 4.56 million tons or around 36% . Thailand is the world's largest Natural Rubber producer, the

highest income among agricultural commodities and the fifth largest among all exporting items, as well as the third largest source of export revenues.

In 2018, the total area of growth was almost 3.3 million hectares throughout Thailand. Since 1990, Thailand has been the largest rubber producer and exporter of natural rubber, over 4.56 million tons, accounting for almost 36% of the world's total natural rubber production. This was followed by Indonesia (26.0%), Vietnam (8.6%), China (8.0%), Malaysia (5.5%), and India (5.0%) (Thai Rubber Association, 2019). Rubber is required in the manufacture of many industrial and consumer products, from hoses and vehicle tires to belts, condoms and gloves. 80-85% of Para Rubber product exported in 2018, the main market of total export was China about 47.5% (Thai Rubber Association, 2019)

In 1839, Charles Goodyear invented vulcanization process that could be applied to produce major commercial success as manufacturing of tire. After this technology is developed to produce automobile tires in the rubber industry (A.Y. Coran, 2013). Natural rubber consists of solids suspended in a milky fluid (that circulates in the inner portions of the bark of many tropical and subtropical trees and shrubs) called latex. Rubber is the basic constituent of the tires used in automotive vehicles (aircraft, and bicycles). More than half of all rubber produced takes to use in automobile tires; the rest leads to use in mechanical parts such as mountings, gaskets, belts, and hoses, as well as consumer products such as shoes, clothing, furniture, and toys.

Crude oil can be used to produce synthetic rubber. Crude oil price is particularly important as it reflects the production costs of synthetic rubber. However, synthetic rubber is not able to 100% absolutely replacement natural Para rubber. Then, Para rubber is still important in world demand.

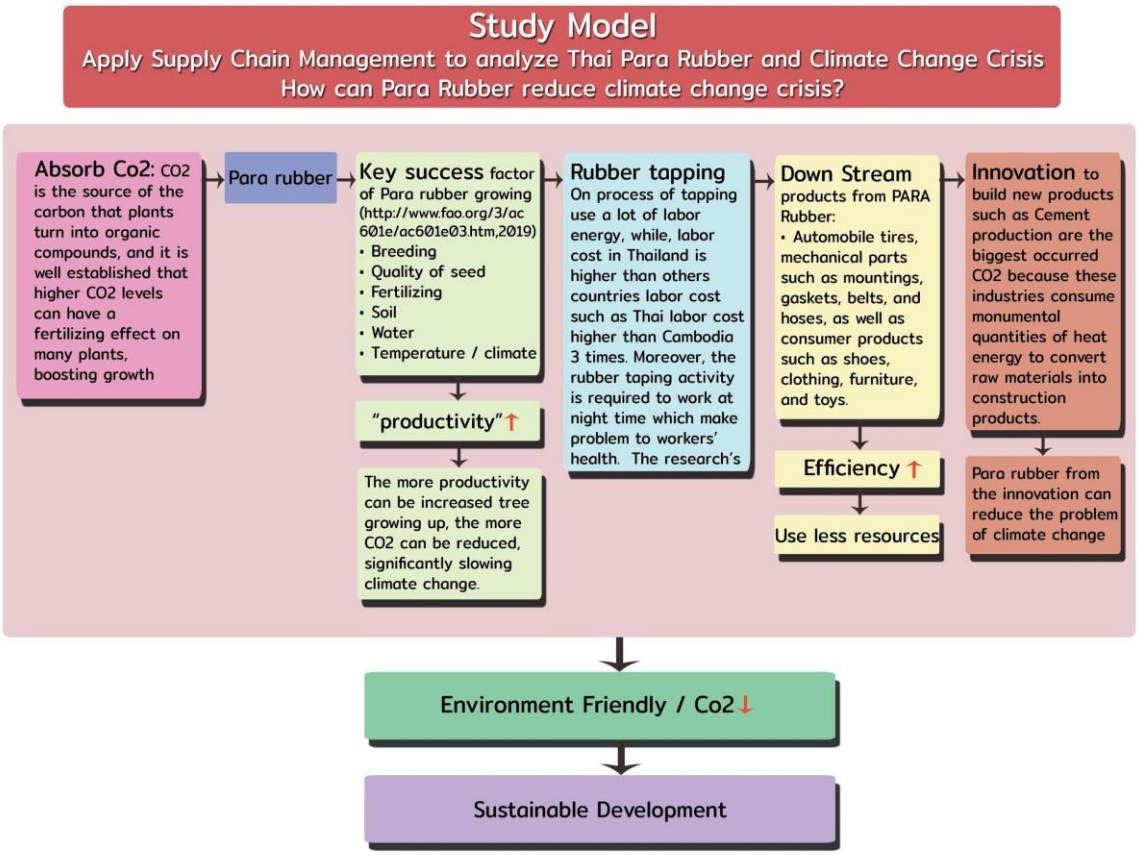
Moreover, Para rubber is one kind of tree that has a positive role in environmentally friendly. Agriculture industry would be the most affected sectors to reduce climate change~~s~~. Carbon dioxide (CO_2) is known as a greenhouse gas (GHG) a gas that absorbs and emits thermal radiation, creating the 'greenhouse effect'. CO_2 is important in sustaining a habitable temperature for the planet. While, Co2 is the source of the carbon that plants turn into organic compounds, and it is well established that higher co2 levels can have a fertilizing effect on many plants, boosting growth.

Today, Thailand and the world have the problem of the climate change crisis. At the same time, each country has the responsibility to reduce greenhouse gas emissions and its contribution to a global problem. On the opposite side, Thailand is the biggest Para rubber grower. Is it possible, Thailand will start to implement interesting strategies as "Para rubber" to link for adapting the climate change crisis? Then, it is interesting to study how Para rubber can reduce the climate change crisis by analyzing along with the supply chain management of Para rubber?

Methodology

The research intents to find the solution to answer the questions' research as how can Para Rubber reduce climate change crisis? The methodology was adopted from the literature review technique by craftily reviewing related literature, justifying the need and essence of the research. The research also does focus groups and a questionnaire depth interview from the rubber farmer cooperative in Chon Bury Province to answer the research questions that drive the study and aid in providing the answer to the problem of the research. (Chon Bury Province is the highest efficiency productivity producer in EEC Area. EEC Area is Thailand's strategic location in the

heart of ASEAN connected with the fast-growing CLMV (Cambodia, Laos, Myanmar, and Vietnam) countries make it an ideal location for businesses and business investors. Finally, draw realistic conclusions from the data collected.



Results

Three major perspectives for Supply Chain Management are technical perspective, managerial perspective & Relationship perspective. In global Supply Chain Management is reviewed for (1) decisions addressed in the model, (2) performance metrics, (3) the degree to which the model supports integrated decision processes, and (4) globalization considerations (Monika Patil, 2015). In this research adopted SCM to review the Relationship perspective of globalization considerations. After evaluating found that each stream along the SCM of rubber business has a great role to reduce climate change.

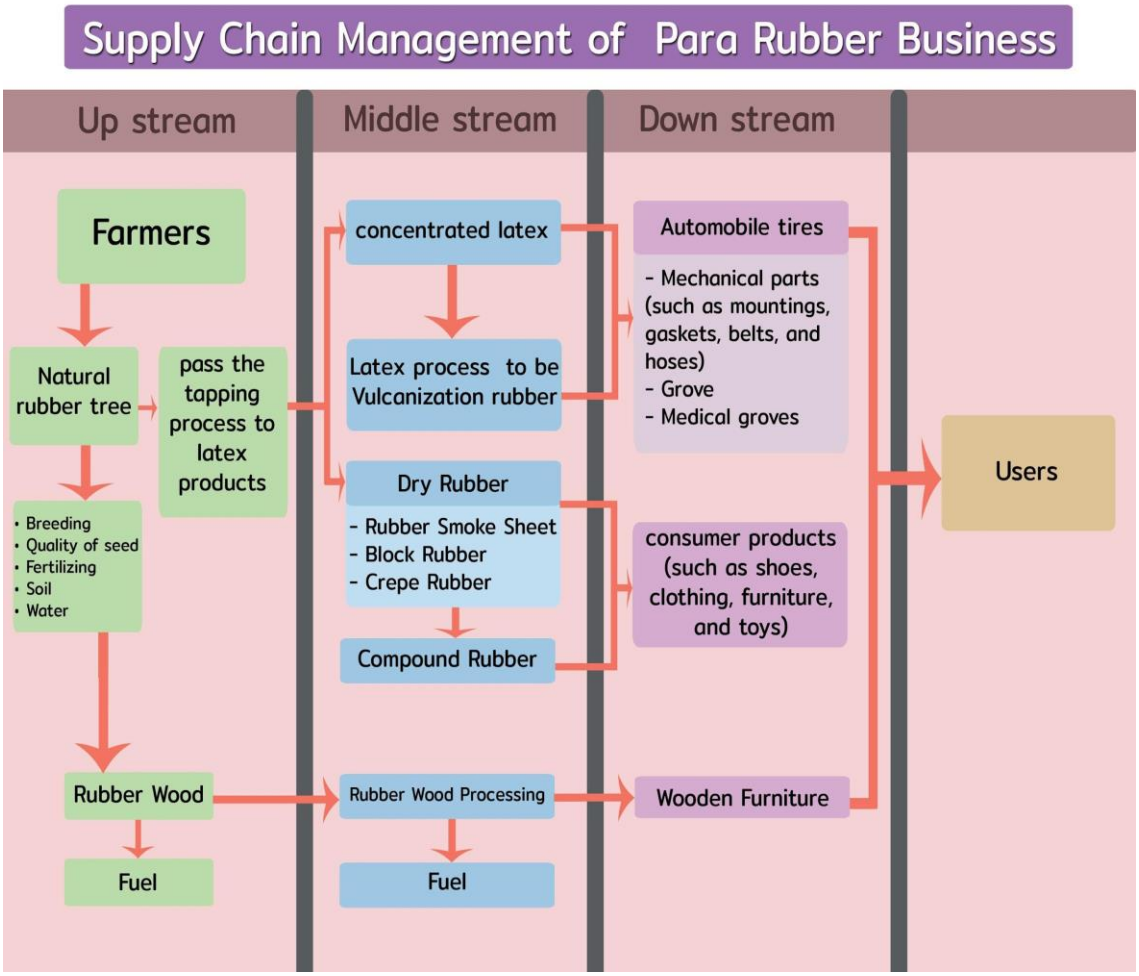
Apply Supply Chain Management to analyze Thai Para Rubber and Climate Change Crisis

Para rubber business has a long supply chain and relates to many parties stakeholders such as farmers (including cooperative, communities, etc.) , small-middle-large industry (including trade partnership, logistics supplier, commercial association, etc.) , government (including a research center, government support function, etc.). Each stream presents;

Up stream (Farmers-Natural rubber tree/ pass the tapping process to latex product, and other up stream product/Rubber Wood/Fuel)

Middle stream Latex process to be Vulcanization rubber/Dry Rubber (Rubber Smoke Sheet -Block Rubber-Crepe Rubber) / Compound Rubber/ Rubber Wood Processing/ Fuel

Down stream Automobile tires/ Mechanical parts (such as mountings, gaskets, belts, and hoses)/Groves /Medical groves/ consumer products (such as shoes, clothing, furniture, and toys) / Wooden Furniture



Source: Draft by Applying from Chetchuda Chuasuwan (2018),"Para rubber processed industry", Krungsri Research Center

Analysis: Apply Supply Chain Management to analyze Thai Para Rubber and Climate Change Crisis

Natural rubber tree: Rubber trees play an important role as a carbon dioxide sequester from the atmosphere impact to the environment and greenhouse gas~~es~~ emission (GHGs) effects (ASumiani Yusoff, Zameri Mohamed and Aireen Zuriani Ahmd, 2019). Regard to the study of Haritsalak Viriya (2017), presented the results that in the seven years prior to latex tapping, rubber plantations had average biomass accumulations of 0.027, 0.200, 0.641, 1.454, 3.343, 8.078 and 15.213 Mg ha^{-1} respectively. This translates to an average biomass carbon storage of 0.014, 0.099, 0.321, 0.727, 1.671, 4.039 and 7.607 Mg ha^{-1}, respectively. Furthermore, the carbon dioxide was absorbed from the atmosphere at levels of 0.051, 0.363, 1.177, 2.666, 6. 127, 14. 810 and 27. 892 Mg ha^{-1}, respectively, during these seven years. Subsequently, the net income from contracts equals US$578.637 ha^{-1} from the carbon

dioxide absorbed from the atmosphere in the case of trading for carbon credits in the voluntary market.

Trapping Rubber Process: after reviewing the literature related to this process, the results showed

It is one difficult process because the process requires using a lot of labor energy; farmers need to go out for trapping at night time or very early morning before sunrise. This practice always impacts farmers' heaths. It is very hard-working and taking a lot of skills for working, while, labor cost in Thailand is higher than in other countries such as the labor cost of Thailand is higher than Cambodia 3 times (http://www.tigersoft.co.th, 2019). The research's results present if farmers adopts high machinery technology to work replace workers' energy on the trapping rubber process. It will increase more efficiency. The more efficiency is increased, the less Co-2 emission will occur, the 'greenhouse effect' will be reduced. Moreover, if there is IT technology inserting more, the more convenience will transfer to farmers. That will make better farmers' heath.

Middle and downstream processes: the business increase valued add products such as automobile tires, mechanical parts such as mountings, gaskets, belts, and hoses, as well as consumer products such as shoes, clothing, furniture, and toys. This process similar to industry process. The more efficiency is increased on production work, the less Co-2 emission will occur, the 'greenhouse effect' will be reduced.

Innovation to build new product: This part is very important because today we can insert adopt to find out innovation technique to reduce the 'greenhouse effect' such as Cement production are the biggest occurred CO2 because these industries consume monumental quantities of heat energy to convert raw materials into construction products (HEATHER KOLICH,2018).

Conclusion

Thai Para Rubber has an important role to reduce Climate Change Crisis because

(1) Thailand is the biggest producer of Para Rubber in the word

(2) Para rubber is one kind of tree, which is the most affected part to reduce climate change; absorb Carbon dioxide (CO_2).

(3) In each process of downstream production, qualified and good management will increase higher efficiency, meaning that lower CO2 emissions.

(4) Moreover, The most important thing is an innovation which will be able to create a new natural product that absorbs co-2 better than the normal product (as Cement product).

Thailand can start to implement interesting strategies as "Para rubber" to link for adapting the climate change crisis. From analyzing along with the supply chain management, the research showed Thai Para rubber can contribute to reducing climate change in all streams of Supply chain management.

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A novel ZnO based Green Nano Catalyst for enhanced Photo Mineralization of Rhodamine 6G Dye

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Abstract:

ZnO nanoparticles were synthesized by a cost-effective and environmental-friendly technique, using Citrus aurantium peel extract as reducing and capping agent. The effect of the green solvent on the structural and optical properties of ZnO was analyzed by X-ray diffraction, Scanning electron microscopy and UV-Visible spectroscopy. Bandgap reduction (2.98 eV) and diverse morphology were observed. Rhodamine 6G, a basic dye was used to evaluate the photocatalytic efficiency of green route synthesized ZnO. The effect of catalyst and the concentration of R6G were systematically studied. ZnO nanoparticle synthesized from the green route shows 95% dye degradation efficiency.

Keywords: ZnO, Bio-extract, bandgap, photo mineralization, R6G dye

Introduction

Land, water and air pollution are the major threats to the environment. In particular, dye effluents from textile industries contribute to major hazard, by discharging toxic and potentially carcinogenic substances into water bodies [1, 2]. Treatment of non-degradable organic pollutants by conventional techniques is the main concern due to high chemical stability and low biodegradability [1], hence it is necessary to adopt new technology for wastewater treatment.

Recently, Nanoparticles are inevitable materials for the development of new cutting-edge technologies like communications, energy storage, optics, environmental protection, and medicine. Particularly in the field of photodegradation of dyes, Zinc oxide (ZnO) photocatalyst exhibits high catalytic efficiency, strong adsorption ability, biocompatibility, and fast electron transfer kinetics [3].

Several methods have been widely used to synthesis a wide variety of ZnO nanoparticles. Amongst all, the sol-gel method is a cost-effective and environmental friendly method. In this regard, the wet synthesis methods, greatly depend on toxic reducing agents and organic solvents. Increasing interest in the minimization of hazardous chemicals, the development of a safe biochemical approach is desirable. The biological approach has ample advantages over physicochemical methods because it is clean, non-toxic and environmentally benign solvents are used, and above all, it is user-friendly by nature [4, 5].

Naturally available resources containing phytochemicals such as honey, soya bean extract, lemongrass, green tea and aloe vera which serve as both reducing and stabilizing agents to synthesize metal oxides [5-7]. Green chemistry principles of less hazardous chemical synthesis, safer solvents and using renewable resources are highly recommended for a safe environment.

In this study, an alcohol-free, green synthesis technique has been adopted to the synthesis ZnO. The significance of bio-solvent in the morphology and its effect on Photodegradation efficiency of Rhodamine 6G (R6G) is reported.

Experimental Section:

Synthesis of ZnO Nanoparticles

0.1M of zinc nitrate hexahydrate ($Zn(NO_3)_3\ 6H_2O$) was dissolved in 20 ml of distilled water. 50 ml of green-solvent extracted from citrus aurantium was added to the above solution with constant stirring and the solution was heated at 60 ºC for 12 h. The obtained gel was dried at 120 ºC for 8 h. The dried powder was further calcined at 500ºC for 2 h to obtain ZnO nanoparticles.

X-ray diffraction (XRD) analysis was carried out using SEIFERT–2002, diffractometer with Cukα radiation (λ=1.5406Å). Surface morphology was recorded using Scanning Electron Microscope (FESEMS-4800 Hitachi). Optical absorption spectra were recorded using UV-Vis 2450 Shimadzu spectrophotometer. The photocatalytic activity of ZnO was evaluated using SAIC double walled quartz photo-reactor.

Results and discussion

Figure1a shows the XRD pattern of ZnO nanoparticle synthesized from bio extract. The peaks at 30.78º, 34.41º, 36.24º and 47.45º correspond to the planes (100), (002), (101) and (102), respectively. XRD results confirm the formation of hexagonal wurtzite ZnO and the result was also supported by JCPDS No 36-1451. The crystallite size was calculated using the Debye Scherrer equation and found to be 42 nm.

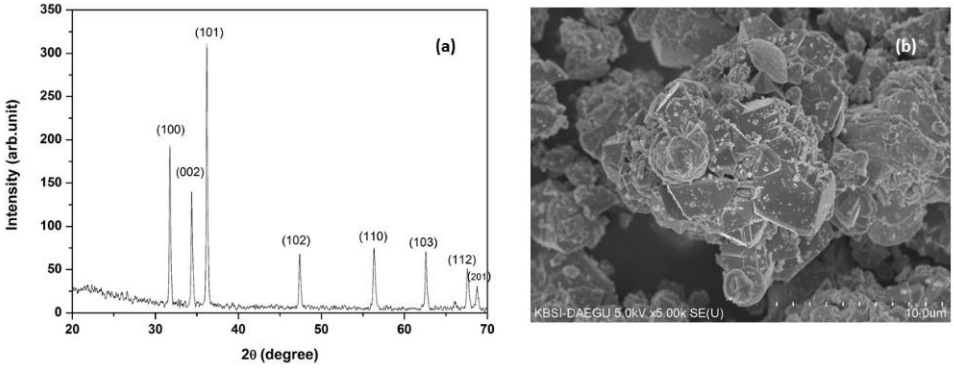

Fig. 1a X- ray diffraction spectra and b) SEM image of ZnO nanoparticles

Figure 1b shows the SEM image of ZnO derived from bio extract and the particle shows triangular morphology. The energy-dispersive X-ray spectroscopy (EDS) result shows 62% Zn and 38% O. No additional impurities were detected in EDS analysis.

The UV-visible absorption spectrum of ZnO is illustrated in Figure 2a. The absorption spectra of ZnO exhibit a blue shift. It is clear that the absorption spectra shift towards a lower wavelength. The bandgap of ZnO is calculated using the Tauc plot and found to be 2.98 eV. The reduction in bandgap could be attributed to the presence of oxygen vacancies and defects in the crystal structure. Migas et al., theoretical calculation explained the same dependency of a decrease in band gap with oxygen vacancies [8].

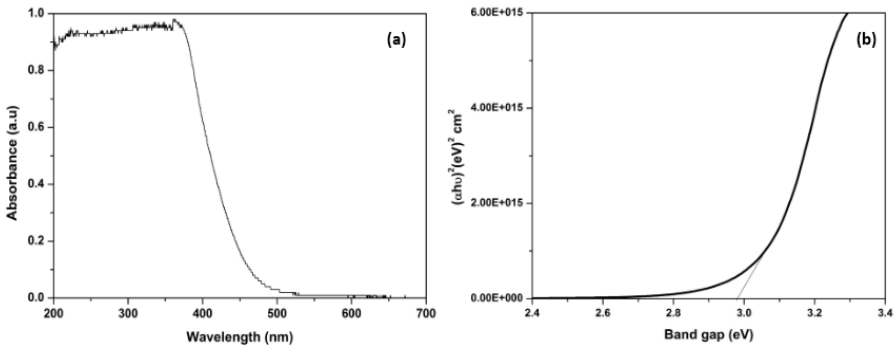

Fig. 2(a) UV-Visible Absorbance spectra and (B) Tauc plot of $(\alpha h\upsilon)^2$ verses Bandgap ($h\upsilon$)

Photocatalytic activity of ZnO nanoparticles

Effect of catalyst

The effect of catalyst concentration on the degradation of R6G is shown in Figure 3a. The concentration of R6G dye was kept constant at 200 ppm for the present analysis. It is quite obvious from Fig.3a, absorption of incident photons by the catalyst increased with increasing catalyst concentration initially. However, a saturation for maximum absorption of incident photons is also observed. Thereafter, further increasing the catalyst concentration a gradual decrease in the rate was observed.

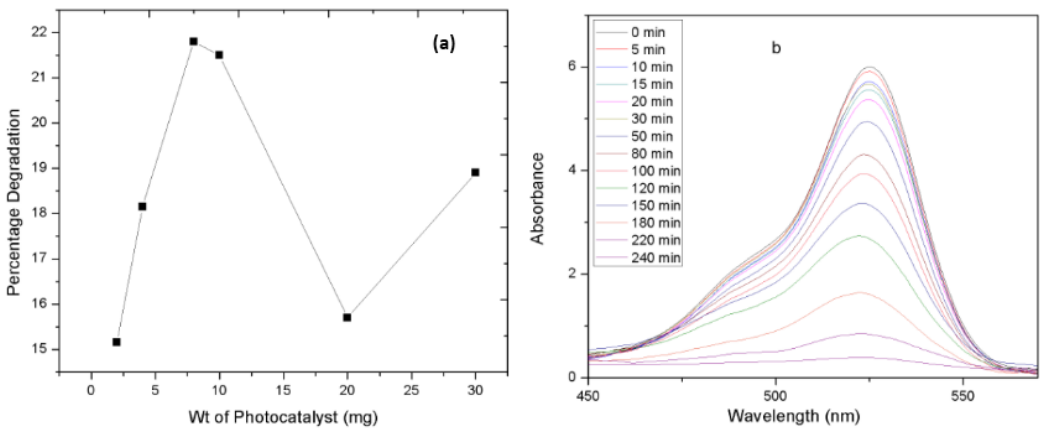

Fig. 3 a) Effect of catalyst on 200 ppm R6G dye b) Absorbance of R6G at various time intervals

The progressive spectral changes of the photodegradation of R6G using UV light is shown in Figure 3b. Almost 95% degradation efficiency is observed within 3h and a gradual decrease of R6G absorption at 524 nm was observed. It is expected that R6G photodegradation usually proceeds with two probable phenomena's namely N-demethylation and destruction of the conjugated structures [9-11]. No shift to shorter wavelengths for the absorption band is observed during R6G decomposition suggesting the destruction of conjugated structures. The decrease in crystallite size and morphology plays a major role in photocatalytic activity [12-14].

Effect of R6G Concentration

The effect of dye concentration on photodegradation of R6G is analyzed by varying initial dye concentration from 10 ppm to 40 ppm with a fixed amount of catalyst (10 mg) at pH 7. Figure 4 (a-d) shows the kinetics of different concentration of R6G dye.

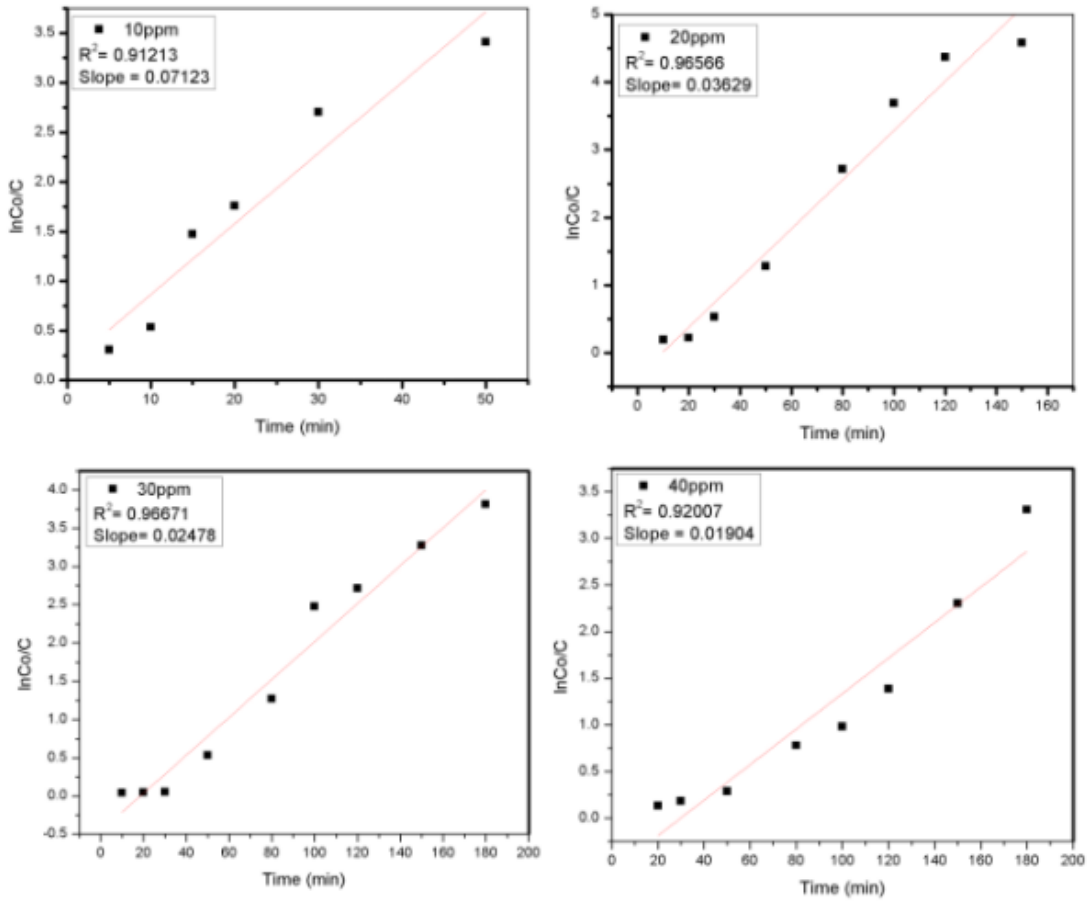

Fig. 4 (a) Kinetics of 10 ppm, b) 20 ppm (c) 30 ppm and (d) 40 ppm R6G dye

Table 1. Summarizes the photodegradation efficiency and kinetic calculation of R6G using 10 mg ZnO as a catalyst in 350 ml R6G solution and the solution pH is 7. The overall decomposition of R6G followed the pseudo first-order Langmuir Hinshelwood kinetic model. The equilibrium time for the degradation of 10, 20, 30, 40 ppm R6G was found to be 50, 100, 150 and 180 min respectively. This observed trend might be due to the fact that a significant amount of photons is absorbed by R6G rather than ZnO substrate at a higher concentration as compared to a lower concentration of R6G. Consequently, the photogeneration of e- and h+ on the ZnO surface or within the surrounding electrical double layer of charged particles decrease which further leads to a longer equilibrium period for higher R6G concentration.

Langmuir Hinshelwood (L.H) adsorption model was adopted to study the photocatalytic degradation of R6G dye and the calculated values are represented in Table 1.

a, percentage degradation = [1-(C/Co)]x100 and Apparent first-order rate constant (min^{-1}) was evaluated from the slope of ln (Co/C) verses Kappt, where C_o is the initial concentration of substrate and C final concentration of substrate at time t and Kappt is the apparent rate constant. The apparent rate constant, Kappt is used to describe the photocatalytic activity.

Table.1 kinetics of R6G at various concentration

Sample	Concentration	a (%)	Kappt (min^{-1})
ZnO	10	96.69	0.0712
	20	97.50	0.0363
	30	96.21	0.0248
	40	96.33	0.0190

Conclusion

A green synthesis process using citrus aurantium peel is demonstrated for the synthesis of ZnO nanoparticles. The presence of D-limonene in bio-extract reduces zinc nitrate to zinc oxide. XRD results confirm the formation of hexagonal wurtzite structure of ZnO. Higher photocatalytic efficiency is observed for ZnO due to morphology change and bandgap reduction. Efficient degradation of Rhodamine 6G dye for a very minimal catalyst loading (i.e.10 mg) demonstrated in the present work will be advantageous for industrial application.

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Testing the post-colonial climate: Deconstructing the binary oppositions of the male protagonists in J. M. Coetzee's *Disgrace*

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Abstract

This research work aims to study the two male protagonists, David and Petrus, in J. M. Coetzee's novel titled *Disgrace* and to deconstruct the binary oppositions perceived to be in existence between these two characters based on the critical framework of Jacques Derrida's deconstruction and différance and the critical approaches of racism and post-colonialism. The investigation of the representation of the power shift reveals the findings in four categories of binary oppositions, namely white/black, colonizer/colonized, culture/nature, and man/animal. David exemplifies a white person who, in the post-colonial climate, loses power on many levels. On the contrary, Petrus, a black native of South Africa, appears at first to typifiy the colonized but, as time progresses, becomes an example of the changing opportunities for blacks in post-apatheid South Africa. During the course of the story, changes gradually take place with Petrus gaining more and more power and David losing his. Power finally shifts from white to black, the colonizer to the colonized, culture to nature and man to animal (in David's case) and animal to man (in Petrus' case).

Key words: Disgrace, J. M. Coetzee, deconstruction, différance, binary opposition, Jacques Derrida's critical framework

Introduction

Disgrace is a novel written by Nobel laureate J. M. Coetzee and published in 1999. The story narrates the life of David Lurie, a university professor of English, who lives in Cape Town, South Africa. After a scandalous affair with a student, he is forced to resign from his job. He then travels to a remote town of Salem in the Eastern Cape to spend time with his daughter who owns a farm there. At the farm, he meets Petrus, a native of the land, whose industriousness helps keep the farm running, and whose connection to the violent robbery and rape that follow is debatable. As the novel progresses, Petrus proves to be much fitter to survive in his native environment. Racial segregation and post-colonialism are reflected and challenged throughout the story, and particularly through the opposition, personal and political, of David and Petrus.

The present study aims to analyze the two male protagonists in this novel, and to deconstruct the binary oppositions perceived to be in existence between these two characters based on the critical framework of Jacques Derrida's deconstruction and différance and the critical approaches of racism and post-colonialism.

Encyclopedia Britannica (2018) defines "deconstruction" as the philosophical and literary analysis developed by French philosopher Jacques Derrida. It questions the binary oppositions through the language and logic of literature. Binary oppositions are pairs of contrary ideas such as male/female, right/left, day/night, in which one is generally regarded as superior to the other – 'male' is generally

regarded as superior to 'female,' for example. (Dobie, 2012) By deconstructing the binary oppositions, a different meaning is created that is not restricted to the fixed relation between the items in the oppositional pairs.

Différance, a term coined by Derrida, identifies how the identity of words is represented by a division synchronized in a form of juxtaposition. The main concept of différance is that nothing has a definite identity by itself. Derrida suggests that opposites are indivisibly concerted; thus, no presence without absence, no man without woman, no culture without nature, etc. Both deconstruction and différance suggest that language with its deceitfulness inhibits the ability to transparently articulate meaning. (Birtell, 2018)

Racism refers to a strong feeling of opposition or hatred on the basis of appearances that results in injustice against individuals who are physically and culturally different. (Bowser, 2017) The deconstruction movement rallies against racism in the attempt to balance the power inherent in such binary oppositions as white/black, culture/nature, colonizer/colonized, etc.

Post-colonialism, according to Boehmer (2005), refers to a critical approach in literary studies indicating a political, historical, and cultural resistance to unequal political and cultural authority of the colonial conflicts between the West and the non-West, dating from the sixteenth century to the present day. Said, Bhabha and Spivak (De Castro, 2014) define post-colonialism in terms of the analysis of gender roles, political hybridity and diaspora, racism, and the significance of individuality within colonial and post-colonial associations. Their common reference point is a resistance against the inequality of perspective and power as a result of experiences of segregation, belittlement, and opposition under systems of colonial control.

Previous studies on *Disgrace* analyzed aspects such as the style, the themes, the use of the present tense, the representation of a post-apartheid and post-colonial society, and the disintegration of white supremacy. (Kamau, 2006, Habibi & Karbalaei, 2012, Mattos, 2012, Stolarek, 2015, and Assefa & Chernet, 2018) Focusing more on the development of the characters, this research study proposes to investigate and discuss the representation of a post-colonial society through the interactions and relationship of two male protagonists in the novel by deconstructing the binary oppositions imposed upon the two male characters as a result of their races and circumstances. Derrida's concept of différance is employed to present the power opposition perceived in the novel, which reflects the characters' gradually reversed roles and the shifting racial and colonial powers, ultimately displacing the binary oppositions during the course of the novel.

Methodology

This study attempts to answer two research questions: First, how are the binary oppositions related to racial and colonial powers represented through the male protagonists in J. M. Coetzee's *Disgrace*? Second, how do these binary oppositions shift during the course of the novel?

In order to answer these two research questions, the critical concepts of Jacques Derrida's deconstruction and différance are employed to analyze the conflict of power and to deconstruct the racial and colonial binary oppositions perceived to be in existence between the two male protagonists.

Results

The investigation of the representation of the binary oppositions and the power shift between the male protagonists, David and Petrus, in J. M. Coetzee's *Disgrace*

offers the findings in four categories of binary oppositions, namely white/black, colonizer/colonized, culture/nature, and man/animal, as follows:

1. White / Black

The white/black binary opposition generally displays the racial segregation in which white people are identical to all goodness while black people are identical to all badness. In *Disgrace*, David thinks that Lucy, his white daughter, should have a better life than living in a farm in a South African society and running an animal welfare with her friend, Bev Shaw. He thinks she is living beneath the merit of her birth; as an educated white female, she should be doing a white-collar job in a civilized – that is white – part of the country. His objection of his daughter's profession and location is based on his alignment of her chosen profession and location with those of black people.

Petrus, on the other hand, is representative of rural unsophistication, as evident in his work clothes and his physical appearances: "a tall man in blue overalls and rubber boots and a woollen cap … A lined, weathered face; shrewd eyes." (Coetzee, 1999: 63-64) Moreover, Petrus introduces himself as the gardener and the dog-man who looks after the dogs. He repeats the phrase 'The dog-man' which shows that he realizes the double meanings of the phrase, and that it could very well be used to compare him to a dog. It could be said that Petrus represents a black colony under the oppression and discrimination of the white colonizers. His appearances and the way he introduces himself to David in terms of his occupation reflect his rural duties typical of the status of the black population in an imperial empire. In addition, David remarks that Petrus seems like a good man, thus affirming that Petrus has behaved properly according to his lower social status.

However, this representation of the white/black binary opposition becomes edgier as the novel progresses. In Salem, David encounters a geographical difficulty. His race and education lose their significance when dealing with the elements of nature as a farmer does on a daily basis. On the other hand, Petrus is the one who is much fitter, physically and mentally, to survive in that native and raw environment. Being industrious and working the land consistently, he thrives in his native surroundings, and his fortune and status continuously expand. A crucial turning point happens when Lucy is raped by three black intruders, and David is locked up in the bathroom, helpless, burnt and beaten. The intruders then steal David's car and shoot his dogs, robbing him of the material connection to the civilized world – his car – and the civilized humanity – his dogs. With the reversal in power and possession, David has no power to protect his daughter and himself. By the end of the novel, Petrus is taking over both David's daughter and her farm by marrying her. Since Lucy has become pregnant as a result of the rape, she is now utterly vulnerable in the black community of Salem. Petrus's offer of marriage, therefore, is made to look like a favor he does out of the goodness of his heart, and not out of a desire, or greed, to take absolute control of what used to be David's. David and Lucy have fallen into this trap of control without any power to negotiate the condition. In conclusion, a racial division which shows the difference between the power of white and black is deconstructed by the displacement of the white characters in terms of space (i.e. from Cape Town to Salem) and time (from the illusion of colonialism to the reality of post-colonialism), and, consequently, the control of power in the white/black binary opposition is shifted from the white over to the black.

2. Colonizer / Colonized

Post-colonial authors are commonly concerned with people bearing the scars of colonialism. *Disgrace*, however, is different. J. M. Coetzee, the author, is white

and, therefore, of the race of the colonizers rather than the colonized. The male protagonist, David, is also white. The novel reflects the struggles of the postcolonial whites in coming to terms with their new social positions and even dependence on others. David is initially sarcastic about his economic status at his daughter's farm where Petrus is slowly taking over: "Give Petrus a hand. I like that. I like the historical piquancy. Will he pay me a wage for my labour, do you think?' (Coetzee, 1999: 76) When Petrus is absent from the farm for a noticeably long period, David asks Lucy about Petrus's whereabouts, but it is clear even to Lucy herself that she has no power over her farmhand despite her status as the rightful owner of the farm: "I can't order Petrus about. He is his own master." (Coetzee, 1999: 114) This shows that Lucy is aware of the changing social status following the end of the apartheid regime. She accepts this new situation with dignity. David, being of an older generation, does not yet understand what is happening and clings to his old ideas of justice.

Throughout the novel, Petrus gains more and more power as David loses his. He acquires more property and declares himself no longer a dog man: "Then Petrus appears at their side. He does not play the eager host, does not offer them a drink, but does say, 'No more dogs. I am not any more the dog-man,' which Lucy chooses to accept as a joke; so all, it appears, is well." (Coetzee, 1999: 129)

In the end, Petrus becomes an example of the changing opportunities for blacks in South Africa in the post-apartheid period. He reclaims the land of his ancestors by investing his energy in it, making it prosper again for his own people, and taking complete control over it financially, socially, and even legally through his marriage to Lucy. However, David seems uncomfortable with the consequent shift of power. He thinks that Lucy sacrifices too much in order to reconcile past injustices of the colonial days. The fact that he also loses control over his daughter and all her decisions only confirms the helplessness he finds himself in.

3. Culture / Nature

In *Disgrace*, David, as a university lecturer and connoisseur of such sophitication as the opera, epitomizes 'culture.' Petrus, on the other hand, represents the 'nature' of the land – robust and fertile. He is constantly at work and productive in ways that David is not. While David whiles away his time in Salem supposedly composing a chamber opera on Byron, Petrus never stops toiling the land and improving the farm: "I look after the dogs and I work in the garden. Yes." Petrus gives a broad smile." (Coetzee, 1999: 64) "It is Saturday, market day. Lucy wakes him at five, as arranged, with coffee. Swaddled against the cold, they join Petrus in the garden, where by the light of a halogen lamp he is already cutting flowers." (Coetzee, 1999: 70)

As it turns out, the situations at the farm eventually forces David to help out with manual tasks. He then falls under Petrus's control: "For a while he and Petrus work in concert, scraping, scrubbing, shovelling out the mud." (Coetzee, 1999: 118) In the environment of a remote town of Salem, the knowledge that David has acquired is more or less useless. In contrast, Petrus is the one who proves to fit in well with the natural environment and finally triumphs over such cultural constructs as the economy and matrimony.

4. Man / Animal

Animals have long been a metaphor to define what humans are and are not. Dogs, so-called man's best friends, play a significant role in *Disgrace*. Throughout the novel, the dogs on Lucy's farm and at the animal welfare center convey the novel's emphasis on social status and personal disgrace. Petrus relates his changing status in terms of his association with the dogs, either he is "the dog-man" or he is "not any

more the dog-man". David eventually comes to accept the disgrace of his professional and personal losses through the eyes of the dogs and to learn to live with the humiliations "like a dog". (Coetzee, 1999: 205) In the transformational social and political climate of post-colonial South Africa, he has finally learned that the time has come to exit the scene and admit defeats, as represented though the condition of a dying dog: "Its period of grace is almost over; soon it will have to submit to the needle." (Coetzee, 1999: 215)

Conclusion

In deconstructing the binary oppositions of the male protagonists, David and Petrus, in J. M. Coetzee's *Disgrace*, the shift of power that takes place in the novel is analyzed and discussed. Four types of binary oppositions: white/black, colonizer/colonized, culture/nature, and man/animal are deconstructed in the context of racial and colonial powers. The message of the novel is that power is problematic. When it shifts, it has consequences for the two main characters. David's situation in Salem is destabilized because he has been displaced from the traditional ways of white supremacy and is at the mercy of the black people there. Petrus, on the contrary, gradually reclaims the territories the white people took away from his ancestors. At the end of the novel, power – social, financial and political – has completely tipped over to the side of the native of the land – black and colonized though he is.

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Reading into a zombie apocalypse: 3 ways to present a dystopia of lies and laughter

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Abstract

This study aims to explore Don Zolidis' play titled *10 Ways to Survive the Zombie Apocalypse* to demonstrate ways by which the play relates a precautionary message of both moral and social breakdown. The analysis discusses how oversimplification of a serious problem, humor, and tonal allusions to dystopian classics enable the playwright to successfully deliver his message. First, the play imitates the modern world's fondness for simplified solutions that are often presented as a list and aptly reflected in the play's title. Next, the play draws laugher from both light and dark humor. The deliberate absurdity of the turning point at the end creates a dramatic surprise and surreal humor. Finally, the play pays homage to the dystopian societies portrayed in previous works of other creators by predicting a similar state of physical and moral ruin, thus making the audience leave the show light with the comedy of zombie affairs and heavy with the reality of human affronts.

Key words: dystopia, Don Zolidis, 10 Ways to Survive the Zombie Apocalypse, zombie apocalypse

Introduction

10 Ways to Survive the Zombie Apocalypse (2013) is a one-act comedy written by American playwright Don Zolidis. The play is modernist as well as minimalistic in style but optimizes on story where four friends, collectively referred to as the 'Survivors,' struggle to stay alive from imminent zombie attacks in episodes that are watched, commented and eventually acted upon by two 'Narrators.' The zombies, on the other hand, are intrigued as much by brains (i.e. "Braiiiiins.") as by thoughts generated by the human brains, thus rendering the brains into both food and 'food for thought' for the zombies.

As an apocalyptic story, albeit with an overlay of comedy, Zolidis' play presents desperate characters in a dissonant society wrecked by a plague that is as disruptive as any extreme climatic change. At first glance, the play seems to poke fun at human hunger for morbid fantasies. A close reading, however, reveals a not so unrealistic tale of human struggles in an utterly inhuman climate. This study proposes to demonstrate ways by which the play relays a precautionary message of both moral and social collapse. The results indicate that the play employs modernist tools to negotiate the audience's attention, to find a comic niche in dire circumstances, and to make even the zombies relatable to the modern world.

Methodology

This study investigates approaches by which Don Zolidis'*10 Ways to Survive the Zombie Apocalypse* illustrates human paranoia to take control and human fear of an irretrievable societal and cultural breakdown, as represented through a dystopia caused by a zombie plague. Literary perspectives as well as considerations for popular culture are the lenses through which the textual analysis is conducted. In keeping with the spirit of the comedy of Zolidis' original play, the results of the study are presented in language that aims to lighten the actual earnestness of the message, a guise Zolidis' play has mastered.

Results

The results of the analysis are presented in three sections illustrating different aspects of the findings, namely "Tidying the Mess", "Make 'Em Laugh", and "*Nineteen Eighty-Four* Once More."[1]

Tidying the Mess

The modern world is a hectic, fast-changing place. The modern-day population often experiences a sense of loss of direction and values as the knowledge they have inherited from trusted sources can no longer guide them to the goals they wish to achieve at the speed they wish to achieve them. To deal with pressing tasks, they are required to discard well-rehearsed values and hurriedly acquire untried ones, creating both a cultural and an emotional mess in the process, as a result. Directions are needed, and, as is the case, promptly provided. Evidence of this can be seen in countless How-to manuals on virtually all subjects and in all forms in which complex and not-so complex situations are digested, and advice to tackle them is offered in preferably not too many steps or methods. A quick search on the Internet will give results such as "3 Tips to Manage Stress" (American Heart Association, n.d.), "Give Me 5 Minutes and I'll Give You 5 Ways to Earn More" (Foroux, 2019), and "9 Different Ways to Say "Stupid"" (Dictionary.com, n.d.).

Ten is an especially strong number as it is tidy yet powerful, suggesting completion, achievement and fulfillment. In everyday usage, the expression "ten out of ten" is used to indicate that "someone is completely correct or did extremely well." (Macmillan Dictionary, n.d.) In entertainment, movie titles such as "10 Things I Hate about You" (1999) and "How to Lose a Guy in 10 Days" (2003) have proved to be crowd drawers in recent decades.

Don Zolidis' *10 Ways to Survive the Zombie Apocalypse* reflects with some fun or fondness, depending on one's level of sarcasm, the modern world's tendency to simplify and categorize ideas into a convenient number regardless of probability or logic, or reality. Fleeing zombies could no doubt be overwhelmingly tasking, especially when the number of the zombies is overwhelming in the first place. Fortunately, when a zombie apocalypse finally arrives, we have some handy methods to resort to – the play showcasing ten methods to do just that. Some are obvious, and

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[1] The section titles, though reflecting the message of the play, are not taken from any part of Zolidis' play. They are a nod to the daily linguistic usage ("Tidying the Mess"), popular culture ("Make 'Em Laugh" – a musical number in the celebrated musical *Singin' in the Rain*) and literary acknowledgment ("*Ningteen Eighty-Four* Once More" – a pastiche of George Orwell's dystopian novel and a soppy, popular song by The Carpenters) that are the spirit of a modern/postmodern comedy.

thus inescapably sensible. Who would argue with the logic of Method 9: Run Really Fast, for example? Some require certain skills (e.g. Method 6: Kung Fu), certain tools (e.g. Method 3: Overwhelming Firepower) and complete faith (e.g. Method 8: Romance the Zombies). Some are plain vicious (e.g. Method 1: Sacrifice the Weak). And some are not even remotely feasible for most Earth-dwellers (e.g. Method 10: Leave the Planet). But there they are should we need any, or all, of them. The author provides the security of ten steps to take to remedy an apocalypse which implies that if you follow the steps, then balance and control are certainly regained. Right?

Not quite yet, as it turns out. Just when all seems well and extra-terrestrial (i.e. Method 10: Leave the Planet), man reverts to animalism (Method 11: Cannibalism) and chickens out of the play (Method 12: Leave the Play). These two extra methods are self-serving and non-apologetic, inserted to satirize man's self-interest that is a threat far greater than that of a horde of zombies (in these methods the Survivors and the Narrators play dirty tricks to turn one another into food first for the humans and then for the zombies, thus making themselves indistinguishable from the brain-thirsty, blood-sucking zombies) as well as to parody the definiteness of the number ten (noting that the number ten in the title now becomes ten plus two, and not twelve). By overstuffing the list with two extra, incidental yet crucial methods, the play ridicules man's attempt as well as failure to take control of others' as much as of his own doings.

No matter how seemingly so doable handling zombies is with the handy list of '10 ways,' in reality the playwright knows and relates to the audience that ten ways will not suffice – he then throws in a couple more. In this, there is a hidden message that life is tougher than we think no matter how modern times have simplified everything into lists. The point is well-made that Zolidis names his play as having ten ways when in desperation or panic, nothing seems to help, not even the covert addition of more solutions. For all the lies and laughter these scenes produce, the human effort to take control is flaunted, first over the zombies and finally over themselves. The message could not be clearer, or more ironic – that man is his own worst enemy, and that keeping the Earth in order starts with keeping man in order. And the zombies? They, like global warming, are mere excuses for man to throw dirt to one another and to exploit poor old Mars.

Make 'Em Laugh

Another way Zolidis engages the audience in the serious subject of the play is to embrace the absurd. "Make 'em laugh" is a prevalent approach – this being a comedy after all. Laughter can be elicited from glancing at the titles of the methods alone (e.g. Method 4: Join the Zombies, Method 7: Reason with the Zombies, and Method 8: Romance the Zombies). These titles are deliberate, desperate and pathetic, but who wouldn't be, in such a situation? And so they are easy to laugh at and with.

The humor becomes several shades darker if one looks beyond the titles into the ironies of the theatrical farce. Dramatic irony brings about a wary laugh or two when, for example, in Method 5: Raise Genetically Modified Killer Dogs Which Can Attack and Destroy Zombies, an injured Survivor is deserted by all his friends because he is considered the weakest link, hence disposable, due to his injury, but turns out to be the only one to survive the scene. As the scene title suggests, he owes his survival to the "genetically modified killer dogs which can attack and destroy zombies" which he has been raising in secret and from which his friends could not benefit because they were in such a hurry to run away from him, and, as it happened, straight into the jaws of the zombies.

In addition, situational irony primes a laugh for a twist at the end, a U-turn in logos, pathos and ethos[2], when, in Method 10: Leave the Planet, the Survivors arrive expectantly at a space center ready to make a celestial escape from Earth and the zombies, hence from their 'worldly' dilemma, only to find that the state-of-the-art, much publicized spaceship is indeed the size of a baseball – so much for the taxpayers' money. Therefore, a belief in an escape from the earth to the heavens is just illusory. This becomes a turning point for the exhausted Survivors who suddenly realize that only the here and the now are real. Overwhelmed by disillusionment, disappointment and despair, they abandon all civilization and make a cannibalistic plot against the Narrators, the god-like figures who have been chorusing the narrative. As it often happens when humans meddle with the gods, "the gods" turn against them and have the zombies eat all the Survivors lasciviously. Zolidis is first showcasing life's inescapable horrors and then suggesting that the gods (portrayed as the Narrators) are just as ironically of no use as the list of ways to combat the zombies. Religious and spiritual beliefs are, as is the case here, often listed as culprits. The moral of the story? To quote Zolidis, "There is no survival. You are doomed." (Zolidis, 2013: 32) One may need reminding at this point that this is a comedy.

Nineteen Eighty-Four Once More

A dystopian society such as that presented in *10 Ways to Survive the Zombie Apocalypse* recalls other dystopias in popular works such as Los Angeles in the neo-noir movie *Blade Runner* (1982) and Oceania in George Orwell's novel *Nineteen Eighty-Four* (1949). This tonal connection to previous cinematic and literary phenomena lends weight to the message of the play and turns a subject of fantasy (i.e. anything zombie-related) into a currency with serious relevance to the concerns of the modern world – dehumanization, tyrannical rulers, environmental disaster, and cataclysmic decline in morality and society.

As should be obvious by the end of the play, a principal aim for those struggling against inhuman antagonism is not only to try to survive it but also to work against the odds to retain humanism within themselves. Without it, humans are no different from the zombies they so abhor. Also, Zolidis' play mirrors Orwell's Big Brother who keeps order through constant vigilance and intervenes when his own interest is threatened. The omnipresent, omnipotent Narrators of the play are Zolidis' Big Brother whose tyranny is displayed most clearly towards the end when the narrative they have been dictating is challenged by the outburst of the repressed, manipulated Survivors, and whose sermon of love and humanity: "If we all just love each other, and believe in peace, humanity will be just fine," (Zolidis, 2013: 32) is seriously misleading and only serving as self-promotion. At the closure of the play, the Survivors are dead, the zombies are still at large, and the Narrators' status quo is kept intact. The image projected is that of glory and camaraderie typical of a totalitarian propaganda: "NARRATOR 1 and NARRATOR 2 stand shoulder-to-shoulder gazing out at their bright future." (Zolidis, 2013: 33) Contrary to the "bright future" ironically depicted, one imagines, without difficulty, a dark and desolate landscape void of natural beauty or human warmth. On the horizon, the zombies are shuffling about oblivious of the crumbling world around them.

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[2] Terms for rhetorical appeals coined by Aristotle to suggest means for persuading the audience through reason (logos), emotion (pathos), and ethics (ethos). (Stanford Encyclopedia of Philosophy, n.d.)

Conclusion

The study of Don Zolidis' *10 Ways to Survive the Zombie Apocalypse* explores three ways by which the play relates to modern audiences a precautionary message of both moral and social collapse. First, the play imitates the modern world's fondness for simplified solutions presented as a list and aptly reflected in the play's title. It then jabs at its own joke by overstuffing the list with two incidental, yet crucial, methods, thus suggesting man's attempt as well as failure to take control of others' as much as of his own doings. Next, the play draws different shades of laugher from both light and dark humor. And in spite of the doomsday prophecy insisted upon by one of the Narrators, the deliberate absurdity of the turning point (in which the Narrators take active part in the direction of the story) overrides its gravity, thus creating a dramatic surprise and surreal humor. Finally, the play pays homage to the Orwellian societies portrayed in its forerunners by predicting a similar state of physical and moral ruins, hence making sure that the audience will leave the theatre light with the comedy of zombie affairs and heavy with the reality of human affronts.

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Garbage Situation and Management at the Communities in the Small Island: A Case Study of Libong Island, Trang Province, Thailand

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Abstract

The objective of this study was to study the situation and solid waste management of communities on Libong Island, Trang Province by using quantitative research methods. The sample groups were composed of 260 households. Data were collected using questionnaires for interviewing the villagers. Data was analyzed using descriptive statistics and Chi-Square statistics. The results were as follows: 1) Most household waste per week was general waste which mostly occurred from the use of daily necessities followed by organic waste which largely occurred from cooking. 2) Waste separation in the communities, most of the sample groups had garbage separation before disposal. 3) Waste disposal, most of the sample groups had organic waste disposal as organic fertilizer. There was general waste disposal by placing garbage bins for being collected by local government organization. There was recycling waste disposal by selling and the disposal of dangerous waste by placing rubbish bins for being collected by local government organization. 4) Waste management behaviours were conducted such as seperating garbage before disposal, avoiding and reducing the use of foam and plastic bags, etc. The sample groups in each village behaved themselves in various ways differently ($P < 0.05$). On the other hand, it was found that the sample groups had no different understanding of waste management. The majority of the sample groups agreed that the solutions to garbage management problems in Libong should be 1) organizing campaign activities 2) training to provide knowledge and 3) providing public relations for garbage management continuously and seriously.

Key words: garbage separation, garbage disposal, behaviour, case study and household waste**.**

Introduction

The amount of garbage around the world tends to increase continuously which is caused by a global population growth resulting in increasing human production and consumption For garbage management from the past to the present, there have been differences in the context under the conditions and limitations of different societies (Haesakul, 2018). The concept of garbage management was

focused on the use of technology to help eliminate garbage rather than the management at the root cause of the problem (Desa et al., 2011; Haesakul, 2018)

From the situation of garbage management in Thailand, most of the garbage management was done improperly such as garbage disposal by dumping and burning. In addition, a large amount of garbage made it impossible to collect all of the garbage and therefore resulted in residual garbage left over in various locations, especially in the areas like islands that had space limitations (Navykarn, 2015)

The island of Libong, Trang Province was experiencing an increasing amount of garbage and incorrect sanitation disposal (Naveekarn et al., 2009; Navykarn, 2015). Garbage piles were placed around houses, public places, beach and some were dumped into the sea (Navykarn, 2015). In this way, improper garbage management had an adverse impact on environment and marine animals such as dugongs eating plastic fragments causing clogging of its digestive tract and death. The researchers foresaw the importance of the aforementioned problem

The aim of this study was to study the situation and waste management of communities on Libong Island, Trang Province as well as finding ways to solve the problems that occur in the communities.

Methodology

The study area consisted of 4 villages on Libong Island, namely Ban Khok Sathon. Ban Batu Poo Tae, Ban Lung Khao and Ban Sai Kaew. In this study, quantitative research methods were employed. The study samples were households living on Libong Island and the sample size of 260 households was determined by using the Yamane population sampling table)Sreesawat, 1999). Sampling method for data collection using the quota determination method was used. The samples were separated into 4 groups divided by the number of 4 villages including: Ban Khok Sathon = 67 households, Ban Batu Poo Tae = 63 households, Ban Lung Khao = 53 households and Ban Sai Kaew = 77 households, and the accidental sampling was used for random sampling.

Data was collected by using questionnaires with in-depth interviews to collect economic, social and household waste situation, knowledge of household garbage management and behaviours in garbage management as well as guidelines for solving garbage problems.

Data was analyzed using descriptive statistics by showing data in the form of numbers, percentages, averages and standard deviations. For inferential statistics was conducted by analyzing One-way ANOVA and Chi-square.

Results

1. Economic and social data revealed that most of the sample groups were female (64.6%) and mostly working age (67.7%) with the age range = 30-60 years. Half of the sample groups (50.4%) completed primary education. Almost all of them were Muslim (99.2%) and largely engaged in gardening (35.2%). Their incomes were less than 10,000 baht per month (46.9%) since the sample groups had a low level of education and incomes and most of them were engaged in rubber plantations. In managing to gain access to sample groups, the easy-to-understand media were employed (Kawtep et al., 2000). The suitable time period for the media activity for them had to be their free time after they finished gardening such as the afternoon, with television being the most accessible and easiest media (Naveekarn et al., 2009). Salhofer and A.Isaac, 2002. said that good public relations about garbage management had to conveniently reach the target audience.

2. Situation of household garbage

2.1 Household garbage per week, most of which was general garbage mostly from the use of necessary things in daily life (70.4%), followed by organic garbage mostly from cooking activity (80.8%) (Table 1). The activities that generated the most household garbage were related to the items being used in daily life. This was consistent with the study results of Naknan et al.,)2009(; Naveekarn et al., 2009.

Table 1 Data regarding household garbage of households on Libong Island, Trang Province

Garbage type	**Total household garbage in every household (Kilograms per week)**	**Activity causing garbage (Number of households (percent))**			
		Cooking	**Eating**	**Working**	**Using items in daily life**
Organic garbage	821.70	210 (80.8)	144 (55.4)	53 (20.4)	43 (16.5)
General garbage	931.70	73 (28.1)	100 (38.5)	85 (32.7)	183 (70.4)
Recyclable garbage	619.90	56 (21.5)	67 (25.8)	70 (26.9)	178 (68.5)
Hazardous garbage	78.90	1 (0.4)	1 (0.4)	25 (9.6)	41 (15.8)

2.2 Garbage sorting investigation showed that most of the sample groups had garbage separation before disposal (70.3%), which was well agreed with the results of the study of Naveekarn et al., (2009).

2.3 Garbage disposal study revealed that organic garbage disposal was mainly used as organic fertilizer (54.2%). For general and hazardous garbage disposal, 57.2% and 78.4% of the total garbage of each type was put in the garbage bins of the local government organization respectively whereas recyclable garbage was mostly sold (48.5%) for being eradicated.

Most of the sample groups had household garbage sorting. However, they eliminated the garbage in the incorrect way including organic garbage with only half of it produced as organic fertilizer. The rest was buried and put in garbage bins of the local government organization. If every household sample group is encouraged to use organic garbage to make organic fertilizer, it can help reduce the amount of garbage that local government organizations have to collect. This was consistent with the results of the study of Naveekarn et al., (2009). General garbage was dumped into the bins of the local government whereas the rest was burned and piled up. This was an incorrect garbage disposal method. Therefore, there should be promotion and education regarding the correct separation and disposal of garbage to the sample groups.

3. Knowledge regarding garbage management was investigated by questionnaire consisting of 15 items with 1 point per item. It was found that the interviewee with the most correct answer had 15 points whereas the one with the least correct answer was 4 points with an average value = 11.92 points and standard deviation = 1.985. Most of the sample groups had high level of knowledge of garbage management. From the questions with incorrect answers, it was found that the sample groups lacked knowledge about garbage types. This was caused by the question

regarding the disposal of garbage that should be divided into wet and dry garbage only. This was the question with the least correct answer (3.1%), which was consistent with the results of the study of Sornplang, (2008) and Jaisue et al., (2009). For the method of proper garbage disposal obtained from the question mentioned that all the types of garbage had the same disposal methods possessed correct answer approximately 31.5% which was consistent with the results of Jaisue et al., (2009). Furthermore, the impact of marine waste on humans obtained from the question of garbage dumping into the sea does not affect humans. This was a question that half of the interviewees correctly answered approximately 53.8%. Thus, there should be activities to educate about garbage, such as garbage types, garbage sorting methods, garbage disposal methods and garbage management as the whole system including the impact of garbage on human and animal health. This should include community garbage, marine waste and micro-plastic which are the connected issues as well.

In addition, from the comparison test of different knowledge of household garbage management based on village classification using One-way ANOVA statistics revealed that the value of Sig. = 0.206 was greater than 0.05. This indicated that the sample groups living in different villages had no difference in knowledge of garbage management.

4. Garbage management practice behavior was examined by 12 questions in which each question was divided into 3 levels of practice including: 1) Regular practice was mostly related to the sample group with the garbage separation before disposing = 54.4%. 2) Occasional practice was highly involved in the sample group with community garbage management activities = 42.9 %. Lastly 3) Never practice was mostly involved in the sample group without littering into the sea = 69.5%.

In this study, more than 30% of the sample groups had never used cloth bags or baskets instead of plastic bags, repaired damaged plastic items, avoided and reduced the use of foam as well as repaired broken clothes. In addition, more than 70% of the sample groups were used to burn garbage outdoor. Hence, there should be a public relation campaign to provide the knowledge about methods to reduce garbage and understand correct garbage disposal.

From the test of the relationship between the village and the household garbage management behavior was determined by using Chi-square statistics, the Sig. = 0.013, which was less than 0.05. This indicated that the village was related to the behavior of household garbage management with statistical significance (0.05). The sample groups that lived in different villages had different behaviors in waste management behaviors of households with statistical significance at the level of 0.05.

5. Guidelines for solving garbage problems. Most of the sample groups gave the opinion that campaign activities should be organized. There should be a training to provide knowledge including public relations on garbage management continuously and seriously. This was well agreed with the results of Boonyanuwat, (2002) ; Sornplang, (2008). Furthermore, raising awareness for the youth in garbage separation and disposal should be carried out. This was consistent with the results of the study of Naveekarn et al., (2009).

Conclusion

1. Economic and social conditions revealed that the villagers were in the working age, had a low level of education, and earned their living less than 10,000 baht per month from rubber plantation.

2 . Situation of household garbage. Household garbage per week was mostly general garbage which was generated from daily activity. The daily activities caused

the most household garbage. Most of the garbage was sorted before disposal. For garbage disposal, most villagers used organic garbage to make organic fertilizer. General and hazardous garbage was put into the bins of the local government organization. The recyclable garbage was sold. Some of the villagers still had to get rid of the garbage incorrectly, such as placing general garbage in different areas and burning it.

3 . Knowledge about garbage management. The villagers had a high level of knowledge about garbage management. However, there was still confusion about the type of garbage and the correct methods of garbage disposal including the impact of garbage on the health of humans and other living things.

4. Garbage management practice behaviour. The villagers had garbage separation on a regular basis. Some villagers were sometimes involved in community garbage management activities and had never dumped garbage into the ocean. Others had never used cloth bags or baskets instead of plastic bags. Most villagers were used to burn garbage outdoor. In addition, it was found that different villages had different behaviour in garbage management practices.

5 . Approach to solve the problem of garbage management showed that there should be a campaign to educate and use public relations about garbage management continuously and seriously including raising awareness of proper garbage separation and disposal for the youth.

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Climate Change and Its impacts on Storm Surge and Society: A Case Study of Coastal Community, at Kohtaew Subdistrict, Songkhla Province

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Abstract

Climate change affects the phenomena of abnormal sea level rise near the coast, which is associated with the influence of low air pressure and strong winds. Secondary meteorological data showed that most of the storms moving shoreward in the southern region were in the same period as the northeast monsoon that would result in a storm surge phenomenon. According to interview results with the communities located on the coast of Kohtaew Subdistrict, Muang District, Songkhla Province, it was found that the occurrence of the storm surge washing ashore would carry sands from the sea landward in some areas and accumulate them on the edge of the road. Others caused coastal erosion and the villagers to be unable to go fishing. The adaptation of the people in the storm is to prepare themselves to evacuate to a safe place, move their boats to the coast, monitor storms at all the times, assess the situation as well as prepare important documents, food, clothing, medicine and sack bags. The communities wanted the government to participate in providing sustainable assistance.

Key words: Climate Change, Storm surge, coastal erosion, coastal community and abnormal sea level

Introduction

Climate change affects the phenomena of abnormal sea level rise near the coast, which is associated with the influence of low air pressure and strong winds due to the displacement of the tropical cyclone landward. The rising sea level is caused by the strong wind that causes the sea surface pressure to rise the sea level higher than that of the normal sea level (Wattana, 2013). This has impacts on the people's lives and properties of communities living along the coastal areas as shown by the statistical data between 1951-2009 of the Meteorological Department, the southern coast of the Gulf of Thailand which is located under the influence of the monsoon, such as the southwest monsoon between May – October and northeast monsoon between October - February. According to the storm report from the Meteorological Department between 1951-2017 (Meteorological Department 2019), it was found that

almost all of the storms that moved ashore in the southern region were in the same period as the northeast monsoon. Thailand has experienced at least 3 storm surge waves from the tropical storms and typhoons causing severe damage to the coastal areas of the country (Wannawong & Ekkawatpanit, 2012; Choowong & Chutakositkanon, 2008). Many groups of researchers are interested in the occurrence of tropical cyclones, especially climate change with the view that global warming in the future will affect the nature of tropical cyclone especially the frequency, violence including the path through which the storm moves (Mori & Takemi, 2015). The increase in sea water is a problem of climate change, causing more damage to coastal areas. Severe physical processes occur such as storm surge and storm wave (Mori et al., 2010)

This study is a downscale study on climate change and its impacts on the storm surge and society of coastal communities in Kohtaew Subdistrict, Mueang District, Songkhla Province by using the secondary climate data in Songkhla Province as well as conducting interviews with coastal communities / organizing a stage in Kohtaew Subdistrict, Mueang District, Songkhla Province.

Methodology

Study Area

The study site was Kohtaew Subdistrict located 14 kilometers away from south of Mueang Songkhla District, Songkhla Province with a total area of 28.38 square kilometers (17,738 rai), a residential area of 3,000 rai, a farming area of 11,320 rai and a public area of 3,418 rai consisting of 10 villages of 11,263. persons, 3,501 households as shown in Table 1. The area of Kohtaew Subdistrict has a border with neighboring subdistricts where the north is adjacent to Khao Rup Chang Subdistrict, Mueang Songkhla District, Songkhla Province. The south is adjacent to Thung Wang Subdistrict, Mueang Songkhla District, Songkhla Province and Nat Tab Subdistrict, Chana District, Songkhla Province, Gulf of Thailand and the west is adjacent to Phawong Subdistrict, Mueang Songkhla District, Songkhla Province.

Table 1 Basic information of Kohtaew Subdistrict, Songkhla Province

Village Number	**Village Name**	**Village Population**		**Total)Person(**	**Number of households**
		Male (person)	**Female (person)**		
1	Ban Laem Khian	800	870	1,670	540
2	Ban Samkong	350	431	781	196
3	Ban Chum Pho	628	680	1,308	383
4	Ban Dan	404	416	820	236
5	Ban Dan	382	395	777	268
6	Ban Kohtaew	499	496	995	316
7	Ban Ko Wa	386	392	778	234
8	Ban Bo It	1,189	1,190	2,379	855
9	Ban Chukiat	384	423	807	213
10	Ban Dan Klang	482	466	948	260
Total		**5,504**	**5,759**	**11,263**	**3,501**

Source: Local Registration Office of Kohtaew Subdistrict Municipality, Mueang Songkhla District, Songkhla Province on October 2016.

Sampling method

Collect secondary data (storm data) and use 80 specific interviews to interview villagers living in the coastal area of Bo It Subdistrict, Songkhla Province. Analyze descriptive and statistical data.

Results

Storms entered the southern region and Songkhla Province and their impacts

Storm statistical data in the southern region was collected from the Meteorological Department between 1956-2019. It was found that 48 storms that moved landward in the southern region and most of them occurred during the northeast monsoon season. However, there were only two storms that landed ashore during the summer in 1961 and 2007 as shown in Figure 1. In addition, the researchers conducted the further studies regarding the date of the occurrence of the storm hitting shore during the northeast monsoon. It revealed that the day which the storm entering shore had more tendency to move towards the end of the year. From the storm data entering Songkhla Province and moving through Songkhla Province during the past 68 years (Table 2), most of them occurred at the end of the year between October - December, including Pabuk Storm (Fig. 2) that moved through Songkhla Province towards the end of the year 2018 and entered the coast at Nakhon Si Thammarat Province on January 4, 2019, which Pabuk Storm caused damage and the storm surge washed away and carried the sands depositing on the roads in Songkhla Province as well as the other provinces that it moved through.

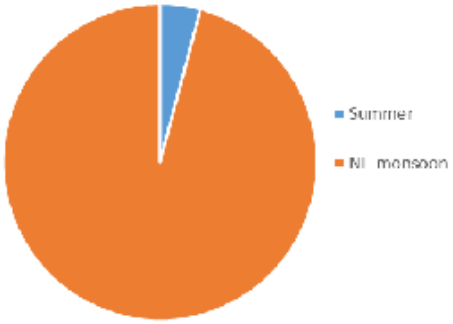

Figure 1 The storms hitting the coastal areas in the southern region during the 1956-2019.

Table 2: Statistical data of tropical cyclones that moved to the southern region for 68 years (1951-2019)

Year	Storm name	Details when entering Thailand		
		Date of Entering	Province of Entering	Passing Area
1961	Depression	12 April	Songkhla	-
1965	Depression	20-21 December	Songkhla	Satun
1966	Depression	30-31 October	Songkhla	Phatthalung, Krabi, Trang
1968	Typhoon NINA (6826)	29 November.	Songkhla	Phatthalung
1969	Depression	28-29 October	Songkhla	Phatthalung, Trang

1971	Depression	15 October	Songkhla	Krabi, Trang
1974	Tropical Storm KIT (7432)	25-26 December	Songkhla	Phatthalung, Krabi, Trang
1993	Typhoon MANNY (9327)	15 December	Songkhla	Phatthalung, Trang, Satun
2010	Depression 4 (TD 4)	1 November	Songkhla	Phatthalung, Trang, Krabi, Phang Nga
2019	Tropical storm	4January	Nakhon Si Thammarat	Songkhla, Phatthalung

Note:

1. The parenthesis following the storm name means the last two digits of the year and the order of the storm that occurred. In the western Pacific Ocean region in the west and the South China Sea of that year (XX: exact order unknown)
2. The underscore refers to the center of the storm moving through the boundary of the province.

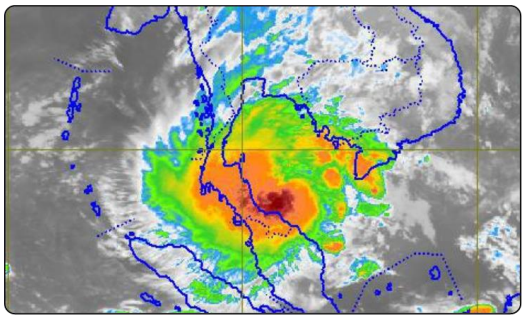

Figure 2: Pabuk Storm moving through Songkhla Province (Meteorological Department, 2019)

From the interview form

The information obtained from each question of the questionnaire was as follows:

1. In this community, how severe was the storm situation (the time of occurrence- from what year – what time of the year, how long did the storm occur?) What kind of damage or loss?

- Landspout in 2012, blown roof, damaged houses, fallen trees, damaged road
- Pabuk Storm in 2019 causing debris or garbage on coast
- Strong waves hit the coast during November - January every year. infrastructure must be repaired every year, the fallen electricity poles
- Strong wind, strong waves, characteristic like landspout occurring in December 2018, blown house tile, water eroded in the back of the house
- 28 years ago, Gay Typhoon passed the Gulf of Thailand, The typhoon with wide area of coastal erosion. More than a hundred homes were damaged.
- During Nov - Mar. of every year, fishermen cannot go fishing. The fishing nets were disappeared and submerged.

- When the storm surge washed ashore, caused coastal erosion, made a barrier to go to work. For the fishing community near the shore, the houses were collapsed and unable to go fishing, made life difficult, worried about monitoring storms at all the times, difficult transportation, no parking spot for fishing boats, power blackout, lack of income, difficult to park boat due to high wave.

2. When the past disaster did the storm surge occur? What kind of preparation or preparedness did you have? (family members, houses, boats, or fishing gear)

- Prepare to evacuate to a safe place, move ships to coast, monitor storm at all the times, assess the situation, prepare important documents, money and sand sacks, local leader give an advice in advance to prepare dry food, clothing, medicine and car service available for evacuation.

3. Impact from disasters or storms washed ashore. What ways did it affect you at the community level?

- Trees and electric poles were fallen. The beach was eroded. Fishermen could not go fishing, damaged houses, anxiety occurred, broken electrical appliances, damaged livelihood tools, damaged transportation, damaged land. beach area began to disappear, seafood began to disappear.

4. Your community prepared an evacuation area (safe area) for the disaster or not (Where was there?)

- Ban Kohtaew School, Pondok Kohtaew Municipality, Ban Bo It School, Mosque, Ban Kee La School, Kuan Ko Taeo, Koh Yo School, government agencies provided Ulum Mutdin Foundation School, Kubo area

Conclusion

Climate change results in higher temperatures, causing cool air mass to rise which tends to decrease the storm's frequency. Adaptation of the coastal communities was imperative. Furthermore, the stronger monsoon might cause more severe coastal erosion problems which would affect coastal ecosystems, fisheries and population settlements and tourism industries. Therefore, the adaptation of the coastal communities was necessary for all the sectors to join in solving this problem.

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