IMAGE: A MAP OF THE STARS OF THE ORION CONSTELLATION

Print ISSN: 2631-8490 Online ISSN: 2631-8504

JournalPreview

London Journal of Research in Science: Natural and Formal
Volume 24 | Issue 8 | Compilation 1.0

Great Britain Journals Press

WWW.JOURNALSPRESS.COM

Journal Content
In this Issue

Great Britain Journals Press

i. Journal introduction and copyrights

ii. Featured blogs and online content

iii. Journal content

iv. Editorial Board Members

1. The Fourth Exploration of the Fundamental Nature of the Universe. ***1-10***
2. Agriculture Development and its Impact: A Comprehensive Time series Analysis of Climate Variables. ***11-22***
3. The Fifth Discussion on the Origin of the Universe. ***23-32***
4. Dietary Habits and Nutritional Status of Hemodialysis Patients Seen in Some Hemodialysis Centers In Lomé. ***33-46***
5. Modelling of Large Fire Insurance Claims: An Extreme Value Theory Approach. ***47-67***

v. Great Britain Journals Press Membership

The Fourth Exploration of the Fundamental Nature of the Universe

Samo Liu

ABSTRACT

The article published earlier discusses space and time, the existence within space, and human existence. If science proves the correctness of zero-dimensional space, the contradictions in modern physics can be resolved. Material philosophy is based on thinking about the material universe. Cosmogony is thinking based on space and existence in space. Based on our ancestors handed down the basic idea of the origin of the universe, in-depth study of the existence of space in the scientific philosophy thinking

Keywords: fundamental nature of the universe, zero-dimensional space, scientific philosophy and reflection, ancestral teachings, relativity, force and time, space and existence, fundamental force and thermodynamics, scientific philosophy.

Classification: LCC Code: QB981

Language: English

Great Britain Journals Press

LJP Copyright ID: 925691
Print ISSN: 2631-8490
Online ISSN: 2631-8504

London Journal of Research in Science: Natural and Formal

Volume 24 | Issue 8 | Compilation 1.0

The Fourth Exploration of the Fundamental Nature of the Universe

Samo Liu

ABSTRACT

The article published earlier discusses space and time, the existence within space, and human existence. If science proves the correctness of zero-dimensional space, the contradictions in modern physics can be resolved. Material philosophy is based on thinking about the material universe. Cosmogony is thinking based on space and existence in space. Based on our ancestors handed down the basic idea of the origin of the universe, in-depth study of the existence of space in the scientific philosophy thinking.

Keywords: fundamental nature of the universe, zero-dimensional space, scientific philosophy and reflection, ancestral teachings, relativity, force and time, space and existence, fundamental force and thermodynamics, scientific philosophy.

Author: Ph.D., Professor-level Senior Engineer China Occupational Safety and Health Association, Beijing.

I. INTRODUCTION: HUMANITY AS THE REPRESENTATIVE OF THE UNIVERSE

The issue of zero-dimensional space and the reevaluation of the fundamental nature of the universe may represent a current phase in humanity's understanding of the true nature of the cosmos, marking a progression in human thought. Considering the contradictions between relativity and quantum mechanics through the lens of a zero-dimensional universe could, with high probability, be a correct approach to resolving these modern physical paradoxes. If science proves this to be true, many might find it surprisingly simple. Does human thought need a paradigm shift or a revolutionary way of thinking?

However, this issue is far from simple. The contemplation of this problem has spanned over 2,500 years of recorded human history and 500 years of scientific inquiry. How long did our ancestors ponder this issue before 2,500 years ago? We do not know. Our ancestors, worthy of our pride, may have experienced or even embodied a divine phase in human history. The notion of divinity has persisted throughout human history (Liu, "The Zero-Dimensional Universe: 绝对空间考"). We sometimes declare our material divinity, which science has proven to exist. The spiritual aspect of divinity, intertwined with material progress, has become blurred and diffused but has not vanished, as evidenced by love, compassion, and creativity.

The concept of the zero-dimensional universe's fundamental nature is a method of thought our ancestors bequeathed to us—a scientific approach to perceiving the universe. Through arduous efforts, 500 years of material science, and material philosophy, we have mastered classical and modern physics, validating the scientific contemplations of our great ancestors. We express gratitude to our ancestors and to humanity's efforts and struggles. The achievements of modern physics have validated the ancestral thoughts on the fundamental nature of the universe, leading to new reflections and advancements in human thought.

London Journal of Research in Science: Natural and Formal

Humanity has not betrayed the causes and conditions of the universe that created us and has, for now, lived up to the universe's expectations for our creation (Liu, "人类本原考"). The term "representative" is a concept created by humanity. Do humans truly represent the universe? This is a matter for human judgment and for time to reveal.

II. HUMAN EXISTENCE WAS THE REPRESENTATIVE OF THE UNIVERSE EXIST

The universe and its existence consist of information, energy, and matter, along with their mutual movement and change. The existence of an individual human, their creation, life, and death, is a manifestation of this existence. Could the collective creation, life, and existence of humanity cycle similarly to the universe's existence? In principle, yes. However, humans possess sensations and subjective consciousness, enabling us to think and judge independently. Humans can resist the laws of the universe; thus, our collective existence and existential reflections are determined by human thought and action.

Humans are material beings, and all our sensations stem from material desires and the human body. Language, writing, numbers, and scientific expressions also convey materialized information. How, then, can non-material void and emptiness arise? After studying Aristotle's philosophical works and dialectical materialism, and having the opportunity to read "无中生有的宇宙 A Universe from nothing "(Krauss) and "通向实在之路The Road to Reality" (Penrose), as well as Einstein's theory of relativity on the transformation of matter and energy, Planck's quantum theory, Kelvin's absolute zero, the concept of absolute space and monadology, the electromagnetic forces of the universe, universal gravitation, strong and weak nuclear forces, and after studying systems science and physical cosmology, and practicing mineral processing, it is clear that all forces are perceived as the interaction of matter and energy. Time is the cause of existence. Thanks to the efforts of many scientists, the causes of existence and motion in space have become clear. Scientific verification is merely the result; The author doesn't know how to prove it scientifically,the author uses language, writing, and numbers to examine the thoughts of our ancestors from 2,500 years ago (Liu, 2024.5)（2024.8)（2024.8a)（2024.7)). Next, I will discuss the fundamental nature of the universe.

Physics has discovered a vacuum, also called a quantum vacuum, where no post-atomic matter exists, only quarks, particles, fermions, and bosons, alongside the non-material existence of dark matter and dark energy. Particles are both material and non-material, as demonstrated by wave-particle duality. Their entanglement shows the zero-dimensional spatial properties of non-material energy information, and their unpredictability indicates the instability of particles, non-material, or immature matter. Entanglement illustrates the informational interconnections between existences (Liu, "宇宙本原考").

If zero-dimensional space still needs empirical proof, quantum mechanics has at least shown signs of non-material existence. Four-dimensional spacetime has inspired thoughts on non-material existence with zero time. Once matter has quality and mass and time measurement, it becomes complete matter or energy. Thus, quantum mechanics and relativity have opened the door to the fundamental nature of the universe and zero-dimensional space. Our ancestors' thoughts on the universe's fundamental nature have been largely validated by science, yet we remain entangled in material and materialized language, writing, and numbers. This means that while humans can represent the universe, our thinking still cannot fully represent the entire universe because we have not yet comprehensively understood space and existence within the universe.

The universe is inherently simple but has created a complex entity called humanity. Humans have sensations and subjective consciousness, language, writing, numbers, and have also learned science. For humanity to exist, complexity is necessary to explore and study the issues of existence and

measurement, using language, writing, numbers, and scientific information to prove and describe it (Liu, "Beautiful and fresh flowers").

If humans are to represent the universe, we must understand the true and comprehensive nature of the universe, including both material and non-material existence. To survive and exist, humans must study these existences (Liu, "宇宙本原考" and "人类本原考"). We have understood matter and classical physics, quantum mechanics, and the fact that everything originates from atoms and particles. But how do particles arise? How did bosons and fermions appear? Where did quarks come from? Is there a primordial force that creates quarks?

Quantum mechanics tells us that the universe is an ocean of energy, including kinetic energy, electrical energy, atomic energy, and a force called thermal energy or thermal power. The existence, movement, and change of matter and energy can only be expressed through thermal energy (Langner, “Theoretical Concepts in Physics”). Thus, thermal power might be related to the force that creates energy and matter, referred to as the "The Force" in “宇宙本原考”. While this term also appears in Western films, here it is a physics term specifically referring to primordial force. If there are copyright issues, it can be called thermal power or primal force.

The universe created humanity, and humanity needs to survive and exist. Our ancestors developed the fundamental concepts of the universe, created language, writing, and numbers, and modern humans created science, which has partially validated our ancestors' ideas about the universe. We still need to use language, writing, numbers, and science to empirically verify these ancestral thoughts about the universe and the existence within it. For humanity to exist, live, and survive long-term, we must diligently explore and verify the existence within space and space itself, including human existence.

Proving the nature of space may not be achievable with material science or mathematics in the short term. We may need to transition from three-dimensional to zero-dimensional space to think about Tan（惚） in stages and admire Tan(惚). Physics has already extensively studied matter, and quantum mechanics needs further development for energy. Relativity must continue to expand. Short-term understanding of the forces and time causes that form energy may not be feasible, but this is the direction of physics research. We hope more great scientists and theories emerge to explore the causes of existence and change in matter and energy for humanity's survival and existence.

Whether humanity represents the universe or not, we must first represent ourselves. Both material philosophy and fundamental concepts of the universe are human thoughts. We have contemplated material philosophy for over 2,000 years following Aristotle, and now physics, quantum mechanics, and relativity prompt us to consider zero-dimensional space. This is not humanity's design but the universe's natural push for humanity to survive, exist, and think.

Whether it is Buddha Sakyamuni's predictions (Liu, "宇宙本原经典考") or the natural emergence of modern physics, humans must contemplate what to do next. Having created coordinate systems, we need survival goals and hopes. Facing the contradictions in physics and numerous contradictions in the human world, if we wish to continue existing and surviving happily, we must create new thinking goals.

III. REVISITING SPACE AGAIN

Material philosophy and material science have depicted space as three-dimensional. With the advent of modern physics, we are compelled to explore the concepts of absolute space and zero-dimensional space. As stated in Chapter Four of the *Tao Te Ching*, we might be limited in our understanding because the existence within space determines how we describe Tans（惚的 state.（Liu, “道德经.宇宙本原的宣言”）We are familiar with three-dimensional space, but for the sake of existence and thought, we

must also reconsider zero-dimensional space. However, space also contains other forms of existence, such as the causal relationships in mechanics, the existence of temporal causes, and the state of intelligent energy. Solving these issues might require the contemplation of many future generations. If they discover new forms of existence, it might lead to new ways of describing space. Therefore, we cannot currently define space strictly as three-dimensional or zero-dimensional; this is merely a stage in humanity's understanding of space. (Liu, (2024.5) (2024.8) (2024.8a)

From the material point of view, it can be called three dimensional space; From the perspective of the Cosmic origin, it can be called 0-dimensional space.

Can we and our descendants continue to exist? Humanity itself cannot definitively answer this because we are material beings. However, we also have perceptions, sensations, and subjective consciousness. The causes of the universe created humanity and endowed us with both the potential for greatness and the seeds of destruction (without negative connotation). This duality has led us to create language, writing, numbers, and science in the material world, to develop mechanics and energy, and to establish modern science. These advancements have given us some ability to resist natural laws and to cope with universal threats. At present, no imminent universal cause appears likely to threaten humanity's survival in the near term. However, through the study of material philosophy and science, we have discovered universal causes, the fundamental nature of the universe, and cosmic energy, leading to the creation of nuclear weapons and robots.

The current global situation is chaotic and tense, with frequent discussions about war and even speculation about World War III and nuclear warfare. In "Second time Discussion the Essence of the Universe,"(刘(2024.8)) the author called on scientists to calculate the impact of nuclear explosions, especially hydrogen bombs, on the Earth's environment. This implies that understanding the factors and causes that threaten human survival is crucial. From the perspective of the fundamental principles of the universe, nuclear weapons could potentially lead to the extinction of humanity by disrupting the cosmic energy environment and Earth's paradise-like conditions. Thus, the possibility of human self-destruction is a frightening, laughable, yet very real prospect. The irony is that intelligent and wise humans might cause their own extinction. Do you believe this?

To resolve this contradiction, we must again turn to the principles of the fundamental nature of the universe. We need to analyze the causes and factors that threaten human existence. Resolving contradictions involves understanding and addressing these underlying causes and factors. This topic will be discussed in detail in the next article on the fundamental nature of the universe. For now, we will continue to use science to discuss the fundamental nature of the universe and explore scientific philosophy.

IV. EXISTENCE WITHIN SPACE

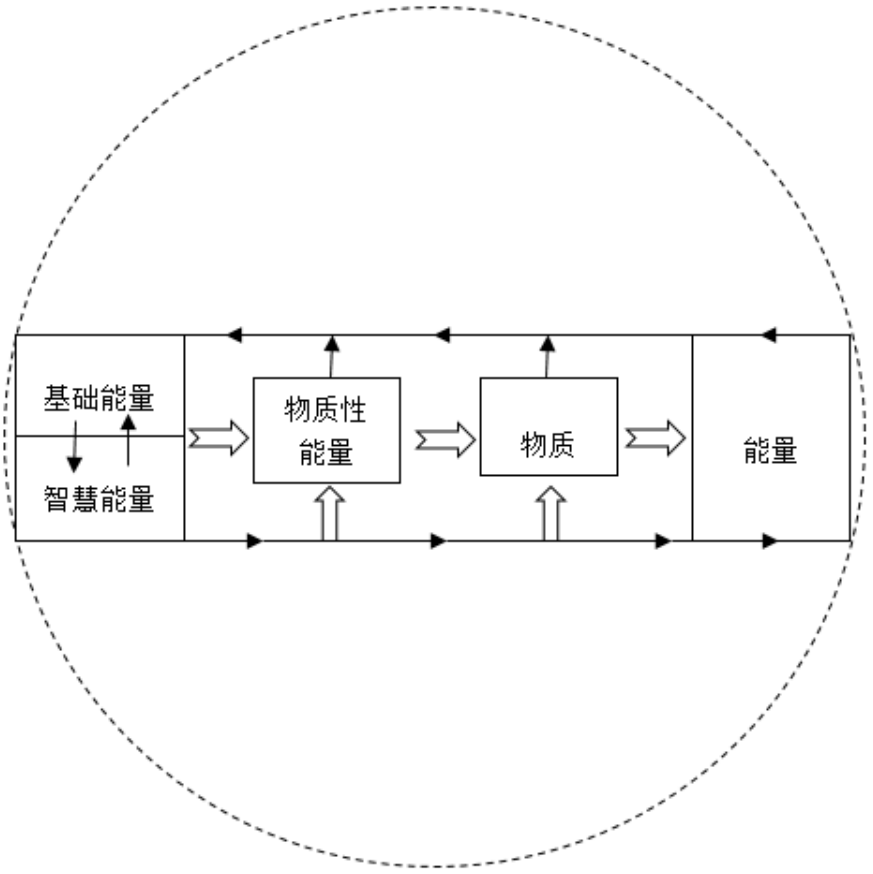
Everything that exists is within space. Analyzing and judging based on current information, the existence of matter and energy is intertwined with the existence of force and time. It is force and time that facilitate the aggregation and dispersion of matter and energy, driving their movement and change. Through the principle of balance, matter is created, exists, moves, and changes in a continuous cycle. Professor Penrose discovered this, but our ancestors had already identified and explained this concept in their fundamental understanding of the universe.

4.1 Balance and Cycles

The fundamental concept of the universe teaches us that the highest principle of the universe is balance, and under this supreme principle, there is continuous cyclicity. Basics energy(基础能量)

and intelligent energy(智慧能量) are unified in a yin-yang relationship, embodying life. First, they create energy-based existence, which then creates matter-based existence. All existences, under the influence of force and time, aggregate, grow, decay, and return to an energy state. This process follows the principle of energy balance and cycles, as illustrated in the energy balance cycle diagram.

（附图）能量平衡循环图



能量平衡循环图

Energy Balance Cycle Diagram: A Modified Taiji Diagram.

The energy balance cycle can be illustrated as a variation of the Taiji (Yin-Yang) symbol, reflecting the Daoist concept of "One gives birth to Two, Two give birth to Three, and Three give birth to all things" from the *Tao Te Ching*. In this diagram。

Let's think about the energy balance diagram.

A dashed circle represents an infinite space that is not closed.

Space is filled with an immaterial basic energy. It is not known what the basic energy is. Space is filled with intelligent energy, or basic energy with intelligence and heart.

Not knowing what intelligent energy is, reflected in matter and energy, man finds that force and time, which are neither matter nor energy, (Liu (2024.8) (2024.7)) are a cause of information, a cause which causes energy and matter to come into being, to exist, to move, to change, and to disappear.

Judging from the previous industrial and scientific and technological revolutions, the discovery of the causes of force and time is the road of human scientific development and the way to the birth of great scientists. Material philosophy and material science have guided the scientific development of human beings for 500 years, so let us welcome the science, technology and industrial revolution behind with a positive attitude.

The supreme principle of the universe is balance. (Liu, “道德经.宇宙本原的宣言”, (2024.5), (2024.8))

The basic energy（基础能量）and intelligent energy（智慧能量）is the concept of yin and yang, cause and factor in the universe, the two sides have the marriage of yin and yang and five elements, do not know what is it，was the concept.Scientific proof of concept is needed.

If existence in the universe were balanced, no energy or matter would be created, absolutely zero degrees.（Liu，(2024.8)）

If there is an imbalance of existence in the universe, energy is created, and thus biomass. Everything is created, exists, moves, changes and disappears in thermal equilibrium.（ Liu（2024.8a））

- Large Arrow ⇨ (Irreversible Process): Represents the creation (or destruction) processes that are unidirectional and cannot be reversed.

- Small Arrow ↑ (Reversible Process): Represents processes that can oscillate or reverse, maintaining a dynamic balance.

Three States of Energy Balance：

1. Creation State: The phase where energy creates new forms of existence, leading to the birth of matter and energy entities.
2. Disappearance State: The phase where matter and energy entities decay or dissolve back into pure energy.
3. Existence, Motion, and Change State: The current phase where humans and all things exist, move, and change in a state of relative balance.

4.2 The Force (原力)

According to “宇宙本原考”, the creation of particles and quarks is driven by a primordial force called "The Force." This force is related to thermal energy, or it can be said to be thermal energy itself. In physics, thermal energy is a force that does not involve interactions but represents the existence and movement of matter and energy (Longair, “Theoretical Concepts in Physics”). Analyzing from the fundamental concept of the universe, thermal energy is the yin-yang interaction of fundamental energy and intelligent energy, a primordial void force. This creative force is present throughout the entire existence of material energy.

Expressing this process using conventional time descriptors is difficult, as it represents the entire material universe's local existence within space.

If our material universe is the only one, it can be referred to as 1 (Liu, 2024.5). If there are other material universes beyond 10^100 light years, the size of this "1" cannot be determined. “宇宙本原考” posits that the universe is like a fireworks display, with countless fireworks, each with a lifespan in the order of hundreds of billions of years, varying in numbers and sizes, on the scale of hundreds of billions of light years (Liu, “宇宙本原考”). Humanity exists on a speck of dust within one of these fireworks. In such a scale, galaxies, galactic clusters, and even distances measured in light years or parsecs are

minuscule. We lack the capacity to contemplate the problem of infinite space. Therefore, we must respect space, seek blessings, and strive through our own efforts.

The existence, movement, and change of humanity and all things are manifestations of heat. Thermal energy represents the existence and movement of material energy, indicating the material universe. The fundamental basics energy's nature is unknown, but when imbalanced, it, together with intelligent energy, generates thermal energy and thermal force. All mechanics and energies are related to thermal energy and thermal force. Thus, it is judged that thermal force is the creative force, the primordial force (Liu, “宇宙本原考”). Humanity cannot create a perpetual motion machine. However, all existents are perpetual motion machines, all alive. (2024.5) (2024.8) (2024.7))

4.3 Relativity

Existence is relative; it involves motion and change through mutual relationships, from zero to zero. Einstein's theory of relativity addresses the gravitational existence, motion, and change of material mass and energy. Other forms of energy and forces should have similar theories of relativity. Scientific research should aim to uncover all such theories. Once all theories of relativity are discovered, the mysteries of the universe will be revealed. There might be only one theory of relativity for matter (Liu, “万物生存考”).

The theory of thermodynamic relativity, which should be credited to Lord Kelvin and Professor Planck, posits that absolute zero is the ultimate limit in relativity. The universe's creation undergoes two stages: first, the creation of energy; second, the creation of matter. Determining to which stage Planck temperature belongs requires scientific judgment. The Planck constant is a fundamental physical constant for understanding the creation of the universe, while M-theory is a mathematical framework for this understanding. However, M-theory is not the ultimate theory, and it is important to avoid using terms like "ultimate" (Liu, 2024.5, 2024.7). Discovering a new theory of relativity could result in the emergence of an Einstein-level scientist.

Similarly, discovering a new force could lead to a Newton-level scientist, sparking an industrial and scientific revolution. This would elevate humanity's levels of material energy and desire (Liu, “宇宙本原考”).

4.4 Force and Time

Using the principles of the fundamental nature of the universe and integrating known information, it can be concluded that force and time are the essence of all existence, encompassing motion, change, balance, and cycles (Liu, 2024.5). Force initiates existence and drives motion and change, while time governs direction and balance (Liu, 2024.5).

Time is related to all forms of force: gravity, mass, and the processes named by humans as the existence and life of matter (Heguanzi”鹖冠子”). Time is linked to electromagnetic force, strong force, and weak force, defining the energy existence and life of matter (Liu, “万物生存考”). Time is also related to thermal force, which is the life force of all existence. If force is considered an angel of the divine universe, then time is the greatest angel.

The weak force is a peculiar force associated with radiation. If other boson models in mechanics are correct, the boson model of the weak force in quantum mechanics might be flawed, as it should not have mass. This is because it represents an angel, an information cause. This hypothesis should be

verified. It can be asserted that the weak force is significantly related to the cause of time and the mass of matter (Liu, “宇宙本原考”, “人类本原考”).

The definition of the "second" by the International Committee for Weights and Measures might be coincidental (13th CGPM, 1969), yet it precisely expresses humanity's concept of time and echoes the ancestral idea of the time cause in the universe's fundamental nature. Studying the initial radiation waves of other atoms and statistically analyzing them could provide insights. However, this is merely one direction for researching the cause of time and is far from simple.

4.5 Basic Energy and Intelligent Energy

Basicl energy and intelligent Basic energy are concepts designed in “宇宙本原考” to express and describe the causes and factors of the universe's void nature, represented by the yin and yang design concept.

Basicl Energy:

The exact nature of fundamental energy is unknown. It could be the primal origin of thermal energy, belonging to the category of energy but distinct from material energy. It is a divine or spiritual concept, not to be confused with material energy.

Intelligent Energy:

Even more elusive, intelligent energy represents the cause of information, akin to the angels of the divine universe. From current information, force and time fall into this category, representing causes of energy. This is not an energy concept but an informational concept. Are there other forms of intelligent energy or informational causes? Scientific thought is required to explore this. Considering the universe as a living entity could lead to greater understanding. (Liu (2024.7))

By contemplating the living nature of the universe, one can better grasp these complex ideas.

V. CONCLUSION

For the survival and continued existence of humanity, science carries a heavy responsibility. There remain many unknowns awaiting exploration. A crucial issue is ensuring the survival and existence of humanity and our descendants; science must address this issue. I have written a letter to you, (Liu (2024.7)) though I am unsure if it has been received.

I hope that by applying scientific philosophy, we can redefine our understanding of space and time, justify zero-dimensional space, and reconsider existence within space. All existence is alive; we must use science to understand it. Death is not what we should fear; what is truly frightening is the potential for intelligent humanity to annihilate itself, losing our inherent compassion and becoming the monsters we define ourselves as, turning Earth into a hell. Both humanity and the universe possess a soul, and science should have one too.)（Liu,（A Letter to the Scientific Community））

If humanity were to cease existing, what purpose would exploring and discussing these topics serve? The goal of humanity’s existence within the coordinate system is to let science play its role. Having retired, without the drive of material desires。More than 40 years of hard work, from the farming society into a modern society, from a poor child to an old man who does not worry about food and drink, living in a stable society, hoping to enjoy a pleasant life after retirement. Ido not know why I have written these books and articles. An intrinsic void-like force compels me to do so. Although publishing books and articles costs money, I am more than willing to do it.

I do not know whether these ideas are right or wrong. It needs scientific confirmationI only know that this information comes from the fundamental concepts of the universe left by our ancestors. I hope this

information is positive and just for humanity. These are not ultimate truths but rather inspirational words, texts, numbers, and scientific information. For the sake of humanity's survival and existence, the existence and joyful survival of humanity are the supreme truths.

PRIMARY REFERENCES

1. Liu, S. (2017). Revelation and Reflection on Mankind by Modern Physics Part I. Open Journal of Philosophy, 7, 435-447. https://doi. org/10.4236/ojpp.2017.74023
2. Liu, S. (2019). Revelation and Reflection on Mankind by Modern Physics Part II Consideration on Multidimensional Universe. Open Journal of Philosophy, 9, 72-81. https://doi.org/10 .4236/ojpp.2019.92007.
3. Liu, S. (2020). Philosophical Reflection over the Origin of the Universe. Philosophy Study,3, 213-222.
4. Liu, S. (2020). The Essence of the Universe and Humankind. Open Journal of Philosophy, 10,316-330. https://doi.org/10.4236/ojpp.20 20.103021.
5. Liu, S. (2021). Cosmic Space in Zero- Dimension: A Discussion on Spatial Question According to the M-Theory, Open Journal of Philosophy> Vol.11 No.1, February 20, https://doi.org/10.4236/ojpp.2021.111012.
6. Liu, S. (2021) A Second Discussion on Cosmic Space in Zero Dimension—A Discussion on Spatial Questions According to Classical Physics. Journal of Applied Mathematics and Physics, 9, 556-564. doi: 10.4236/jamp.2021.94039.
7. Liu, S. (2021) The Third Discussion on Cosmic Space in Zero Dimension_A Discussion on Spatial Questions According to the Correspondence between Clarke and Leibniz. https://scirp.org/journal/paperinformation.as px?paperid=109297.
8. Samo Liu, Revelations and Reflections on Humankind inspired by Modern Physics, Scientific Research Publishing 2021.
9. Philosophical Reflection on the Origin of the Universe, Science Herald, 2020, 23, Liu Hongjun p346.宇宙本原的哲学思考, 科学导报, 刘洪均。
10. Liu Hongjun Samo Liu, Reflection and research on the origin of the universe, 2020.9, Taipei Warmth Publishing,刘洪均 Samo Liu,《宇宙本原考》, 2020.9, 台北旺文出版。
11. Liu Hongjun Samo Liu, Thinking and research on the Human origin, 2021.1, Taipei Warmth publishing,刘洪均 Samo Liu,《人类本原考》, 2021.1, 台北旺文出版。
12. Liu Hongjun Samo Liu, 0-Dimensional Universe - Survival test of all things, 2021.5, Taipei Warmth Publishing.刘洪均 Samo Liu,《0 維的宇宙—萬物生存考》, 2021.5 , 台北旺文出版。
13. Liu Hongjun Samo Liu, 0-Dimensional Universe - Absolute space test, 2021.8, Taipei Warmth Publishing.刘洪均 Samo Liu,《0 維的宇宙—絕對空間考》, 2021.8 , 台北旺文出版。
14. Liu Hongjun Samo Liu, Tao Te Ching- Universal Declaration, 2021.12, Taipei Warmth Publishing..刘洪均 Samo Liu,《道德经-宇宙本原的宣言》, 台北旺文出版。
15. Liu Hongjun Samo Liu, Textual research of the universe original classic, Taipei Warmth Publishing.刘洪均 Samo Liu,《宇宙本原经典考》, 台北旺文出版。
16. Samo Liu, (2024.5) Exploring the Essence of the Universe. Volume 24 | Issue 5 | Compilation 1.0, P1-11, Great Britain Journals Press.
17. Samo Liu, (2024.8) Second time Exploration the Essence of the Universe. Volume 24 | Issue 8 |, Great Britain Journals Press.
18. Samo Liu, (2024.8a) Third Discussion on the Origin of the Universe . Volume 24 | Issue 8|, Great Britain Journals Press.
19. Samo Liu, (2024.7), A Letter to the Scientific Community . Volume 24 | Issue 7 |, Great Britain Journals Press.

Other Reference Books:

Other References

1. 老子(古代,《老子道德经注, 王弼(三国。魏)注, 楼宇烈校释, 2019.12, 北京, 中华书局。
2. 释迦牟尼(古代, 星云大师总监修,《金刚经》恭让释译;《般若心经》程恭让东初释译;《空的哲理》道安著; 2019.9 , 北京, 东方出版社。
3. 龙树(古代, 星云大师总监修,《中论》韩廷杰释译;《大智度论》郑廷础释译;2019.9, 北京, 东方出版社。
4. 元阳真人(古代,《周易, 倪泰一编注, 1993.8, 西南大学出版社。
5. 朱熹(宋,《近思录》吕祖谦编, 中州古籍出版社, 2008.1.
6. 王阳明(明,《传习录》叶圣陶点校, 北京联合出版公司, 2018.1.
7. .文子(古代,《文子疏義》王利器编撰, 2019.6, 北京, 中华书局。
8. 列子(古代,《列子》, 叶蓓卿译注, 2016.1, 北京, 中华书局。
9. 庄子(古代,《庄子》, 孙通海译注, 2017.3, 北京, 中华书局。
10. 元阳真人(古代,《黄帝内经, 陆周华编注, 1995.6, 西南师范大学出版社。
11. 周敦颐(宋,《周敦颐集, 陈克明点校, 1990.5 , 北京, 中华书局。
12. .张载(宋,《张子全书, 林乐昌编校, 2015.1 , 西安, 西北大学出版社。
13. Einstein, "Relativity - Special and General Theory" translated by Li Jingyi(李精益), Guangxi Science and Technology Press, 2020.12.广西科技出版社。
14. Einstein, "Relativity" translated by Zhang Qianqi(张倩绮, Shaanxi Normal University Press, 2020.8. 陕西师范大学出版社。
15. Aristotle, "Physics," translated by Zhang Zhuming(张竹明, October 2019, Beijing, Commercial Press。商务印书馆。
16. Aristotle, "Metaphysics," translated by Cheng Shihe(程诗和), 台海出版社, 2016.9.
17. Jeremy Webb, "Void", translated by Feng Yongyong (冯永勇)and Jin Taifeng(金泰峰), June 2018, Beijing, Commercial Press.北京商务印书馆。
18. Newton, "Mathematical Principles of Natural Philosophy," translated by Yu Liang(余亮), December 2017, Beijing, Beijing Institute of Technology Press.北京理工大学出版社。
19. Eugene Hecht, "Optics" translated by Qin Kecheng(秦克诚), Electronic Industry Press, 2019.6.电子工业出版社, 北京。
20. 俞允强,《物理宇宙学讲义》, 2002.11, 北京大学出版社。
21. Descartes, "Descartes' Geometry" translated by Yuan Xiangdong(袁向东), Peking University Press, 2019.5.北京大学出版社。
22. 13th CGPM. (1969). Comptes Rendus de la 13e CGPM(1967)., (p. p.103). Retrieved https://www.bipm.org/utils/common/pdf/CGPM/CG PM13.pdf#page=103.
23. Max Born,<The Restless Universe永不停息的宇宙>左安浦译, 2023.3, 北京联合出版公司。
24. Penrose彭罗斯,《通向实在之路》, 王文浩译, 湖南科学技术出版社, 2017.2。
25. .汪志诚,《热力学统计物理》2013.1, 高等教育出版社。
26. 克劳斯,《无中生有的宇宙 A Universe from nothing》刘仲敬译, 江苏人民出版社, 2012.9
27. .朗盖尔, Malcolm Longair《物理学中的理论概念Theoretical Concepts in Physics》向守平等译, 中国科学技术大学出版社, 2017.8

Agriculture Development and its Impact: A Comprehensive Time series Analysis of Climate Variables

Ashish Verma, M Umamageswari, Praveen Kumar Verma & Ravi Saxena

Indira Gandhi Krishi Vishwavidalaya

ABSTRACT

Climate change poses significant challenges that necessitate the development of policies aimed at managing aggregate inputs and social costs. For formulating such policies, an analysis of its factors and their current trends needs to be studied. This paper explores the factors influencing climate change and provides insights into their impact through changes in arable land and greenhouse gas (GHG) emissions in India from 1990 to 2020. Utilizing time series analysis, the study examines trends in GHG emissions from agriculture and develops a simulation model to estimate overall GHG emissions through methane and nitrous oxide emissions. Results indicate that enteric fermentation and agricultural soil are major contributors to methane and nitrous oxide emissions, respectively, with enteric fermentation contributing approximately 69.33% to methane emissions and agricultural soil contributing approximately 97.66% to nitrous oxide emissions. Additionally, a higher growth rate is observed for nitrous oxide emissions than methane emissions, with nitrous oxide emissions showing a 161% increase from 1960 to 2010. Furthermore, a positive correlation (i.e. r=0.587) between GHG emissions and changes in annual mean temperature underscores the direct impact of agricultural emissions on climate dynamics in India, with a regression coefficient factor of 0.176.

Keywords: greenhouse gases (GHGs), methane, nitrous oxide, climate change.

Classification: LCC Code: QC903

Language: English

Great Britain Journals Press

LJP Copyright ID: 925692
Print ISSN: 2631-8490
Online ISSN: 2631-8504

London Journal of Research in Science: Natural and Formal

Volume 24 | Issue 8 | Compilation 1.0

Agriculture Development and its Impact: A Comprehensive Time series Analysis of Climate Variables

Ashish Verma[α], M Umamageswari[σ], Praveen Kumar Verma[ρ] & Ravi Saxena[Ↄ]

ABSTRACT

Climate change poses significant challenges that necessitate the development of policies aimed at managing aggregate inputs and social costs. For formulating such policies, an analysis of its factors and their current trends needs to be studied. This paper explores the factors influencing climate change and provides insights into their impact through changes in arable land and greenhouse gas (GHG) emissions in India from 1990 to 2020. Utilizing time series analysis, the study examines trends in GHG emissions from agriculture and develops a simulation model to estimate overall GHG emissions through methane and nitrous oxide emissions. Results indicate that enteric fermentation and agricultural soil are major contributors to methane and nitrous oxide emissions, respectively, with enteric fermentation contributing approximately 69.33% to methane emissions and agricultural soil contributing approximately 97.66% to nitrous oxide emissions. Additionally, a higher growth rate is observed for nitrous oxide emissions than methane emissions, with nitrous oxide emissions showing a 161% increase from 1960 to 2010. Furthermore, a positive correlation (i.e. r=0.587) between GHG emissions and changes in annual mean temperature underscores the direct impact of agricultural emissions on climate dynamics in India, with a regression coefficient factor of 0.176. It is estimated that the overall GHG emission from agriculture through methane and nitrous oxide emission will be approximately 695.87 to 818.73 MMTCDE in the year 2030; while the change in annual mean temperature is estimated to be about 1.65 ± 0.58° C from 1990 to 2030 in India. The findings highlight the urgent need for effective mitigation strategies within the agricultural sector to address the growing threat of climate change.

Keywords: greenhouse gases (GHGs), methane, nitrous oxide, climate change.

Author α: Ph.D. Research Scholar, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidalaya, Raipur, India. 492012.

σ: Assistant Professor, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal (U.T. of Puducherry), Karaikal, India. 609603.

ρ: Assistant Professor, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidalaya, Raipur, India. 492012.

Ↄ: Head & Professor, Department of Agricultural Statistics & Associate Director (Research) Directorate of Research Services, Indira Gandhi Krishi Vishwavidalaya, Raipur, India. 492012 .

I. INTRODUCTION

Agriculture, which accounts for approximately 42.86% of India's workforce (World Bank, 2022), contributes significantly to the country's economy, with its Gross Value Added (GVA) at current prices reaching about 18.3% in FY-23, and total food grain production reaching approximately 3296.87 lakh tonnes (PIB-Delhi, 2023). Not only does agriculture ensure self-sufficiency in feeding the population, but it also boosts exports. India has witnessed substantial growth in agricultural exports, with fruit

and vegetable exports increasing by 18.94%, oilseed exports by 32.83%, oil meal exports by 34.24%, and rice exports by 5.38% in July 2023 compared to July 2022, underscoring the success of agricultural production in the country.

However, despite this growth, if the social costs were to be accounted for, the sustainability of this trajectory would be questioned. The exponential increase in production has led to a significant rise in Greenhouse Gas (GHG) emissions, primarily methane, nitrous oxide, and carbon dioxide (Lynch et al., 2021), emanating from the agriculture sector in India. Previous studies have shown that enteric fermentation by livestock and rice cultivation are major contributors to GHG emissions (Pathak, Bhatia & Jain, 2014). Similarly, recent assessments of GHG emissions from crop cultivation over the past 50 years in India indicate a staggering 161% increase from 1960 to 2010 (Sah & Devkumar, 2018).

Studies by Vetter et al. (2017) have highlighted the changing Indian diet and its implications on GHG emissions from food production, with rice cultivation and ruminant products being significant contributors. Additionally, the burning of agricultural residue and savannas has seen a 75% increase in GHG emissions since 2011 across India (Deshpande et al., 2023). Nitrogen fertilizers, a key component of agricultural practices, have been found to contribute significantly to GHG emissions, with a considerable portion lost to the environment (Gu & Yang, 2022; Coskun et al., 2017).

The surge in GHG emissions has led to observable climate change, with estimates suggesting a rise in Earth's temperature by 1.8-4.0°C by the end of the century (Aggarwal, 2008). Predictions also indicate an annual temperature increase of 0.7 to 1.0°C by 2040 compared to the 1980s, resulting in more frequent extreme weather events such as floods, droughts, and glacier melting (Lal et al., 1998).

This paper aims to analyze the trend and time-series data of GHG emissions in India in relation to changes in arable land. It also seeks to identify the factors driving the surge in nitrous oxide (N2O) and methane (CH4) emissions from agriculture, the two major GHGs. Furthermore, the study develops a model to understand the relationship between overall GHG production and emissions of nitrous oxide (N2O) and methane (CH4) from agricultural and allied activities in India. Finally, it correlates and estimates a model for the annual mean temperature changes in India with GHG emissions over the past 28 years (1990-2018). It is noteworthy that the study does not consider the parameters of carbon dioxide emissions (CO2) from agricultural activities due to its overall negative contribution to the total GHG emissions from agriculture.

II. METHODOLOGY

Greenhouse gases emitted per capita in Turkey were estimated to be about 7.2 to 8.0 tons in 2030 based on emissions from various sectors (Ozdemir, Pehlivan & Melikoglu, 2024). The study utilized both linear and logarithmic models to estimate the findings. Drawing from the references derived from the log-linear regression model developed by Gujarati & Porter (2009), expressed as:

$$Y = \exp(C + \sum_i w_i f_i(X))$$

Where $f_i(X)$) represents quantities that are potential functions of variable X, and generally, a vector of values, while C and w_i refer to the model parameters; a model for greenhouse gas (GHG) emissions from agriculture in India was subsequently developed. The study involves the analysis of secondary time-series data extracted from the Organization for Economic Cooperation and Development (OECD) for the years between 1990 and 2020, focusing on the Agri-Environment and other relevant indicators. The model transformed the data into logarithmic form and a linear regression model is

fitted to derive a model for estimating total greenhouse gas emissions through agriculture $(TGHG_{Agri})$. The model is represented as follows:

$$\log(TGHG_{Agri}) = 0.294_{(\pm 0.13)} + 0.757_{(\pm 0.02995)}\log(TCH4_{Agri}) + 0.233_{(\pm 0.00791)}\log(TN20_{Agri})$$

Where $(TCH4_{Agri})$ represents total methane emissions from agriculture, and $(TN20_{Agri})$ represents total nitrous oxide emissions from agriculture. For further analyzing the climate variables, a second model was estimated through the same process to examine the relationship between the annual mean temperature $(Mean_{Avg})$ and $TGHG_{Agri}$. The secondary data for this model was extracted from the time-series data catalog accessed from the National Data Sharing and Accessibility Policy (NDSAP) for the years 1990 to 2018. The model is described as:

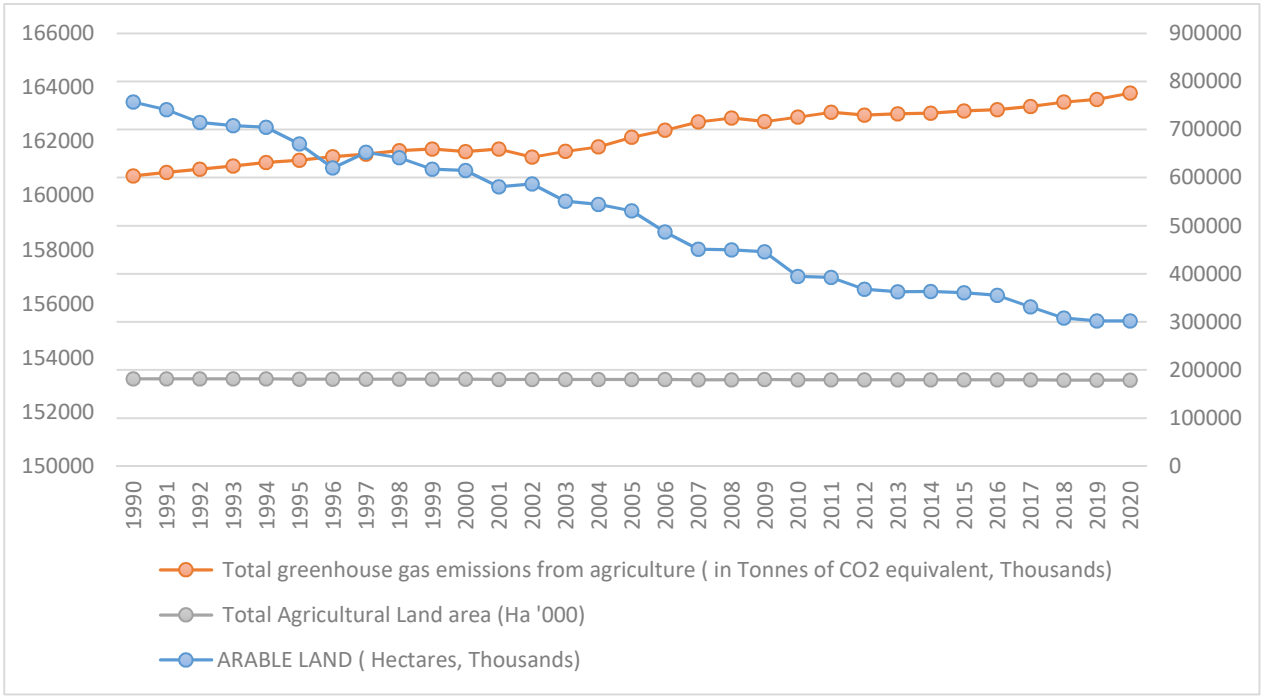
$$\log(Mean_{Avg}) = 0.366_{(\pm 0.2799)} + 0.176_{(\pm 0.0480)}\log(TGHG_{Agri})$$

Both models were estimated with a confidence interval of 95% for accuracy

III. RESULTS & DISCUSSION

3.1 GHG emission and arable land in India

Graph 1 illustrates this relationship further, displaying a negative trend line for arable land and a positive trend line for GHG emissions. Additionally, Table 1 depicts a strong negative correlation (r = -0.986) between total arable land and overall GHG emissions. This indicates a significant decline in total arable land alongside an increase in GHG emissions from agriculture between 1990 and 2020. The reduction in arable land can be attributed to various factors, including increased livestock production (as estimated by increased enteric fermentation), excessive fertilizer usage, rice cultivation, and the burning of agricultural residue. It's important to note that the definition of arable land includes areas used for temporary crops, meadows, market or kitchen gardens, and temporary fallow land, excluding areas abandoned due to shifting cultivation.

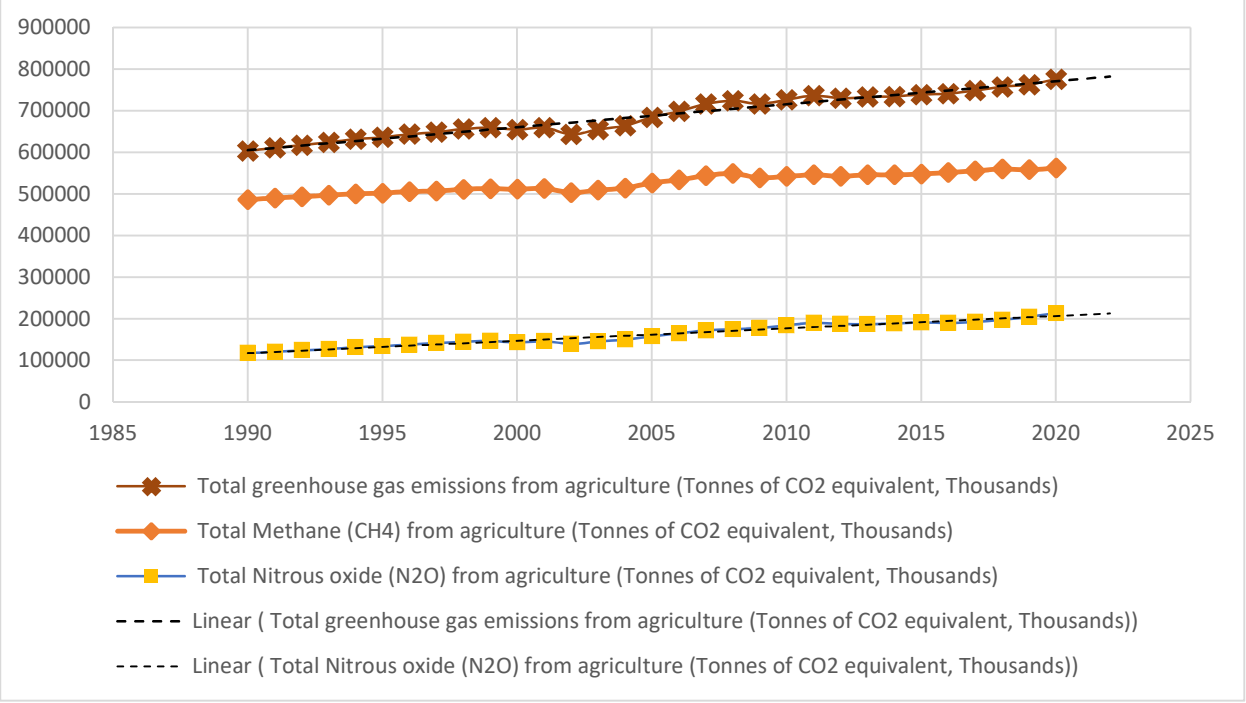


Graph 1: Trend line between Total GHGs emission, Total agricultural land & ARABLE LAND from 1990-2020.

Table 1: Partial Correlation between Total greenhouse gas emission from agriculture and ARABLE LAND

		ARABLE LAND	Total greenhouse gas emissions from agriculture	Total Agricultural Land area
ARABLE LAND	Pearson's r	—		
	p-value	—		
Total greenhouse gas emissions from agriculture	Pearson's r	-0.986	—	
	p-value	< .001	—	
Total Agricultural Land area	Pearson's r	0.979	-0.965	—
	p-value	< .001	< .001	—

From Table 1.1, a model was developed to analyze the contributions of methane and nitrous oxide to total GHG emissions *($TGHG_{Agri}$)*. The model indicated that methane emissions*($TCH4_{Agri}$)* had a higher coefficient of estimation (β1 = 0.757) compared to nitrous oxide (β2 = 0.233), suggesting a greater contribution of methane in total GHG output.



Graph 1.1: Trend lines of Total GHG emission, Total Methane (CH_4) emission & Total Nitrous oxide (N_2O) emission in India from

However, Graph 1.1 revealed that the total emission through methane has been much greater while the trend line for nitrous oxide exhibited a steeper slope than methane emission (ΔN2O/N2O >

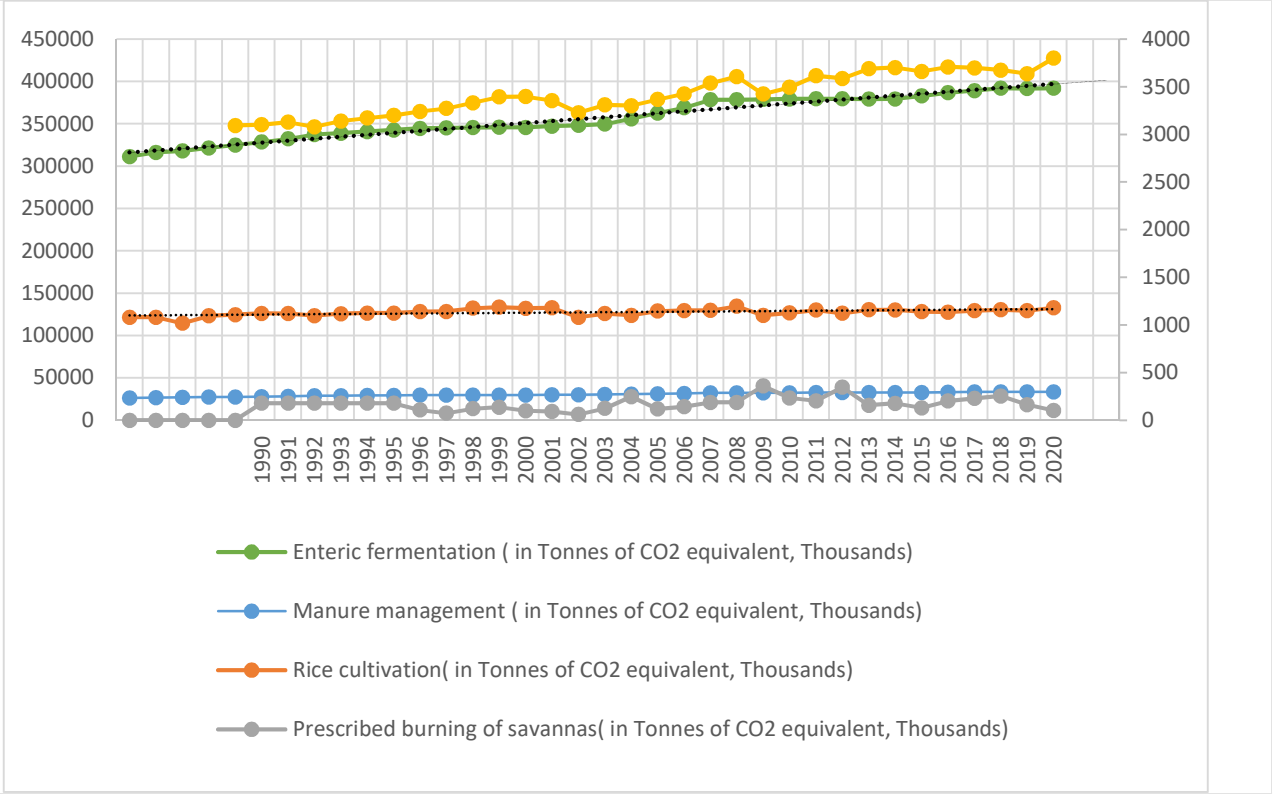
ΔCH4/CH4), indicating a higher rate of nitrous oxide emission growth between 1990 and 2020. This increase in nitrous oxide emissions can be attributed to excessive fertilizer and chemical usage in agricultural soil, leading to increased microbial activities such as denitrification and ammonification and other losses such as volatilization.

Table 1.1: Model Coefficients - TGHG_Agri - Transform

Model Coefficients - TGHG_Agri - Transform 2

Predictor	Estimate	SE	t	p
Intercept	0.294	0.13089	2.25	0.034
TCH4_Agri - Transform 3 (**β1**)	0.757	0.02995	25.28	< .001
TN2O_Agri - Transform 3 (2) (**β2**)	0.233	0.00791	29.45	< .001

The analysis further identified specific sources contributing to methane and nitrous oxide emissions. Graph 1.2 illustrated an upward trend in methane emissions from field burning of agricultural residue and enteric fermentation, while emissions from rice cultivation and manure management remained relatively constant.



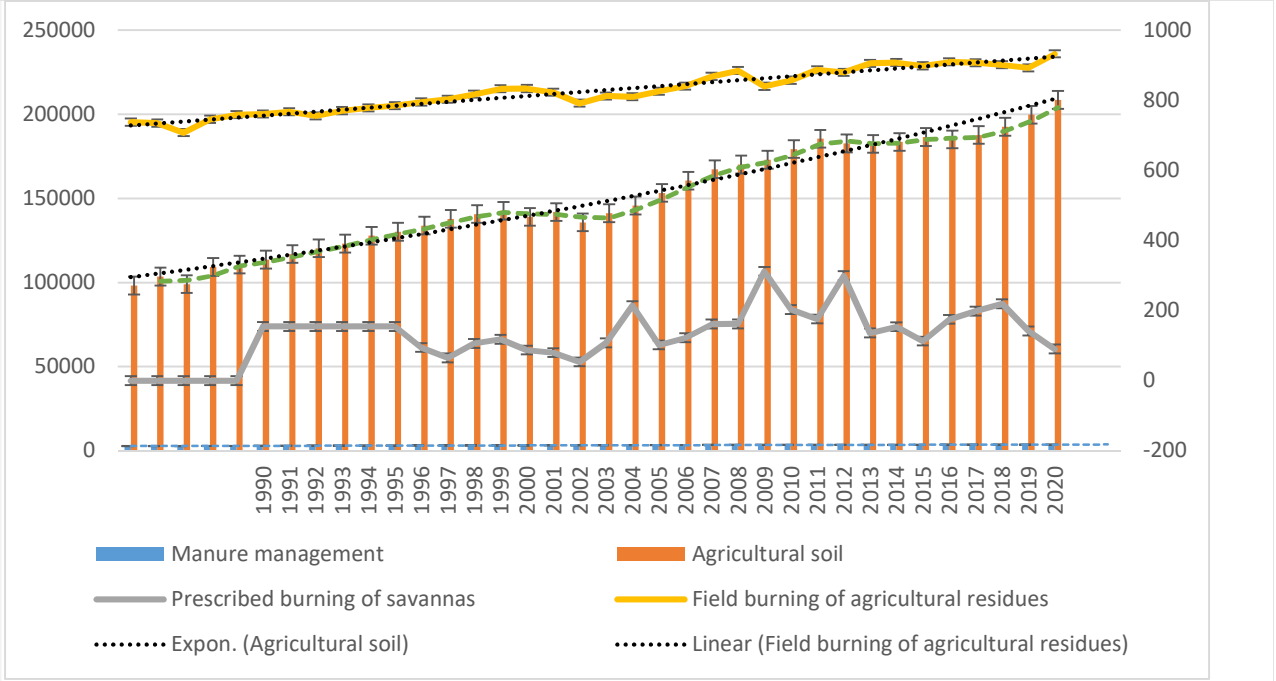
Graph 1.2: Total Methane emission from different sources of agriculture in India (1990-2020)

Table 1.2: provided model coefficients indicating that enteric fer mentation had the highest contribution to methane emissions *(logEnteric_ferment* = 0.6933*)*, followed by rice cultivation *(logRice-cult*=0.2441*)* and burning of agricultural residue *(logburning_agriResidues* = 0.0106*)*.. These findings corroborated with previous studies indicating a shift in dietary habits towards increased consumption of animal-based products in India.

Table 1.2: Model Coefficients for logCH4

Predictor	Estimate	SE	t	p
Intercept	0.3549	0.01694	20.96	< .001
logEnteric_ferment	0.6933	0.01020	67.96	< .001
logManure_mgt	0.0503	0.01097	4.59	< .001
logRice_cult	0.2441	0.00272	89.87	< .001
logburning_savannas	4.75e-4	1.24e-4	3.83	< .001
logburning_agriResidues	0.0106	0.00310	3.42	0.002

Graph 1.3: depicts the total nitrous oxide emissions from various sources in Indian agriculture between 1990 and 2020. It showed an upward trend in emissions from agricultural soil and field burning of agricultural residue, with a significant increase observed over the period.



Graph 1.3: Total Nitrous oxide emission from different sources from agriculture in India (1990-2020)

The model coefficients from Table 1.3 confirmed that agricultural soil had the highest contribution to nitrous oxide emissions *(logAgri_soil* = 0.97657), followed by manure management *(logManure_mgt* = 0.01476).

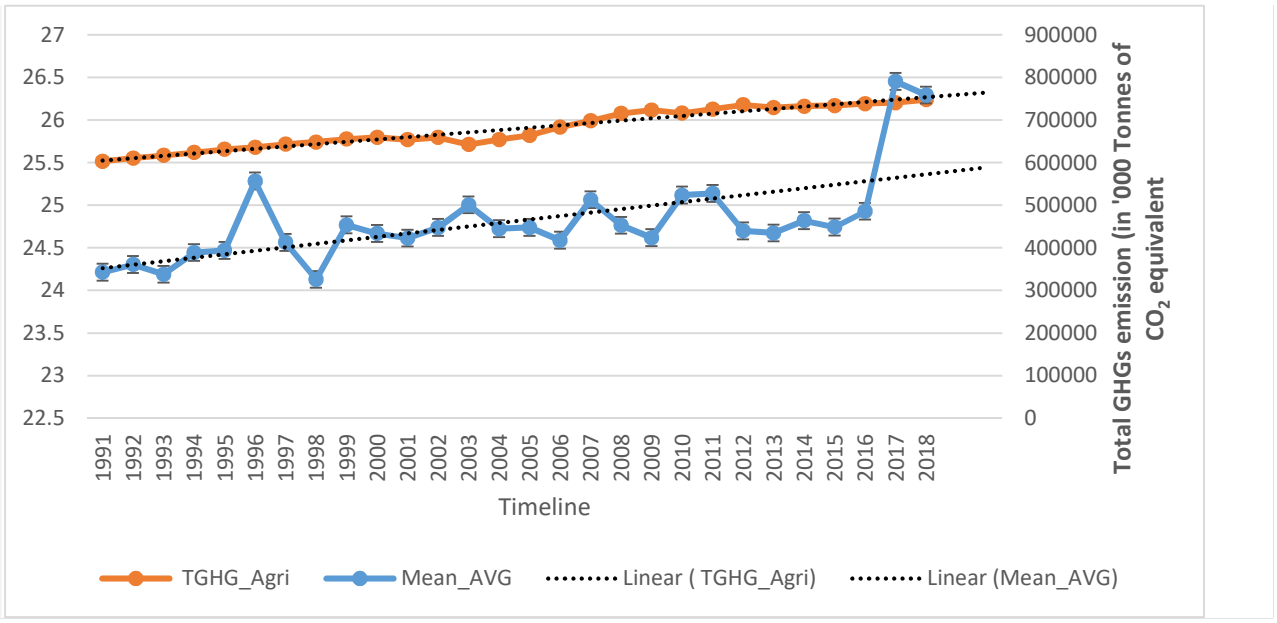
Table 1.3: Model Coefficients - logN2O

Predictor	Estimate	SE	95% Confidence Interval		t	p	Stand. Estimate	95% Confidence Interval	
			Lower	Upper				Lower	Upper
Intercept	0.07476	0.00395	0.06664	0.08289	18.916	< .001			
logManure_mgt	0.01476	0.00187	0.01091	0.01861	7.885	< .001	0.00585	0.00433	0.00738
logAgri_soil	0.97657	0.00105	0.97441	0.97873	927.899	< .001	0.99305	0.99085	0.99525
logburning_savannas	9.02e-4	7.43e-5	7.49e-4	0.00105	12.131	< .001	0.00209	0.00174	0.00244
logburning_agriResidues	0.00168	0.00180	-0.00203	0.00538	0.930	0.361	6.06e-4	-7.34e−4	0.00194

Overall, the results highlight the impact of increased fertilizer usage in agricultural soil on GHG emissions, particularly nitrous oxide, through providing more substrate to microbes and contributing to processes such as ammonification and denitrification. Additionally, unwanted nitrogen losses through volatilization also play a significant role in GHG emissions from agricultural soil (Gu & Yang, 2022).

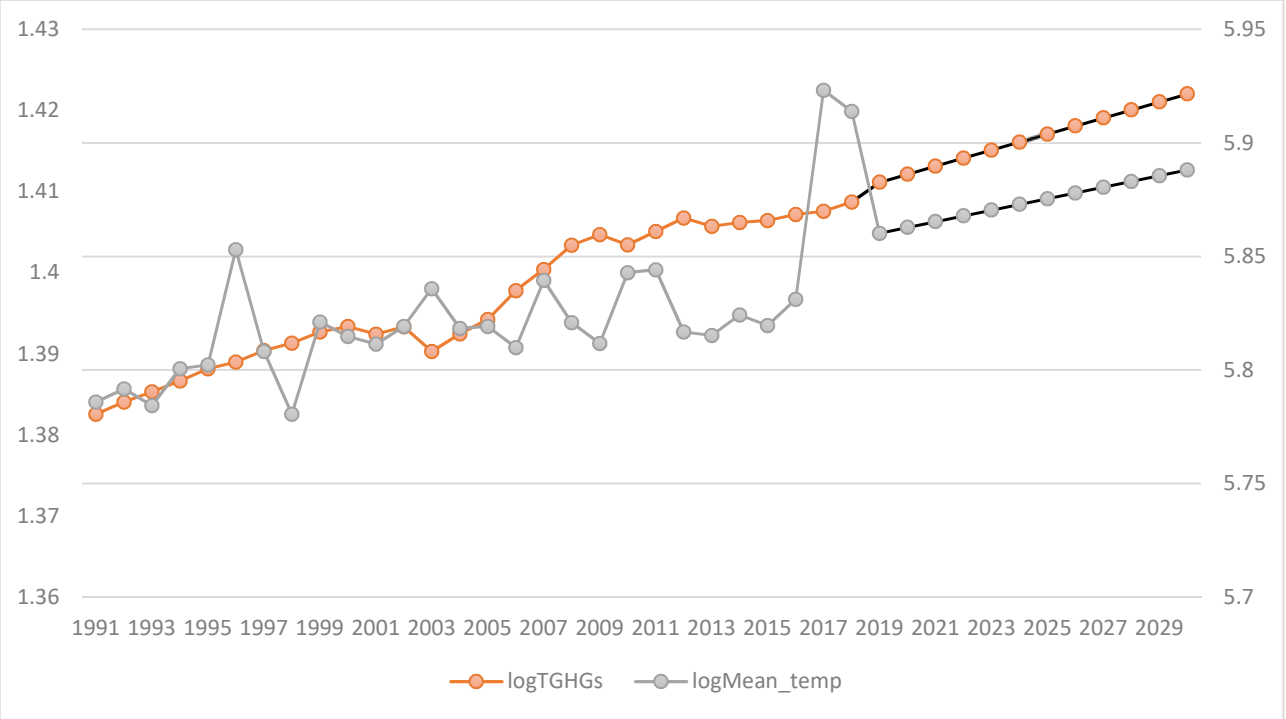
3.2 GHG emission and annual mean temperature change

The examination of greenhouse gas (GHG) emissions and annual mean temperature change unveiled an upward trend for both factors from 1990 to 2018, as illustrated in Graph 2. Although some fluctuations were noted in the annual mean temperature trend line for India, an overarching shift towards higher annual mean temperatures was apparent, suggesting a general increase.



Graph 2: Total GHG emission & Annual Mean Temperature Change in India

Graph 2.1 illustrates the observed and estimated values for GHG emissions and annual mean temperature, which were predicted through the model developed by the time series analysis of logarithmically transformed values for total GHG emissions and annual mean temperature.



Graph 2.1: Observed and Estimated Values of log(TGHGs) & log(Mean_temp)

Table 2: Parameter Estimates for log (annual mean temperature)

Model Fit Measures

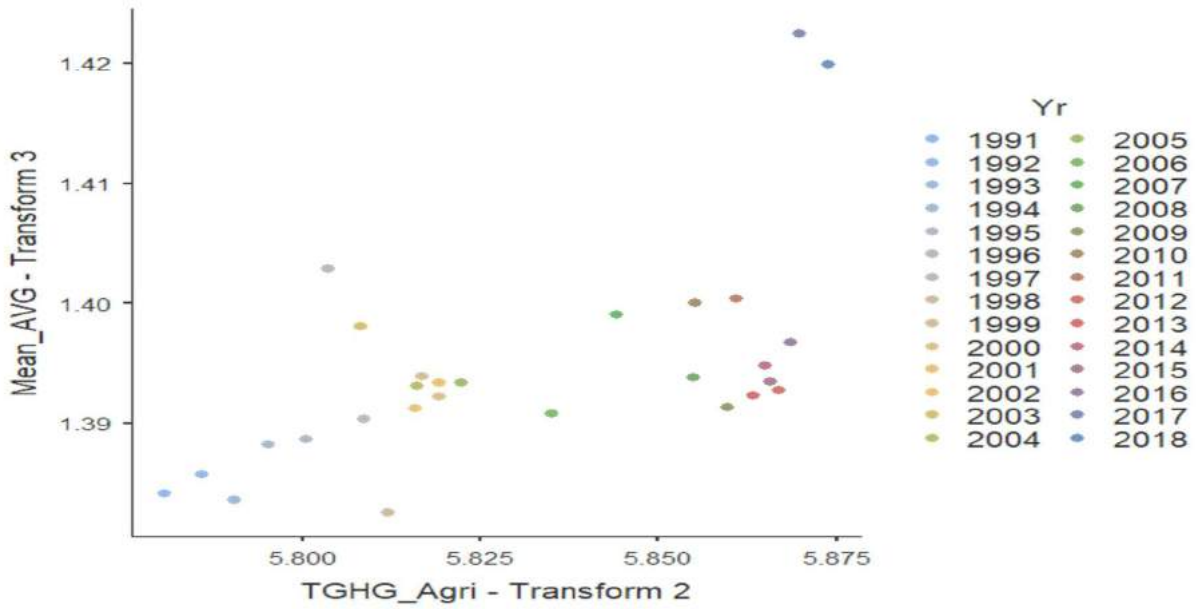
Model	R	R^2
1	0.585	0.342

Model Coefficients - Mean_AVG - Transform 3

Predictor	Estimate	SE	t	p
Intercept	0.366	0.2799	1.31	0.202
TGHG_Agri - Transform 2	0.176	0.0480	3.67	0.001

Table 2, which estimates the model coefficients for annual mean temperature, showed a positive coefficient for total GHG emissions from agriculture. This model explained 99.2% of the variance in the dependent variable *(logMean_AVG)*, indicating a strong relationship between GHG emissions from agriculture and their contribution to temperature change in India.

Graph 2.2 illustrates a scatterplot diagram of the estimator with the actual values obtained for the given period. It can be observed that the estimator responds with 95% accuracy to the original data.



Graph 2.2: Scatterplot diagram of Actual and Predicted Values of Annual Mean Temperature from 1990 to 2018

Thus, it can be inferred that there is a direct relationship between GHG emissions from agriculture and their impact on temperature change in India, with agriculture playing a significant role in influencing the observed changes in temperature.

IV. CONCLUSION

From the study, the following conclusions were drawn:

- Despite agriculture in India emitting a larger overall amount of methane, the rate of nitrous oxide emission was significantly higher.
- Enteric fermentation emerged as the primary contributor to methane emissions, aligning with previous studies such as Singhal and Mohini (2002). Additionally, nitrous oxide emissions from agricultural soil were identified as a major contributor to GHG emissions, corroborating findings by Bhatia, Pathak & Aggarwal (2004).
- A direct relationship between overall GHG emissions and the annual mean temperature in India was observed. With an increase in total GHG emissions, the average annual mean temperature also rose, with a coefficient factor of 0.176. The study revealed that GHG emissions from agriculture directly impacted climate change in India between 1990 and 2020. Similar investigations were conducted by Moiceanu and Dinca (2021) in Romania.
- According to the national greenhouse gas (GHG) inventory, the agriculture sector in India currently emits 408 million metric tons (MMT) of CO2 equivalent. However, projections from a model suggest that GHG emissions from agricultural activities, primarily from methane and nitrous oxide emissions, will increase significantly by 2030. These emissions are estimated to range between 695.87 to 818.73 million metric tons of CO2 equivalent (MMTCDE) by 2030.

Additionally, projections indicate a notable increase in the annual mean temperature in India. Specifically, the temperature is expected to rise by approximately 1.65 ± 0.58 ^{0}C from 1990 to 2030. This temperature rise could have significant implications for various aspects of the environment, agriculture, and human activities in India.

These conclusions underscore the significant role of agricultural activities in contributing to GHG emissions and their subsequent impact on climate change, highlighting the need for effective mitigation strategies within the agricultural sector.

Scope of Study:

To assess the impact of suggested measures on greenhouse gas (GHG) emissions, a comparative experiment could be designed. It will involve two sites, where one will follow conventional agricultural practices, while the other will be untouched by modern farming technologies. After implementing silage feeding for livestock and direct seeded rice practices, the emission of methane and nitrous oxide from both sites will be monitored. This will enable us to examine the effects of these practices in varying conditions and their correlation with soil emissions.

REFERENCE

1. NDSAP (2021), (All India Seasonal and Annual Temperature Series),
2. (URL:https://data.gov.in/catalog/all-india-seasonal-and-annual-temperature-series)OECD (2020), (Agri-Environmental other indicators),(https://doi.org/10.1787/20752288)
3. PIB(2023),(Contribution of Agricultural Sector in GDP) (URL: https://www.pib.gov.in/Press Release Page.aspx?PRID=1909213)

BIBLIOGRAPHY

1. Aggarwal P.K. (2008). Global climate change and Indian agriculture: impacts, adaptation, and mitigation. Indian Journal of Agricultural Sciences. 78 (10). 3-13.
2. Balasubramanian, Muniyandi & Birundha, V. (2012). Climate Change and its Impact on India. Journal of Environmental Sciences. (VI), 32-46.
3. Bhatia A., Pathak H. and Aggarwal P.K. (2004). Inventory of methane and nitrous oxide emissions from agricultural soils of India and their global warming potential. CURRENT SCIENCE, Vol. (8)7, 3. 317-324
4. Chataut G., Bhatta B., Joshi D., Subedi K., & Kafle K., (2023). Greenhouse gases emission from agricultural soil: A review. Journal of Agriculture and Food Research, (11). ISSN 2666-1543. DOI: 10.1016/j.jafr.2023.100533.
5. Climate Change 2022 - Mitigation of Climate Change Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, pp. 3 – 48. DOI: 10.1017/9781009157926.001
6. Coskun, D., Britto, D., Shi, W. et al. (2017). Nitrogen transformations in modern agriculture and the role of biological nitrification inhibition. Nature Plants (3): 17074. DOI: 10.1038/nplants.2017.74
7. Deshpande M.V., Kumar N., Pillai D., Krishna V. V., Jain M. (2023). Greenhouse gas emissions from agricultural residue burning have increased by 75 % since 2011 across India. Science of The Total Environment. 904. 1-14. DOI: 10.1016/j.scitotenv.2023.166944.
8. Dutta A., Patra A., Hazra K.K., Nath C.P., Kumar N. and Rakshit A. (2022). A state of the art review in crop residue burning in India: previous knowledge, present circumstances, and future strategies. Environmental Challenges, 8:100581. DOI: 10.1016/j.envc.2022.100581
9. Gu J. and Yang J. (2022) Nitrogen (N) transformation in paddy rice field: Its effect on N uptake and relation to improved N management. Crop and Environment. Vol (1), Issue 1. 7-14, ISSN 2773- 126X. DOI: 10.1016/j.crope.2022.03.003
10. Gujarati, Damodar N.; Porter, Dawn C. (2009). How to Measure Elasticity: The Log-Linear Model. Basic Econometrics. New York: McGraw-Hill/Irwin. pp. 159–162. ISBN 978-0-07-337577-9.

11. IPCC (2007). Climate Change 2007: The Physical Science Basis. Summary for Policymakers. Inter Governmental Panel on Climate Change.
12. Krishna V. V. and Mkondiwa M. (2023). Economics of Crop Residue Management. Annual Review of Resource Economics 2023.15:1, 19-39
13. Lal M., Singh K.K., Rathore L.S., Srinivasan G., and Saseendran S.A. Vulnerability of rice and wheat yields in NW India to future changes in climate. Agricultural and Forest Meteorology. Volume (89)-Issue 2.101-114. ISSN 0168-1923. DOI: 10.1016/S0168-1923(97)00064-6.
14. Lynch J, Cain M, Frame D and Pierrehumbert R (2021) Agriculture's Contribution to Climate Change and Role in Mitigation is Distinct from Predominantly Fossil CO2-Emitting Sectors. Frontiers Sustainability Food System 4:518039. 1-9 DOI: 10.3389/fsufs.2020.518039
15. Moiceanu G . and D i n c a M . N . (2021). Climate Change - Greenhouse G a s Emissions A n a l y s i s a n d Forecasting R Romania . Sustainability , 13 (21) . DO I: 1 0 . 3 3 9 0 / s u 1 3 2 1 1 2 1 8 6 .
16. O z d e m i r M . , Pehlivan S . & Melikoglu M . (2024)) . Estimation of greenhouse g a s e m i s s i o n s u s i n g l i n e a r a n d l o g a r i t h m i c m o d e l s : A s c e n a r i o - b a s e d a p p r o a c h f o r T u r k i y e ' s 2 0 3 0 v i s i o n . Energy Nexus. 1 3 . I S S N 2 7 7 2 - 4 2 7 1 . D O I : 1 0 . 1 0 1 6 / j . n e x u s . 2 0 2 3 . 1 0 0 2 6 4 .
17. P a t h a k , H . , B h a t i a , A . a n d J a i n , N . (2 0 1 4) G r e e n h o u s e G a s m i s s i o n f r o m I n d i a n Agriculture: Trends, Mitigation, and Policy Needs. Indian Agricultural Research Institute, New Delhi - 110012, p39.
18. Sah D. & Devakumar A.S. (2018) The carbon footprint of agricultural crop cultivation in India. Carbon Management. 9:3. 213-225, DOI: 10.1080/17583004.2018.1457908
19. Singhal K.K., Mohini M. Project report, Dairy Cattle Nutrition Division, National Dairy Research Institute; Karnal, India: 2002. Uncertainty Reduction in Methane and Nitrous Oxide Gases Emission from Livestock in India; p. 62.
20. Vetter SH, Sapkota TB, Hillier J, Stirling CM, Macdiarmid JI, Aleksandrowicz L, Green R, Joy EJ, Dangour AD, Smith P. (2017) Greenhouse gas emissions from agricultural food production to supply Indian diets: Implications for climate change mitigation. Agriculture Ecosystem Environment ;(237)234-241. DOI: 10.1016/j.agee.2016.12.024.
21. Zhong X., Zhou X., Fei J., Huang Y., Wang G., Kang X., Hu W., Zhang H., Rong X. and Peng J. (2021). Reducing ammonia volatilization and increasing nitrogen use efficiency in machine transplanted rice with side-deep fertilization in a double-cropping rice system in Southern China. Agriculture, Ecosystems & Environment. Volume 306:107183. ISSN 0167-8809. DOI: 10.1016/j.agee.2020.107183.

References

1. The jamovi project (2023). jamovi. (Version 2.4) [Computer Software]. Retrieved from https://www.jamovi.org.
2. R Core Team (2022). R: A Language and environment for statistical computing. (Version 4.1) [Computer software]. Retrieved from https://cran.r-project.org. (R packages retrieved from CRAN snapshot 2023-04-07).
3. Fox, J., & Weisberg, S. (2020). car: Companion to Applied Regression. [R package]. Retrieved from https://cran.r-project.org/package=car.
4. Kim, S. (2015). ppcor: Partial and Semi-Partial (Part) Correlation. [R package]. Retrieved from https://cran.r-project.org/package=ppcor.
5. Gallucci, M. (2019). GAMLj: General analyses for linear models. [jamovi module]. Retrieved from https://gamlj.github.io/.

Source codes:

```
jmv::linReg(
    data = data,
    dep = Mean_AVG - Transform 3,
    covs = TGHG_Agri - Transform 2,
    blocks = list(
        list(
            "TGHG_Agri - Transform 2")),
    refLevels = list())

jmv::linReg(
    data = data,
    dep = TGHG_Agri - Transform 2,
    covs = vars(TCH4_Agri - Transform 3, TN2O_Agri - Transform 3 (2)),
    blocks = list(
        list(
            "TCH4_Agri - Transform 3",
            "TN2O_Agri - Transform 3 (2)")),
    refLevels = list(),
    r2Adj = TRUE,
    ci = TRUE,
    stdEst = TRUE,
    ciStdEst = TRUE,
    norm = TRUE,
    resPlots = TRUE,
    durbin = TRUE)
```

```
jmv::corrPart(
    data = data,
    vars = vars(Mean_AVG, TGHG_Agri),
    controls = vars(),
    sig = FALSE)

gamlj::gamljGzlm(
    formula = `Mean_AVG - Transform 3` ~ `TGHG_Agri - Transform 2`,
    data = data,
    showParamsCI = TRUE,
    showExpbCI = FALSE,
    eDesc = TRUE,
    custom_family = "poisson")


jmv::linReg(
    data = data,
    dep = TGHG_Agri - Transform 2,
    covs = vars(TCH4_Agri - Transform 3, TN2O_Agri - Transform 3 (2)),
    blocks = list(
        list(
            "TCH4_Agri - Transform 3",
            "TN2O_Agri - Transform 3 (2)")),
    refLevels = list(),
    r2Adj = TRUE,
    ci = TRUE,
    stdEst = TRUE,
    ciStdEst = TRUE,
    norm = TRUE,
    resPlots = TRUE,
    durbin = TRUE)

scatr::scat(
    data = data,
    x = Mean_AVG - Transform 3,
    y = Predicted values,
    group = Yr)
```

The Fifth Discussion on the Origin of the Universe

Samo Liu

ABSTRACT

Humans are an amalgamation of matter and spirit (Liu, 2024.8a). They are a combination of the three-dimensional universe and the zero-dimensional universe (Liu, 2024.5). Humans have two origins: the origin of the spirit and the origin of the body (Liu, "人类本原考"). The return to the origin of the spirit is called the death of the human body; the return to the origin of the body is called the death of the flesh. Humans are computer-like materials created by the universe, and the human spirit is software installed by the universe. The existence and survival of humans are determined by the universe and by themselves.

Keywords: origin of the universe, information, energy, matter, spirit, body, computer and software, software programming.

Classification: LCC Code: QB981

Language: English

Great Britain Journals Press

LJP Copyright ID: 925693
Print ISSN: 2631-8490
Online ISSN: 2631-8504

London Journal of Research in Science: Natural and Formal

Volume 24 | Issue 8 | Compilation 1.0

The Fifth Discussion on the Origin of the Universe

Samo Liu

ABSTRACT

Humans are an amalgamation of matter and spirit (Liu, 2024.8a). They are a combination of the three-dimensional universe and the zero-dimensional universe (Liu, 2024.5). Humans have two origins: the origin of the spirit and the origin of the body (Liu, "人类本原考"). The return to the origin of the spirit is called the death of the human body; the return to the origin of the body is called the death of the flesh. Humans are computer-like materials created by the universe, and the human spirit is software installed by the universe. The existence and survival of humans are determined by the universe and by themselves.

Keywords: origin of the universe, information, energy, matter, spirit, body, computer and software, software programming.

Author: Ph.D., Senior Engineer China Occupational Safety and Health Association, Beijing.

I. INTRODUCTION: THE HUMAN SPIRIT IS SOFTWARE INSTALLED BY THE UNIVERSE

The spirit(心灵), commonly referred to as the soul(灵魂), possesses a mystical quality. This mystique dissipated after humanity invented the computer. Computers have chips, similar to the human brain. The operation of computer chips is directed by software programs. These software programs, which are the essence of a computer, are designed and installed by humans; thus, a computer's spirit（心灵)is akin to the human spirit (Liu, "宇宙本原考"). So, who created humans? Humans have brains and software programs too. Who installed and endowed humans with these software programs? Humans were created by the cosmic mother, and the human spirit's（心灵)software program was installed and endowed by the cosmic deity, which is emptiness itself. Both the universe's and humanity's spirits(心灵） are characterized by this emptiness. They are unified and harmonious. ("心经", Referencing Zhuangzi's "庄子," Wang Yangming's "传习录," Leibniz's "Monadology," and Liu's "宇宙本原考," 2024.8a)

Therefore, the philosopher Marcus Aurelius stated: "Human = Body + Soul" (Marcus Aurelius, "The Meditations").

Humans must learn to communicate with the spirit of the cosmic heart, and while they have learned to create science, they must also learn to achieve balance and follow the middle way (Liu，2024, 8a). The cosmological ideas left by our ancestors are the thoughts of scientific philosophy. The human spirit is interconnected with the universe's spirit. Humanity must learn from the cosmos. Chapter 77 of the "Tao Te Ching" states: "天之道，损有余而补不足；人之道则不然，损不足以奉有余." (Liu, "道德经.宇宙本原的宣言").

It means：The principle of space天之道 is balance, the principle of matter 人之道is imbalance.

The human spirit is software installed by the cosmic deity in humans. This software is of an empty nature, a software of nothingness, without dimension. Yet, it is a great spirit software, possessing the emptiness and the grand characteristics described in Chapter 77 of the "Tao Te Ching," which speaks of

"天之道，损有余而补不足"—a principle of balance and greatness. Thermal energy may be the principle of creation energy and matter, a balanced and powerful force (Liu, 2024.8b). It embodies fairness, balance, love, democracy, unity, and more. However, humans are material beings. Within the human spirit, the cosmic deity has also installed a contradictory software, that of material nature, reflecting material philosophy. It embodies the thought described in Chapter 77 of the "Tao Te Ching" as "损不足以奉有余," a domineering way of thinking, generating confrontation (Liu, "道德经.宇宙本原的宣言"). It inclines towards self, desire, freedom, rights, etc. This contradiction is both intriguing and complex. The universe is full of contradictions, and human existence is a constant process of creating, identifying, and resolving these contradictions, living amid the troubles and joys of discovering and resolving contradictions, until death.

Material philosophy and the philosophy of cosmic origin already exist within the human spirit; these represent two different philosophical considerations, yet they converge into a unified philosophical thought. Humanity itself is a combination of three-dimensional and zero-dimensional, a fusion of matter and emptiness. The material nature of humans and other material entities are completely consistent, and the human spirit, the spirit of the cosmic deity, and the spirit of all things are unified (Liu, "人类本原考"). Due to the different material structures, like other cellular materials, the human spirit has two levels of perception: explicit perception and implicit perception (Liu, 宇宙本原考," "万物生存考"). Thus, when a person dies and loses sensation, they still possess perception; human life exists in two phases. Therefore, the existence and survival of humanity require an analysis of the causes and factors of human existence, as well as the conditions of these causes and factors, referred to here as the issue of the power of thought. Human thought power directs how humans live and survive (Liu, "宇宙本原考," 2024.8a). Human existence represents the existence of the universe (Liu, 2024.8b).

Chapter 52 of the "Tao Te Ching" states: "开其兑，济其事，终身不救." It means that people live in contradiction until they die. (Liu, "Tao Te Ching:宇宙本原的宣言"). The "Tao Te Ching" is elusive in translation, suggesting that the concepts of the origin of the universe are best directly comprehended through classical Chinese.

The philosophy of the origin of the universe allows humans to perceive a comprehensive view of the universe, as well as a comprehensive understanding of humanity itself. Recognizing these aspects means embracing the great characteristics of space, analyzing the causes and factors of human existence, as well as their conditions. This may represent the fundamental ideas guiding human existence and survival. This is the philosophy of the origin of the universe—a profound philosophical of scientific thought that can guide the development of science and direct human survival.

II. THE ORIGIN OF THE UNIVERSE AND SCIENCE

Having written six books and published several articles, I summarize here: Material philosophy is based on the human contemplation that the universe is material. It uses the rationale, logic, contradictions, and dialectics of material existence to explore the issues and contradictions within the universe. All existence is based on materialistic thought. Thus, modern physics, relativity, and quantum mechanics are confined to this kind of thinking, leading to artificial contradictions. (Liu, 2024.5, 2024.8)

The philosophy of the cosmic origin left by our ancestors is based on spatial thinking. It acknowledges that the universe is both material and non-material, existing as a collective of emptiness and fullness, non-existence and existence. The philosophy of the origin of the universe is a philosophical thought in science. This scientific philosophy can resolve the contradictions in modern physics by delving deeper, and it can also address the contradictions in human survival and thought, making it a profound

philosophical or scientific concept. To contemplate the origin of the universe, one must start from the zero-dimensional space, the zero-dimensional universe, considering the creation, inclusion, and existence of the great cosmic deity, and ponder the conditions of matter, energy, and information after creation, along with existence, motion, and change. This contemplation can address the existing problems and contradictions in modern physics and science, and furthermore, it can be used to think about human survival and existence. The universe is alive; all existence is alive and represents a thermodynamic equilibrium. (Liu, "宇宙本原考," 2024.7, 2024.8b)

The double-edged sword of science stems from human materialistic philosophical thought, which is not to blame, as the nature of material existence is inherently so. However, like the universe and all things within it, science must live and have a soul; with a soul, science becomes a beacon of light (Liu, 2024.7). When the scientific philosophical thought of the cosmic origin guides human thinking, we should reevaluate our understanding of time and space (Liu, 2024.5). When scientific philosophical thought guides us, we must rethink the existence within the universe (Liu, 2024.8). When employing the scientific philosophical thought of cosmic origin to understand human survival and existence, we should start by analyzing the causes and factors affecting human life and existence, to equip our thoughts (2024.8a). When we use the scientific philosophical thought of cosmic origin to understand science and modern physics, we can realize that the emergence of scientists is not overly complex (2024.x). Scientists should heed the words of the "Tao Te Ching": "Reach the ultimate emptiness, hold on to the truest tranquility致虚极，守静笃"; comprehend the phrase from the "Heart Sutra": "Practice the profound Prajñāpāramitā行深般若波罗蜜多"; and embrace the Chinese idiom "Be focused聚精会神" (Liu, "2024.8b" "Zero-Dimensional Space: 绝对空间考").

Therefore, the scientific philosophical thought of cosmic origin should become the dialectic and methodology of science, guiding it to recognize the soul in all existence, thus endowing science itself with a soul (Liu, 2024.7). This approach positions the philosophy of cosmic origin as the guiding principle in scientific thought and methodology.

2.1 Cosmic Origin and Human Spirit（心灵）

The human spirit is zero-dimensional, an existence of emptiness, endowed with both divinity and demonic traits. This is an unknown realm and category. According to the philosophical thoughts in the "Heart Sutra心经," "传习录," and "Monadology," the human spirit is unified with the cosmic spirit; they are congruent. Just as humans have created computers and installed software programs, the computer's software and the human spirit are interconnected and one. The programs installed by humans in computers are rigid programs solidified with current knowledge and information. Conversely, the universe, in creating humans, has installed in them a software that is alive, contradictory, and unknown. Upgrades to computer software must be performed by humans, while upgrades to human software require the acceptance of contradictory information and reflection.

Thus, the human spirit, combined with the human body, forms the universe's most precise instrument. The condition is that in a quiet environment, by reaching the ultimate emptiness, maintaining deep tranquility, and engaging in profound Prajñāpāramitā, one can enter a state of deep, serene, quiet, and meditative thought. It is possible that our ancestors, in such states, possessed a divine spirit, thereby generating divine perceptions and thoughts (Liu, "绝对空间考").

However, in the mundane, noisy material world, humans become the least precise instruments of the universe. For example, humans have subjective consciousness and can create information, even intentionally creating incorrect information. In contexts like informational warfare during conflicts or philosophical debates aimed at winning, the goal is to create incorrect or contradictory information to achieve victory. The human spirit can also intentionally amplify information, such as love and hate,

right and wrong, etc. The information humans normally see and feel, like the proverbial "blind men touching an elephant," varies depending on the perspective. Hence, the information created by humans has the dual nature of waves and particles, entanglement, and unpredictability found in quantum mechanics. Conversely, particles and quarks in quantum mechanics share great similarities with the human spirit and its information. The difference lies in one being with subjective consciousness and the other being a state of consciousness without subjectivity. The human spirit possesses a natural resistance to nature, or rather, human subjective consciousness inherently magnifies natural information (Liu, 2024.8a).

The thoughts and actions generated by the human spirit are the results of subjective consciousness under the directive of established coordinates in human thought. Science must engage in studying the human spirit, or it risks devolving into mysticism. If science does not address this issue, it will in turn affect human science and scientific thought.Such is the contradiction between relativity and quantum mechanics (Liu, 2024.8)。 In the scientific community, we often see statements such as one scientist overturning another's theory to establish a new one, which is an inappropriate expression of scientific information. It must be stated that even if science proves the existence of zero-dimensional space or the philosophy of cosmic origin, it should not be said that the zero-dimensional universe overturns the three-dimensional universe, or that cosmic origin philosophy overturns material philosophy, as these are non-scientific expressions of information. Humanity is far from truly understanding cosmic truths, and even when some correct information is discovered, it is merely part of the unified information of the universe.Only partial truth.

The deepest reflection of the scientific philosophical thought of cosmic origin is our ancestors' teaching, pondering human survival and existence. How should humanity survive and exist? How can we exist and survive pleasurably? These are key questions. Why do we have material philosophy? Why have we created atomic bombs and robots? Discovered DNA? Because humans like these things. Humans are material and thus enjoy material desires, material philosophy, and material science. Discovering mechanics once led to an industrial revolution enhancing human material enjoyment. Creating robots was to aid human survival and pleasurable existence. Discovering DNA was to explore the temporal aspects of human survival.

Yet, do we truly like these things we have created? We created nuclear weapons, but we fear they might turn our Earth into Jupiter, Mars, or the Sun. We created robots, yet we fear the threat they pose to humanity. We discovered DNA, which can identify and alter the factors of human existence, and we hope it can extend individual human lifespans. But can it really? Do we truly understand the principle? Might we turn the discovery of DNA into a weapon of human warfare? These could all potentially threaten human survival and existence.

2.3 Right and Wrong

The terms "right" and "wrong" are also human creations. Within the cosmic origin, there is no concept of right or wrong; it is only humans who make judgments and definitions about what is supposedly correct or incorrect.

The human spirit is a software, programmed through knowledge and information, meaning we humans are programming our own spiritual software. Through knowledge and information, this becomes the coordinate system of our spirit. Once you grasp this information, it becomes the standard of your spiritual coordinate system, and you begin to judge what is right or wrong. Particularly, it is used to judge whether others are right or wrong. Consider the debates between idealism and materialism, market economies and planned economies, or the correctness of different religious views, traditional Chinese medicine versus Western medicine—who is right and who is wrong? These kinds of judgments

and statements, including our everyday assertions that what another person knows is erroneous while our own knowledge is the truth and correct. Think about it, who causes the anger and confrontations we frequently experience in daily life? It's caused by the natural and cosmic reasons embedded in the programming of the human spirit's software. The human spirit is merely nature, and natural information directs our actions. Is the knowledge and information we possess truly correct? It is all human-made (Liu, "宇宙本原考," "人类本原考"). If humans ceased to exist, would the universe care about these human-made entities? Human existence makes these information entities exist; without humans, they would cease to exist. Only humans care about this man-made information.

This might seem somewhat humorous, yet it is reality. Science and the philosophy of science must confront these realities, understand the existence of these realities, and comprehend the causes and factors of these realities. This is what leads to human confrontations. This is both a phenomenon determined by human subjective consciousness and a natural phenomenon, a phenomenon produced by the cosmic cause and the cosmic spirit in humans. Scientific understanding of this phenomenon is essential, recognizing the causes and factors brought about by this human-existence-related information.

Therefore, understanding the human spirit and the cosmic spirit necessitates scientific involvement. We must employ philosophical science to analyze and judge, learning to use dialectical methods (Liu, 2024.8a).

2.4 On Extraterrestrials

The individual death of a human is not to be feared, as it is a natural law of human existence. Likewise, the collective existence and non-existence of humanity is not something to dread. Since humans were created by the universe, our current wave of human existence is likely neither the first nor the last (Liu, "Classical Study on the Origin of the Universe"). If this wave of humanity were to disappear, it would be a great pity and loss, given how difficult it has been for us to evolve to this point. After perhaps more than four billion years (kalpa, 劫), the universe might create another wave.

The "Diamond Sutra" raises the question of the “度” of humanity. Can our current wave of people achieve “度”? Both Daoist and Buddhist philosophies suggest it is possible (Liu, "宇宙本原经典考"). However, to grasp and understand the thoughts of cosmic origin, humans must learn to control their own spirits.

In the vast expanse of the universe and the infinite river of time, a gap of one hundred million years seems trivial. Our scientific fantasies have depicted extraterrestrials, and it is reasonable to deduce their existence (Liu, "万物生存考"). The universe's space is infinite, and so are the entities within it. We cannot find extraterrestrials because the speed of light and electromagnetic waves are far too slow in the cosmic scale, making the light-year too small a measure for the vast distances of the universe. Using materialistic, energetic, and informational methods, humans cannot find extraterrestrials. If they have existed for a hundred million years more than us and still exist, they are essentially what humanity might look like a hundred million years from now (Liu, "人类本原考," "万物生存考").

Our current humans are like the gods of humans from ten thousand years ago. Even a thousand years ago, the gods imagined by humans likely could not match the level of material, energy, and information we possess today. A thousand years from now, ten thousand years later, our descendants could become like gods to us today. Thus, intelligent beings similar to humans likely exist in the universe, perhaps having become like gods, having already mastered the cosmic spatial thoughts. They do not concern themselves with human affairs. If there is any contact, it would be a connection between the human

spirit and the cosmic spirit, not through light waves or electromagnetic waves, or the kind of informational contact we currently use.

We should not overly anthropomorphize extraterrestrials with literary creations or narratives of cosmic wars. Such portrayals are a degradation and defamation of extraterrestrials through materialistic thinking. Aliens with the capabilities of cosmic deities would use a non-materialistic, spiritual approach to merely remind us of our existence. "绝对空间考" suggests that our great ancestors may have had such experiences, recorded in some great classics (details omitted). We have not taken these seriously, dismissing them as mythological. One can imagine that if extraterrestrials cannot overcome their own spirits and the impacts of material philosophy, they too might annihilate themselves.

III. COSMIC ORIGIN AND PHILOSOPHY

The author is not a professional philosopher but has read various philosophical texts (2024,5). From these readings, it is clear that philosophy has many definitions. In essence, philosophy is the contemplation of human nature endowed by the universe (Liu, "宇宙本原考").

Everyone is a philosopher, a thinker, who reflects, judges, and acts within the realm of existence and survival, until death. Philosophy should become as accessible as possible. Otherwise, people might fear philosophy. Philosophy is human thought, the discovery and resolution of problems and contradictions. It describes the causal relationships of existence, the logical relations between phenomena and essence (Hegel, "The Logic of Hegel"), focusing on how to resolve contradictions. Philosophy has coined a significant term called dialectics, which embodies the ideas of balance and the middle way. When philosophy evolves from these contradictions to become purely materialistic, it discovers the universe's three great philosophical laws: the law of negation of negation, the law of the unity of opposites, and the law of the transformation of quantity into quality. These three laws are discoveries of material philosophy and are also laws of cosmic origin philosophy. The law of the transformation of quantity into quality can be converted into the law of mass-energy equivalence.

Philosophical thought forms the human spirit's software. It is powerful because it solidifies human thoughts. Metaphysics（形而上学）, as described in Buddhist philosophy as the phenomenon of "寿者相" (Liu, "宇宙本原经典考"), is something everyone possesses. The primary content of philosophy is the discussion of cosmic origin. Before the advent of relativity and quantum mechanics, humanity's scientific knowledge was insufficient to contemplate the issues of cosmic origin; thinking was merely arguing. Modern physics has resolved this significant information gap, allowing our material philosophy to transition towards cosmic origin philosophical thought.

Metaphysics. It is unscientific and unjust to call Aristotle's Metaphysics "Metaphysics" "形而上学" or any other definition in the field of philosophy. The author believes that Aristotle's thought is dialectic.（Liu, "宇宙本原考"）This is not my profession, not to open a discussion.

We must use scientific philosophical thought to consider the issues of material philosophy, a necessary stage in human experience. However, if we do not transcend this stage, material philosophy will induce confrontations in the human spirit. Such confrontations, especially once humanity acquires the material capabilities of the cosmic deity, can lead to self-confrontation and self-annihilation. Particularly after grasping the information provided by modern physics, we should promptly transition from material philosophy to cosmic origin philosophy. This is not only a practical issue but also a reminder and teaching from our ancestors, likely concerning a significant problem related to human survival and existence.

IV. COSMIC ORIGIN AND RELIGION

Religion serves as a beacon for the human spirit, a conduit for the dissemination of cosmic origin science and philosophical thought, and a form of belief within the human spirit. Humans, including scientists, should refrain from casually critiquing religion.

Following Aristotle, religion broadly proliferated throughout human history, though it too was influenced by material philosophy and science. However, religion has been a carrier of cosmic origin thought. Due to the insufficiency of scientific information, it has been unable to fully explain that great existence. Nonetheless, the ideas of cosmic origin have been preserved and disseminated through religion, and this great manifestation of the human spirit deserves respect. This is a part of human culture and spirituality.

V. ON THE SAVIOR

If there truly exists a god in the universe who says, "You must believe in me, you must give me money, and then I can bless you," what distinguishes such a god from corrupt human officials? Yet, humans have designed such personified deities. Similarly, if there is a person in reality who claims to be a savior and speaks in such terms, would you believe he is a savior?

Different groups of people have conceptualized a god in their minds, each hoping for divine protection. If these groups go to war, whom would God protect? Historical evidence suggests that God does not intervene in such matters. What might intervene are the causes of demons because a god conceived by material philosophy thought is materialistically desirous and constitutes a desecration of what a god should represent. God does not wish for humans to harbor excessive desires, engage in fratricidal conflicts, or wage wars. In other words, the cosmic god would not protect hostile, excessively selfish thoughts or actions among humans.

Each individual is their own savior. Using the principles of dialectics and scientific philosophy, one should protect oneself, prioritize personal safety, and focus on the joy of one's spirit. Emphasize a scientific approach to safe living and existence, understanding the causes and factors that affect one's life. Identify contradictions and resolve them. Use scientific philosophy to safely save oneself; use scientific philosophy to aid others; use scientific philosophy to protect the environment and existence; respect heaven, earth, and humanity (Liu, 2024.8a).

The same principles apply at the level of human groups.

VI. COSMIC ORIGIN AND HUMAN SURVIVAL AND EXISTENCE

The transition from material philosophy to the philosophy of cosmic origin might be a challenging and prolonged process. It would be beneficial if science could lead the way in this transition.

Material philosophy is a stubborn existence. The approach of considering the universe purely as material has dominated for over 2000 years and has significantly influenced human thought. Even with the discoveries of quantum mechanics and relativity, these are often seen as paradoxical existences, artificial contradictions created by traditional perspectives (Liu, 2024.8), These are the achievements of material philosophy.

Material philosophy is confrontational and authoritarian, reflecting the natural and human materialistic nature. Humans possess this nature because it is inherent to the material itself. However, what can be done? Human thought is a matter of personal decision-making. Everyone is a thinker.

VII. CONCLUSION

The "Diamond Sutra" states: The past mind cannot be obtained, the present mind cannot be obtained, and the future mind cannot be obtained. The existence of causes and the conditions they create, along with the mutual existence of contradictions, have profound implications for human survival and existence. After discussing so much, I still do not know what the outcome of human survival and existence will be in the future. Consider the missiles armed with nuclear weapons, each one growing wings, all facing the vastness of space, targeting every corner of the Earth; imagine the horrifying spectacle of nuclear weapons flying through the sky in the event of a world war.

There is no answer for now,Wait for science to participate and respond. As I write this, I cry. While crying, I begin to hum "The Internationale国际歌" in Chinese:

There has never been any savior, nor do we rely on emperors or gods. To create human happiness, we must rely entirely on ourselves.从来就没有任何救世主，也不靠神仙皇帝。要创造人类的幸福，全靠我们自己。

PRIMARY REFERENCES

1. Liu, S. (2017). Revelation and Reflection on Mankind by Modern Physics Part I. Open Journal of Philosophy, 7, 435-447. https://doi. org/10.4236/ojpp.2017.74023
2. Liu, S. (2019). Revelation and Reflection on Mankind by Modern Physics Part II Consideration on Multidimensional Universe. Open Journal of Philosophy, 9, 72-81. https:// doi.org/10.4236/ojpp.2019.92007.
3. Liu, S. (2020). Philosophical Reflection over the Origin of the Universe. Philosophy Study,March2020, Vol.10, No.3, 214-223。 DOI:10.17265/2159-5313/2020.03.005.
4. Liu, S. (2020). The Essence of the Universe and Humankind. Open Journal of Philosophy, 10,316-330. https://doi.org/10.4236/ojpp.2020.103021.
5. Liu, S. (2021). Cosmic Space in Zero- Dimension: A Discussion on Spatial Question According to the M-Theory, Open Journal of Philosophy> Vol.11 No.1, February 20, https://doi.org/10.4236/ojpp.2021.111012.
6. Liu, S. (2021) A Second Discussion on Cosmic Space in Zero Dimension—A Discussion on Spatial Questions According to Classical Physics. Journal of Applied Mathematics and Physics, Vol. 9, No.4,April 2021. doi: 10.4236/jamp.2021.94039.
7. Liu, S. (2021) The Third Discussion on Cosmic Space in Zero Dimension_A Discussion on Spatial Questions According to the Correspondence between Clarke and Leibniz. https://scirp.org/journal/paperinformation.aspx?paperid=109297.
8. Samo Liu, Revelations and Reflections on Humankind inspired by Modern Physics, Scientific Research Publishing 2021.
9. Philosophical Reflection on the Origin of the Universe, Science Herald, 2020, 23, Liu Hongjun p346.宇宙本原的哲学思考，科学导报，刘洪均。
10. Liu Hongjun Samo Liu, Reflection and research on the origin of the universe, 2020.9, Taipei Warmth Publishing,刘洪均 Samo Liu,《宇宙本原考》, 2020.9，台北旺文出版。
11. Liu Hongjun Samo Liu, Thinking and research on the Human origin, 2021.1, Taipei Warmth publishing,刘洪均 Samo Liu,《人类本原考》, 2021.1，台北旺文出版。
12. Liu Hongjun Samo Liu, 0-Dimensional Universe - Survival test of all things, 2021.5, Taipei Warmth Publishing.刘洪均 Samo Liu,《0 維的宇宙—萬物生存考》, 2021.5，台北旺文出版。
13. Liu Hongjun Samo Liu, 0-Dimensional Universe - Absolute space test, 2021.8, Taipei Warmth Publishing.刘洪均 Samo Liu,《0 維的宇宙—絕對空間考，2021.8，台北旺文出版。
14. Liu Hongjun Samo Liu, Tao Te Ching- Universal Declaration, 2021.12, Taipei Warmth Publishing..刘洪均 Samo Liu,《道德经-宇宙本原的宣言，台北旺文出版。

15. Liu Hongjun Samo Liu, Textual research of the universe original classic, Taipei Warmth Publishing.刘洪均 Samo Liu,《宇宙本原经典考》, 台北旺文出版。
16. Samo Liu, (2024.5) Exploring the Essence of the Universe. LJRHSS_Vol_24_Issue_5, Great Britain Journals Press.
17. Samo Liu, (2024.8) Second time Exploration the Essence of the Universe.LJRHSS_Vol_24_Issue_8, Great Britain Journals Press.
18. Samo Liu, (2024.8a) Third Discussion on the Origin of the Universe .LJRHSS_Vol_24_Issue_8 Great Britain Journals Press.
19. Samo Liu, (2024.7) A Letter to the Scientific Community .LJRS_Vol_24_Issue_7, Great Britain Journals Press.
20. Samo Liu, (2024.8b) The Fourth Discussion on the Origin of the Universe. LJRS_Vol_24_Issue_8, Great Britain Journals Press.

Other References

1. 老子(古代),《老子道德经注》, 王弼(三国。魏)注, 楼宇烈校释, 2019.12, 北京, 中华书局。
2. 释迦牟尼(古代), 星云大师总监修,《金刚经》恭让释译;《般若心经》程恭让东初释译;《空的哲理》道安著; 2019.9 , 北京, 东方出版社。龙树(古代), 星云大师总监修,《中论》韩廷杰释译;《大智度论》郑廷础释译;2019.9, 北京,东方出版社。
3. 元阳真人(古代,《周易》, 倪泰一编注, 1993.8, 西南大学出版社。
4. 朱熹(宋,《近思录》吕祖谦编, 中州古籍出版社, 2008.1.
5. 王阳明(明,《传习录》叶圣陶点校, 北京联合出版公司, 2018.1.
6. 文子(古代,《文子疏義》王利器编撰, 2019.6, 北京, 中华书局。
7. 列子(古代,《列子, 叶蓓卿译注, 2016.1, 北京, 中华书局。
8. 庄子(古代,《庄子, 孙通海译注, 2017.3, 北京, 中华书局。
9. 元阳真人(古代,《黄帝内经》, 陆周华编注, 1995.6, 西南师范大学出版社。
10. 周敦颐(宋,《周敦颐集》, 陈克明点校, 1990.5 , 北京, 中华书局。
11. 张载(宋,《张子全书》, 林乐昌编校, 2015.1 , 西安, 西北大学出版社。
12. Einstein, "Relativity - Special and General Theory" translated by Li Jingyi(李精益), Guangxi Science and Technology Press, 2020.12.广西科技出版社. Einstein, "Relativity" translated by Zhang Qianqi(张倩绮),Shaanxi Normal University Press, 2020.8.陕西师范大学出版社。
13. Aristotle, "Physics," translated by Zhang Zhuming(张竹明), October 2019, Beijing, Commercial Press。商务印书馆。
14. Aristotle, "Metaphysics," translated by Cheng Shihe(程诗和), 台海出版社, 2016.9.
15. Jeremy Webb, "Void", translated by Feng Yongyong (冯永勇)and Jin Taifeng(金泰峰), June 2018, Beijing, Commercial Press.北京商务印书馆。
16. Newton, "Mathematical Principles of Natural Philosophy," translated by Yu Liang(余亮), December 2017, Beijing, Beijing Institute of Technology Press.北京理工大学出版社。
17. Eugene Hecht, "Optics" translated by Qin Kecheng(秦克诚), Electronic Industry Press, 2019.6.电子工业出版社, 北京。
18. 俞允强,《物理宇宙学讲义》, 2002.11, 北京大学出版社。
19. Descartes, "Descartes' Geometry" translated by Yuan Xiangdong(袁向东), Peking University Press, 2019.5.北京大学出版社。
20. 13th CGPM. (1969). Comptes Rendus de la 13e CGPM(1967)., (p. p.103). Retrieved https://www.bipm.org/utils/common/pdf/CGPM/CG PM13.pdf#page=103.
21. Max Born,<The Restless Universe永不停息的宇宙>左安浦译, 2023.3, 北京联合出版公司。
22. Penrose彭罗斯,《通向实在之路》, 王文浩译, 湖南科学技术出版社, 2017.2。
23. 汪志诚,《热力学统计物理》2013.1, 高等教育出版社。
24. 克劳斯,《无中生有的宇宙》刘仲敬译, 江苏人民出版社, 2012.9

25. 朗盖尔,《物理学中的理论概念》向守平等译, 中国科学技术大学出版社, 2017.8
26. .黑格尔, Hegel,《The Logic of Hegel小逻辑》王义国译, 金城出版社, 2019.4。
27. .黑格尔,《黑格尔著作集.第十卷。精神哲学》杨祖陶译, 人民出版社, 2015.1。
28. .黑格尔,《黑格尔著作集.第九卷。自然哲学》刘哲译, 人民出版社, 2021.11。
29. 马克.奥勒留Marcus Aurelius,《沉思录The Meditations》梁实秋译, 天津人民出版社, 2017.9。

Dietary Habits and Nutritional Status of Hemodialysis Patients Seen in Some Hemodialysis Centers In Lomé

Essognim Bitori, Mamatchi Melila , Kouévi Satchi & Akomola Kossi Sabi

University of Lomé

ABSTRACT

Chronic renal failure (CKD) is kidney damage defined by a permanent decrease in glomerular filtration rate (GFR) characterized by biological signs present for more than three months. Protein-energy malnutrition (PED) in hemodialysis is also a factor of morbidity and mortality in patients with a prevalence ranging from 15 to 75% worldwide. However, the care of hemodialysis patients often does not include nutritional care. This study aims to contribute to the promotion of the health of patients with chronic renal failure on hemodialysis, by evaluating their nutritional status and identifying the incriminating diets in the deterioration of their health.

This is a cross-sectional, prospective and multicenter study, both descriptive and analytical over a period from May 05 to August 05, 2023. It focused on patients with chronic renal failure (CKD) treated with hemodialysis in the clinics "Unidial", "Martin Luther King" and the CMS "Maison du Hadj". Nutritional status was assessed using ISRNM 2008 criteria. Mantel Haenszel's Chi-square (χ^2) test was used to compare proportions, relative risk (RR) to look for associations between variables, and Pearson's coefficient for correlations. It was included 32 patients whose average age was 53.13 ± 14.37 years.

Keywords: chronic renal failure, hemodialysis, protein-energy malnutrition, dietary habits.

Classification: LCC Code: RC918.R4

Language: English

Great Britain Journals Press

LJP Copyright ID: 925694
Print ISSN: 2631-8490
Online ISSN: 2631-8504

London Journal of Research in Science: Natural and Formal

Volume 24 | Issue 8 | Compilation 1.0

Dietary Habits and Nutritional Status of Hemodialysis Patients Seen in Some Hemodialysis Centers In Lomé

Essognim Bitori [α], Mamatchi Melila [σ], Kouévi Satchi [ρ] &Akomola Kossi Sabi[Ꞷ]

ABSTRACT

Chronic renal failure (CKD) is kidney damage defined by a permanent decrease in glomerular filtration rate (GFR) characterized by biological signs present for more than three months. Protein-energy malnutrition (PED) in hemodialysis is also a factor of morbidity and mortality in patients with a prevalence ranging from 15 to 75% worldwide. However, the care of hemodialysis patients often does not include nutritional care. This study aims to contribute to the promotion of the health of patients with chronic renal failure on hemodialysis, by evaluating their nutritional status and identifying the incriminating diets in the deterioration of their health.

This is a cross-sectional, prospective and multicenter study, both descriptive and analytical over a period from May 05 to August 05, 2023. It focused on patients with chronic renal failure (CKD) treated with hemodialysis in the clinics "Unidial", "Martin Luther King" and the CMS "Maison du Hadj". Nutritional status was assessed using ISRNM 2008 criteria. Mantel Haenszel's Chi-square (χ^2) test was used to compare proportions, relative risk (RR) to look for associations between variables, and Pearson's coefficient for correlations. It was included 32 patients whose average age was 53.13 ± 14.37 years. The prevalence of protein-energy malnutrition varied from 53.13 to 65.63% depending on the indicator used. A correlation between various malnutrition indicators was found with two risk factors. First, insufficient protein intake: serum albumin was correlated with arm circumference (r = 0.93; p = 0.0001). Second, insufficient energy intake with a BMI strongly correlated with arm circumference (r = 0.96; p = 0.0000). Obesity was present in 6.25% of cases. Abdominal obesity was 43.75% in women and 25% in men.

Protein-energy malnutrition is therefore a frequent problem in hemodialysis. It is therefore necessary to improve the hemodialysis program with the integration of adequate and effective nutritional support through lifestyle and dietary interventions in chronic hemodialysis patients.

Keywords: chronic renal failure, hemodialysis, protein-energy malnutrition, dietary habits.

Author α: Food Hygiene and Quality Management, School of Medical Assistants, University of Lomé, Togo.
σ: Department of Biochemistry and Nutrition, Faculty of Sciences, University of Lomé, Togo.
ρ Ꞷ: Nephrology department at the Sylvanus Olympio University Hospital Center, Lomé, Togo.

I. INTRODUCTION

Chronic renal failure (CRI) is kidney damage defined by a permanent decrease in glomerular filtration rate (GFR), with a chronic nature confirmed by biological signs present for more than three months [1]. It results from the progressive destruction of the renal parenchyma and evolves more or less rapidly towards complete renal failure. Long silent, kidney disease first manifests biologically and then

clinically [1]. Indeed, chronic kidney disease (CRD) affects more than 850 million people worldwide, i.e. one in ten adults causing at least 2.4 million deaths per year and is the 6th leading cause of death whose growth is the fastest [2]. In Togo, a hospital frequency of 93.7% of patients with end-stage chronic renal failure (ESRD) was reported in the first nephrology consultation [3]. Moreover, among the risk factors associated with this pathology, malnutrition remains decisive. Indeed, according to the World Health Organization (WHO), malnutrition is a pathological state resulting from the relative or absolute deficiency or excess of one or more essential nutrients, whether this state manifests itself clinically or it can only be detected by biological, anthropometric or physiological analyzes [4]. Risk factors such as high blood pressure, obesity, diabetes and dyslipidemia are diseases that mostly have causes of nutritional origin, including excess malnutrition [5]. The occurrence of chronic renal failure is also associated with an increased risk of protein-energy malnutrition (PED) in individuals with this pathology [6]. Malnutrition is a pathological state characterized by an imbalance in the energy balance, i.e. an insufficient intake in relation to the body's nutritional needs [7]. It is defined by a deficiency in protein and energy, most often accompanied by a deficiency in vitamins and trace elements. According to the High Authority of Health (HAH) in France, undernutrition represents the state of an organism in nutritional imbalance characterized by a negative energy and/or protein balance [8]. Indeed, protein-energy malnutrition (PEM) is frequently encountered in patients with chronic renal failure treated by hemodialysis and is thus associated with a significant increase in the risk of morbidity and mortality [9]. In addition, PED in hemodialysis is a morbidity and mortality factor with a prevalence ranging from 15 to 75% worldwide (Delma et al., 2020). The prevalence of PED in hemodialysis patients in developing countries is superimposable to that in developed countries [10].

In addition, a study conducted on the "Influence of nutritional factors and the adequacy of hemodialysis on the survival of 1610 French patients", reported that protein-energy malnutrition concerns 30 to 50% of these hemodialysis patients. [11]. In sub-Saharan Africa, protein-energy malnutrition is also a real public health problem, including 20 to 50% of hemodialysis patients, often with a multifactorial origin [12].

Indeed, patients with chronic renal failure often present with protein-energy malnutrition related to an imbalance between insufficient nutritional intake, protein hypercatabolism and increased energy needs. These patients also have specific nutritional deficits associated with deficiencies in micronutrients and vitamins (iron, folic acid, vitamin B12, zinc, etc.). This increase in metabolism must then be satisfied by an adequate diet in order to maintain the body's muscle mass and an acceptable nutritional balance in these patients. However, it is observed that the increased needs are often not satisfied in patients with renal insufficiency, thus rendering their nutritional balance deficient compared to that of normal individuals. Although an adequate nutritional intake is thus necessary to ensure a good nutritional status of the hemodialysis patient, we note that there are very few data on the relationship between the diet of subjects with chronic renal failure and their state of health, particularly in Togo. However, these data are necessary to develop lifestyle and dietary interventions, in the prevention and treatment of these nutritional disorders for better management of chronic hemodialysis patients, thus improving their quality of life and overall survival. It is in this context that this study on the eating habits and nutritional status of hemodialysis patients in some hemodialysis centers in Togo takes place. It is therefore a contribution to the care and improvement of the quality of life of hemodialysis patients in Togo.

II. MATERIALS AND METHODS

2.1. Type of study

This is a cross-sectional, prospective and multicenter study, both descriptive and analytical, which was carried out over a period from May 5 to August 5, 2023. It took place in the various hemodialysis units Unidial, Martin Luther King and CMS Maison du Hadj clinics in Lomé (Togo). The patients had hemodialysis sessions, the frequency of which is 2 to 3 times a week. The study then focused on patients with chronic renal failure (CKD) treated by hemodialysis in the centers considered.

2.2. Inclusion criteria

The study included patients on regular hemodialysis for at least three months and aged at least 18 years.

2.3. Non-inclusion criteria

Patients aged at least 18 years with chronic renal failure not undergoing hemodialysis replacement therapy were not included in the study. Patients on hemodialysis for acute renal failure or aged under 18 were also not included in the study.

2.4. Exclusion criteria

Patients with neuropsychiatric or auditory disorders, a major disability limiting the taking of anthropometric measurements (limb amputation and paraplegia) and patients who refused to participate in the study were excluded from the study.

2.5. Variables collected

Sociodemographic characteristics, medical history (diabetes, hypertension, length of hemodialysis), dietary habits, dietary restrictions, anthropometric and biological parameters were collected in the study.

2.6. Assessment of nutritional status

The nutritional status of hemodialysis patients was assessed according to the criteria of the "International Society of Renal Nutrition and Metabolism (ISRNM)" for the selected indicators [13].

The body mass index (BMI) was calculated from the dry weight defined by the weight for which the patient does not show signs of extracellular dehydration or signs of fluid overload.

In the study, a chronic hemodialysis patient with one of the following criteria was considered malnourished: a body mass index of less than 23 kg/m2 (BMI < 23 kg/m2), an arm circumference of less than 29 cm (MUAC < 29 cm) and albuminemia less than 38 g/L (ALB < 38 g/L).

Obesity was defined by a body mass index greater than or equal to 30 kg/m² (BMI ≥ 30 kg/m²).

Abdominal obesity was defined by a waist circumference greater than 88 cm (TT > 88 cm) in women and a waist circumference greater than 102 cm (TT > 102 cm) in men included in the study.

The determination of the eating habits of hemodialysis patients was based on eight (08) food groups and their consumption frequencies. It is:

Group 1 (Fruits and vegetables): Apple, orange, mangoes, pineapple, avocado, spinach, fresh or dried baobab leaves, ademin, dates, tigernuts, okra leaves, onion, eggplant, carrots, sugar beets, cucumber, etc. .

Group 2 (Cereals and legumes): Rice, maize, white beans, peas, millet, sorghum, etc.

Group 3 (Dairy products): Milk, cheese made from cow's milk or soy, yogurt, dêguê, etc.

Group 4 (Meat, fish and seafood): Red meats (beef, goat, mutton), white meats (chicken, duck, guinea fowl), fish (tilapia), shrimps, crabs, lobsters, mussels, etc.

Group 5 (High-fat foods): Butters, peanut paste, donuts, cakes, botokoin, etc.

Group 6 (Sweet products): Sweet bread, sweets, chocolate, sugar, etc.

Group 7 (Salty foods): Salt, salty bread, sausages, ham, etc.

Group 8 (Caffeinated drinks): Nest coffee, tea, coca cola drink.

The potential identification of incriminating diets in the alteration of nutritional status was based primarily on dietary restrictions in hemodialysis patients.

2.7. Statistical analyzes

Data collection and entry were performed using the KoboToolbox server. Data processing and analysis were done with Epiinfo software version 7.2 and Microsoft Excel 2013. The comparison of proportions was made by Mantel Haenszel's Chi-square (χ^2) test with a significance level of 5% ($p < 0.05$). The search for associations between the variables was made based on a risk ratio or relative risk (RR) according to the conditions of application. The Pearson correlation between various indicators of protein-energy malnutrition was also used for the quantitative variables with a significance level of 5% ($p < 0.05$). The different proportions were calculated with a 95% confidence interval.

III. RESULTS

3.1. Sociodemographic, clinical, anthropometric and biological characteristics.

The study included 32 patients with an average age of 53.13 ± 14.37 years. It involved 50% women and 50% men, i.e. a sex ratio of 1 (Table 1). The main pathologies associated with chronic renal failure (CRF) were arterial hypertension (38.46%), followed by diabetes (15.38%) in the chronic hemodialysis patients surveyed. Sociodemographic characteristics, medical history (diabetes, hypertension, length of hemodialysis), dietary restrictions, anthropometric and biological parameters are presented in Table 1.

Table 1: Demographic, clinical, anthropometric and biological characteristics.

Variables	Hemodialysis patients (n=32)
Average age (years)	53,17 ± 14,37
Hemodialysis centers	
Unidial Clinic n (%)	19 (59,38%)
Martin Luther King Clinic	7 (21,88%)
CMS Hajj House	6 (18,75%)
Sex ratio (M/F)	1 (a man for a woman)
Pathologies associated with CRF	
High blood pressure n (%)	10 (38,46%)
Diabetes n (%)	4 (15,38%)
Seniority in hemodialysis	
< 5 years n (%)	31 (96,88%)

≥ 5 years n (%)	1 (3,13%)
Average BMI (Kg/m²)	22,25 ± 4,61
BMI < 23 Kg/m² n (%)	17 (53,13%)
BMI ≥ 30 Kg/m² n (%)	2 (6,25%)
Average waist circumference (cm)	90,13 ± 18,43
Women's waist circumference > 88 cm n (%)	7 (43,75%)
Men's waist circumference > 102 cm n (%)	4 (25,00%)
Mean arm circumference (cm)	26,34 ± 4,57
Mid-upper arm circumference (MUAC) < 29 cm n (%)	20 (62,50%)
Mean albumin (g/L)	35,21 ± 6,52
Albuminemia < 38 g/L n (%)	21 (65,63%)

The prevalence of protein-energy malnutrition therefore varied from 53.13 to 65.63% depending on the indicator used (Table 1).

The matrix of the different correlations between various indicators of protein-energy malnutrition in chronic hemodialysis patients is presented in Table 2.

Table 2: Pearson correlations between various indicators of PED in chronic hemodialysis patients in the hemodialysis centers surveyed.

Variables		n	r	p	Significance
BMI	MUAC	32	0,96	0,0000	****
BMI	Waist size	32	0,93	0,0291	*
MUAC	ALB	32	0,89	0,0684	NS
MUAC	Age	32	0,1689	0,3554	NS
MUAC	Waist size	32	0,89	0,1290	NS
MUAC	ALB	32	0,90	0,0461	*
MUAC	Age	32	0,1017	0,5796	NS
ALB	Age	32	-0,0433	0,8140	NS
ALB	MUAC	32	0,93	0,0001	***
ALB	Waist size	32	0,94	0,0240	*
Waist size	Age	32	0,3425	0,0550	NS

*NS: Not significant; MUAC: Mid-upper arm circumference; BMI: Body Mass Index; ALB: Albuminemia; r: Pearson correlation coefficient; p: the statistical probability; n: sample size; *: Statistical significance of the correlations: * p < 0.05; ***p <0.001; ****p < 0.0001.*

3.2. Prevalence of PED according to anthropometric parameters

The prevalence of PED according to arm circumference (MUAC) was 62.50% (95% CI: 43.69-78.90). MUAC was significantly correlated with serum albumin (r = 0.90; p < 0.05) (Table 2). The correlation between MUAC and waist circumference was not significant (r = 0.89; p > 0.05).

The prevalence of PED defined by BMI < 23 kg/m2 was 53.13% (95% CI: 34.74-70.91). BMI was significantly and positively correlated with MUAC (r = 0.96; p < 0.001) and waist circumference (r = 0.93; p < 0.05) (Table 2). The correlations between BMI and serum albumin (r = 0.89; p > 0.05) and between BMI and age (r = 0.1689; p > 0.05) were not significant (Table 2).

3.3. Prevalence of PED according to biological parameters

The prevalence of PED according to serum albumin was 65.63% (95% CI: 46.81-81.43). Serum albumin was significantly and positively correlated with MUAC ($r = 0.93$; $p < 0.001$) and waist circumference ($r = 0.94$; $p < 0.05$) (Table 2). The correlation between serum albumin and age was negative and not significant ($r = -0.0433$; $p > 0.05$).

3.4. Prevalence of obesity

The prevalence of obesity defined by BMI ≥ 30 kg/m2 in the study was 6.25% (95% CI: 0.77-20.81) in the patients surveyed (Table 1).

3.5. Prevalence of abdominal obesity according to waist circumference (WC)

The prevalence of abdominal obesity defined by a waist circumference of > 88 cm was 43.75% (95% CI: 19.75-70.12) in the chronic hemodialysis women surveyed (Table 1).
The prevalence of abdominal obesity defined by a waist circumference of > 102 cm was 25.00% (95% CI: 7.27-52.38) in the chronic hemodialysis men surveyed (Table 1).

3.6. Eating habits

The present study reported that 100% of the patients surveyed consumed fruits and vegetables and 50% consumed them very often (Figure 1).

In the study, 96.88% of the patients surveyed consumed cereal and legume products and 43.75% consumed them very often (Figure 2).

The consumption of dairy products reported by the study was 71.88% among the patients surveyed and 18.75% consumed them very often (Figure 3).

All chronic hemodialysis patients surveyed consumed meat, fish and seafood, i.e. 100% and 81.25% consumed them very often (Figure 4).

The present study showed that 53.12% of the patients surveyed consumed high-fat foods with only 6.25% consuming them very often (Figure 5).

In the study, 53.12% of the patients surveyed consumed sweet products and 15.62% consumed them very often (Figure 6).

The consumption of salty foods was observed in 50% of the patients surveyed and only 3.12% consumed them very often (Figure 7).

Among the respondents, 43.75% of the patients surveyed consumed beverages containing caffeine and only 6.25% consumed them very often (Figure 8).

The present study reported that 65.62% of the patients surveyed consumed an amount of water between 0.5 to 0.75 L/day (Figure 9).

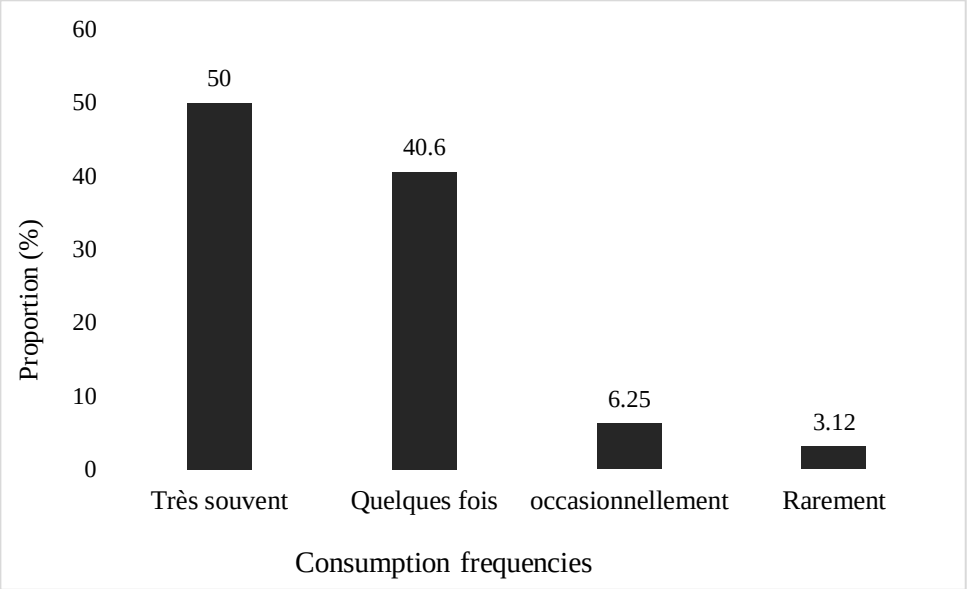


Figure 1: Distribution of chronic hemodialysis patients according to the frequency of fruit and vegetable consumption.

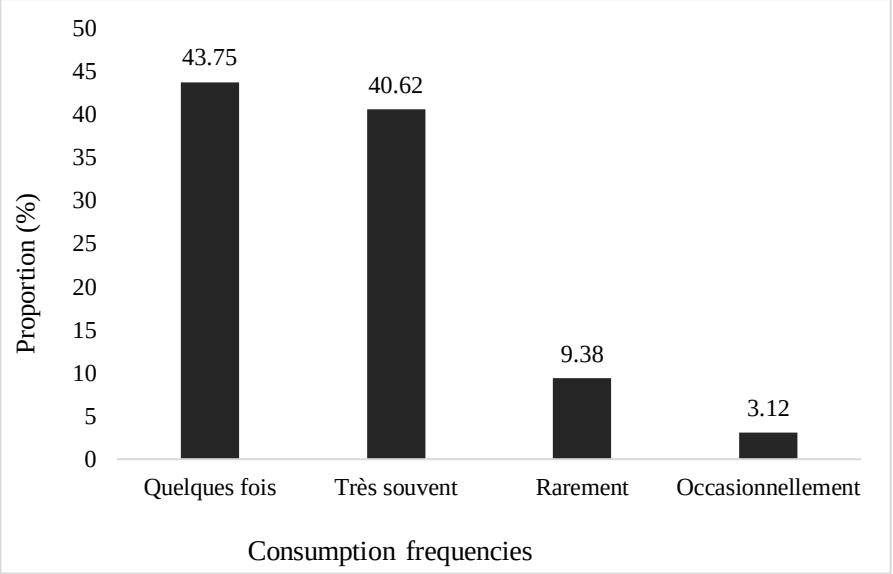


Figure 2: Distribution of hemodialysis patients according to the frequency of consumption of cereal products and vegetables.

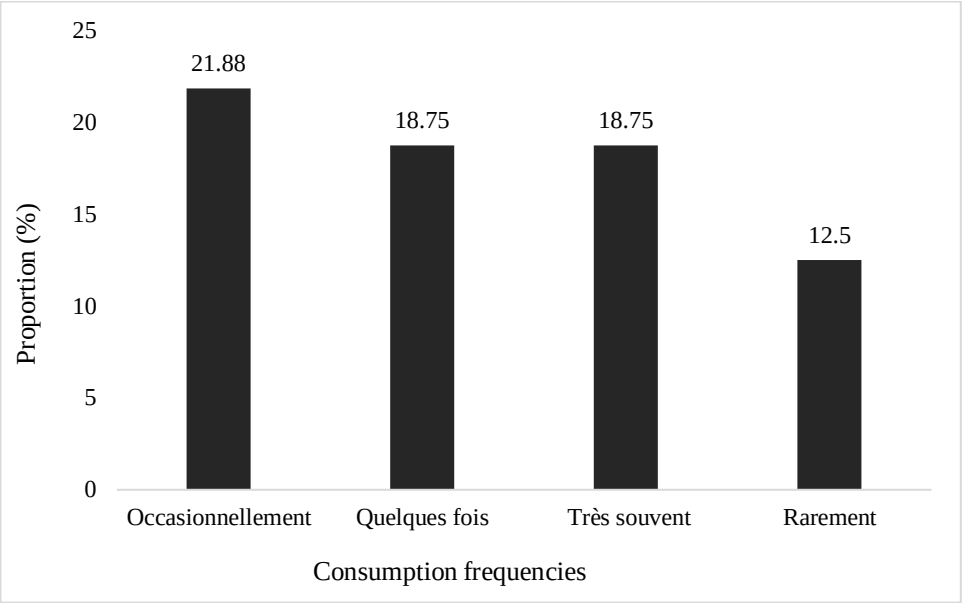


Figure 3: Distribution of hemodialysis patients according to the frequency of consumption of dairy products.

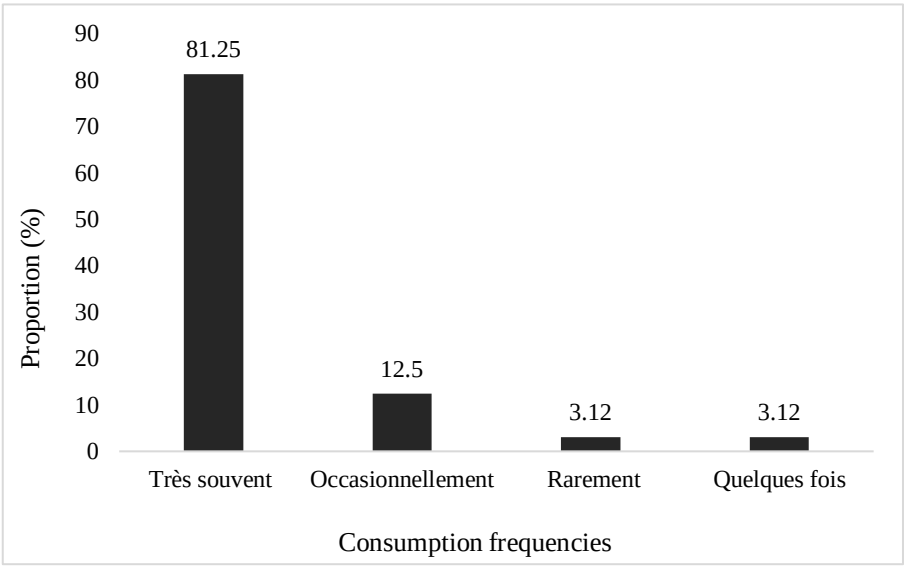


Figure 4: Distribution of hemodialysis patients according to the frequency of consumption of meat, fish and seafood.

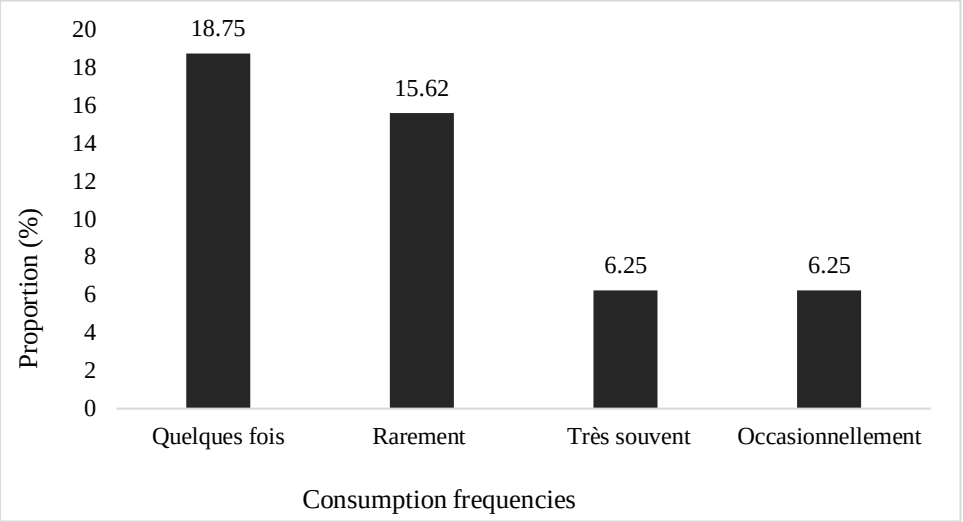


Figure 5: Distribution of hemodialysis patients according to the frequency of consumption of high-fat foods.

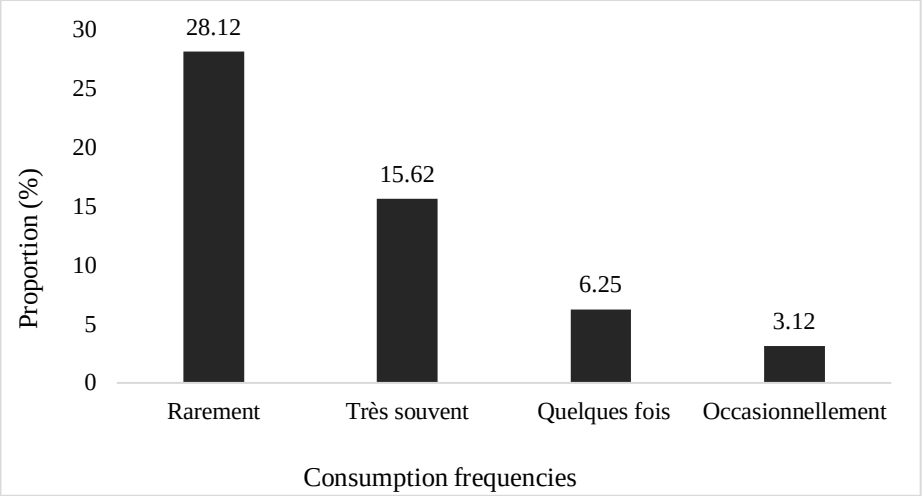


Figure 6: Distribution of hemodialysis patients according to the frequency of consumption of sugary products.

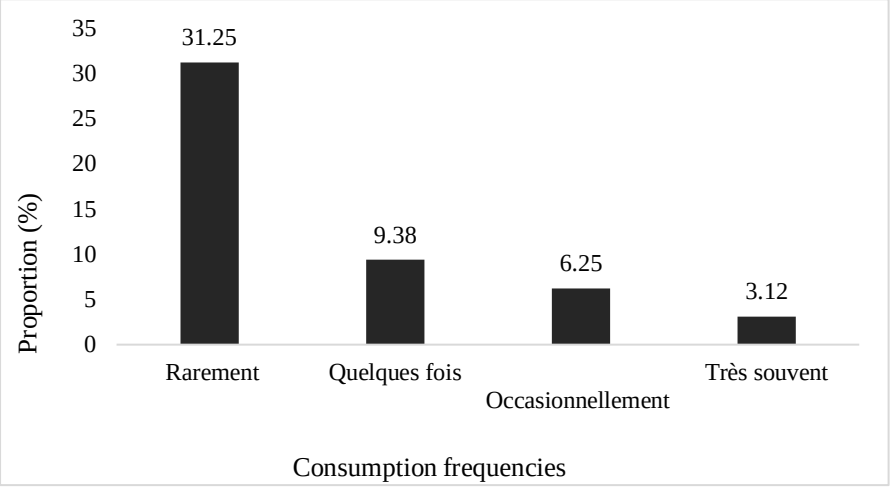


Figure 7: Distribution of hemodialysis patients according to the frequency of consumption of salty foods.

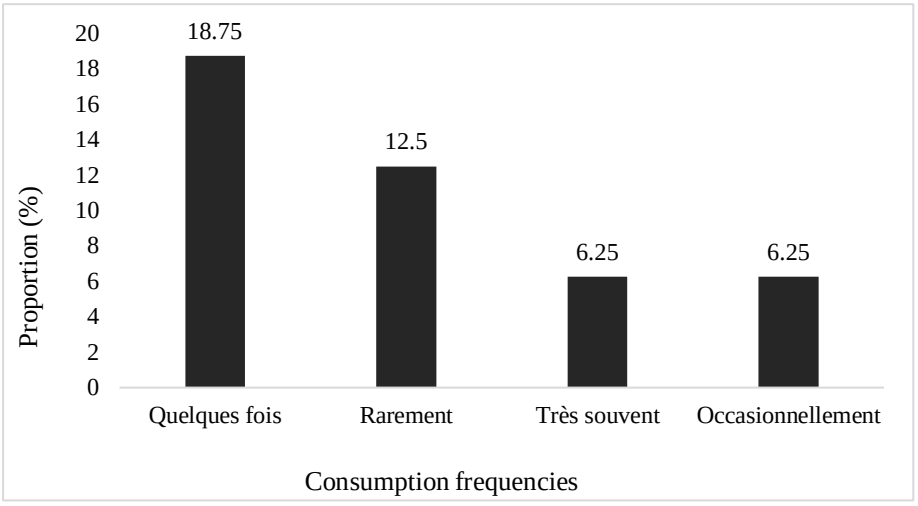


Figure 8: Distribution of hemodialysis patients according to the frequency of consumption of beverages containing caffeine.

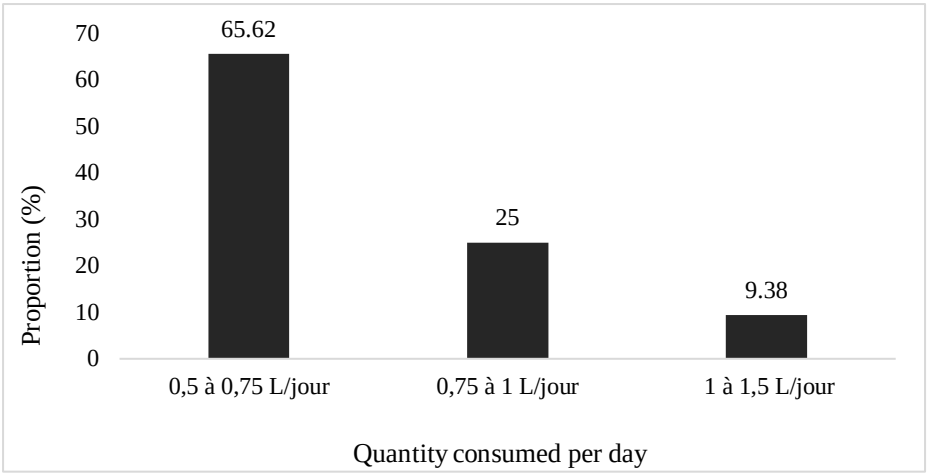
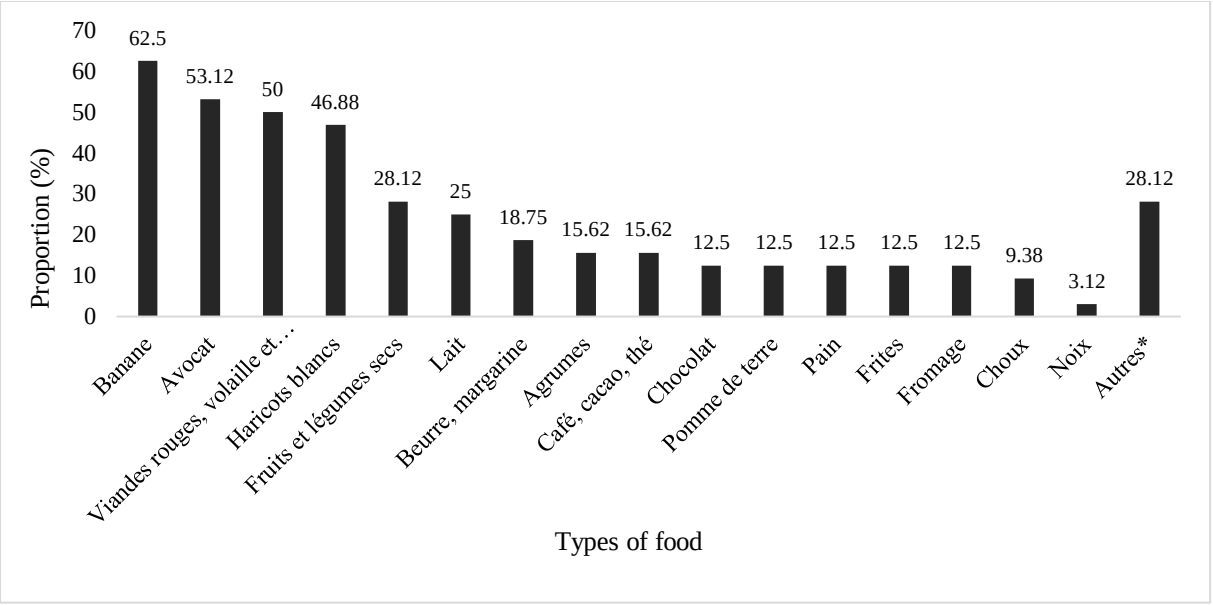


Figure 9: Distribution of hemodialysis patients according to the amount of water consumed per day.

3.6. Food restriction

Of the patients surveyed, 87.5% had received dietary restrictions from their nephrologists.
The different proportions of respondents according to restricted foods are shown in Figure 10.



Others: Grapes, foufou, broths, salt, plantains, apple fruit.

Figure 10: Distribution of respondents according to the different types of restricted foods.

The main incriminating diets in the deterioration of the state of health of hemodialysis patients included in the present study, were related to protein intake and insufficient energy intake related to food restriction in these patients.

3.7. Analytical study

The prevalence of EPD according to serum albumin was 57.14% in female patients and 42.86% in male patients (Table III). This difference is not statistically significant (Khi2 = 1.2078 and p > 0.05).

Table 3: Prevalence of PED according to anthropometric and biological indicators according to the sex of the patients surveyed.

Sexe	Effectif (n)	Prevalence (%)
Périmètre brachial (PB)		
Female	12	60,00
Male	8	40,00
Total	20	100,00
Body Mass Index (BMI)		
Female	11	64,71
Male	6	35,29
Total	17	100,00
Albuminemia (ALB)		
Female	12	57,14
Male	9	42,86
Total	21	100,00

The hazard ratio (RR) was also 1.33. This ratio was then greater than 1 (RR >1); which means that female patients are 1.3 times more likely to suffer from protein-energy malnutrition than male patients according to serum albumin.

The prevalence of EPD according to arm circumference was 60% in female patients and 40% in male patients (Table III). This difference is not statistically significant (Khi2 = 2.0667 and $p > 0.05$) with a risk ratio (RR) of 1.50. This ratio was then greater than 1 (RR >1); which means that female patients are 1.5 times more likely to suffer from protein-energy malnutrition than male patients according to arm circumference.

The prevalence of EPD according to body mass index was 64.71% in female patients and 35.29% in male patients (Table III). This difference is not statistically significant (Khi2 = 3.0392 and $p > 0.05$) and the hazard ratio (RR) was 1.8333. This ratio was also greater than 1 (RR >1); which means that female patients are 1.83 times more likely to suffer from protein-energy malnutrition than male patients according to body mass index. The prevalence of EPD according to body mass index was 64.71% in female patients and 35.29% in male patients (Table III). This difference is not statistically significant (Khi2 = 3.0392 and $p > 0.05$) and the hazard ratio (RR) was 1.8333. This ratio was also greater than 1 (RR >1); which means that female patients are 1.83 times more likely to suffer from protein-energy malnutrition than male patients according to body mass index.

IV. DISCUSSION

The results of the present study were discussed in the light of the literature in relation to previous studies.

The average age of hemodialysis patients for chronic renal failure observed in the present study (53.13 ± 14.37 years) slightly exceeded those reported by Fadli et al. (2018) (44.21 ± 3.65 years) in Algeria and by Delma et al. (2020) (44.76 ± 15.5 years) in Burkina. This difference in average age could be explained by a relatively young population surveyed in Algeria and Burkina compared to that concerned by this study.

A strong positive and significant correlation was observed between BMI and arm circumference ($r = 0.96$; $p < 0.001$) on the one hand, and between BMI and waist circumference ($r = 0.93$; $p < 0.05$) on the other hand in the present study. Delma et al. (2020) also showed a good correlation between BMI and MUAC ($r = 0.883$; $p < 0.001$) and also between BMI and waist circumference ($r = 0.910$; $p < 0.001$). This means that variations in BMI influence those in arm circumference (MUAC) and waist circumference and vice versa.

A positive and significant correlation was observed in the present study between arm circumference and serum albumin ($r = 0.90$; $p < 0.05$). Delma et al. (2020) also showed that arm circumference is correlated with serum albumin ($r = 0.439$; $p < 0.05$). This means that variations in MUAC also affect serum albumin and vice versa.

Arterial hypertension (HTA), as the main pathology associated with chronic renal failure (CRI) in the present study (38.46%), was also reported by Ahmadi and Cherfi (2019) (37%) in Algeria and by Delma et al. (2020) (89.3%) in Burkina. This similarity to hypertension as the main pathology associated with CKD in several studies confirms that hypertension is a risk factor and/or an aggravating factor for CKD.

In the present study, the evaluation of the nutritional status of chronic hemodialysis patients showed that the main nutritional problem is PED, whose prevalence varied between 53.13 and 65.63% depending on the indicator considered. This prevalence of PED falls within the range reported by Delma et al. (2020) where PED varied between 17 and 70.20% in Burkina and by Keita et al. (2018) where this PED varied between 10.3 and 55.9% in Senegal depending on the indicator used.

The prevalence of PED according to MUAC observed in the present study (62.50%) was close to that reported by Delma et al. (2020) (66%) in Burkina and well above that reported by Keita et al. (2018)

(25%) in Senegal. These high prevalences of PED observed could be explained by insufficient protein intake due to dietary restriction compared to protein sources, especially of animal origin, in hemodialysis patients.

The prevalence of PED according to BMI observed in the present study (53.13%) was below that reported by Saile et al. (2016) (63.50%) in Morocco and by Delma et al. (2020) (70.20%) in Burkina and moderately above that reported by Keita et al. (2018) (47.1%) in Senegal. This difference in prevalence could be explained by a very high insufficiency of protein-energy intakes in patients surveyed in Morocco and Burkina compared to those surveyed in Senegal and in the present study.

The prevalence of PED according to serum albumin in the present study (65.63%) was moderately above that reported by Sail et al. (2016) (58.00%) in Morocco and by Delma et al. (2020) (59.60%) in Burkina and well above that reported by Keita et al. (2018) (10.3%) in Senegal. This difference in prevalence could also be explained by a very high insufficiency of protein intake in patients surveyed in Senegal compared to those surveyed in Morocco, Burkina and in the present study.

The prevalence of obesity in the present study (6.25%) was similar to those reported by Delma et al. (2020) (4.2%) in Burkina and by Kéita et al. (2018) (8.8%) in Senegal. However, the difference between these prevalences could be explained by a high number of obese patients included in the present study and that of Senegal compared to those included in the study in Burkina.

V. CONCLUSION

The objective of this study was to contribute to the management and improvement of the quality of life of hemodialysis patients in Togo. To this end, it was a question of knowing the eating habits and evaluating the nutritional status of the latter. The evaluation of nutritional status was based mainly on anthropometric and biological parameters. The "International Society of Renal Nutrition and Metabolism (ISRNM)" criteria for the indicators retained from 2008 were used for the evaluation of the nutritional status in the chronic hemodialysis patients included in the study.

The results obtained following this evaluation showed that the main nutritional problem in the patients considered is protein-energy malnutrition (PED), with a high prevalence that varied according to the indicator used. PED therefore constitutes a health problem in chronic hemodialysis patients followed in the hemodialysis centers considered. The risk factors for undernutrition are mainly insufficient food intake linked in particular to protein restriction and a drop in energy reserves in these patients. In view of the high prevalence of PED in the hemodialysis patients surveyed, early diagnosis and appropriate and rigorous nutritional management are necessary to restore good nutritional status in these patients and reduce the frequency of pathologies associated with the insufficiency chronic kidney disease thus providing them with a better quality of life. The provision of oral nutritional supplements and parenteral nutrition bags is then necessary. The involvement of a specialist in food hygiene or nutrition and dietetics would also be a great asset for the care of hemodialysis patients.

Declaration of interests

The authors declare that they have no conflict of interest in relation to this study.

RÉFÉRENCES

1. Taleb S., Brik A., Bouchagoura A., 2016. Etude épidémiologique de l'insuffisance rénale chronique à Tébessa (Algérie), cas de 71 patients. Antropo, 36, 91-98.
2. Bême D, Priam E., 2020. Chiffres d'insuffisance rénale. Disponible sur : https://www.doctissimo.fr/html/dossiers/rein/8995-insuffisance-renale-chiffres.htm.

3. Consulté le 3 Avril 2023.
4. Tsevi Y.M., Dolaama B., Tona K.G., Tevi A.A., Affanou E.C., Amede A.D., Haroune-Traore J., Amekoudi Y.E.M., Sabi A.K., Tia W.M., Lagou D.A., 2021. Insuffisance rénale chronique et hémodialyse à Lomé: l´hémodialysé et son entourage sont-ils bien informés? Pan Afr Med J, 39, 85.
5. World Health Organization (Ed.), 2000. The Management of nutrition in major emergencies. World Health Organization, Geneva.
6. Larose D., 2021. Insuffisance rénale : quels facteurs de risque ?
7. Disponible sur : https://www.passeportsante.net/. Consulté le 3 Avril 2023.
8. Burnier M., 2010. La nutrition et le métabolisme dans les maladies rénales. Rev Med Suisse 238, 427–428.
9. Nutrisens, 2022. Dénutrition de la personne âgée : Définition, causes et conséquences. Disponible sur : https://www.nutrisens.com/denutrition/. Consulté le 3 Avril 2023.
10. Gerard A., 2022. Dénutrition : définition officielle, symptômes, conséquences, traitement. Femme Actuelle. Disponible sur : https://www.femmeactuelle.fr/sante/maladie/ denutrition-definition-officielle-symptomes-consequences-traitement-2136132. Consulté le 3 Avril 2023.
11. Azar R., Al-Moubarak I., Barsumau J., Smessaert C., Vairon M.-X., 2009. Évaluation et suivi nutritionnels des patients hémodialysés. Néphrologie & Thérapeutique, Université d'été de la société francophone de dialyse « Malnutrition et dialyse » Aix-la-Chapelle, 5, 317–322.
12. Delma S., Zoungrana N.W., Sere L., Bonzi J.Y., Coulibaly G., 2020. État nutritionnel des patients hémodialysés chroniques au CHU de Tengandogo, Ouagadougou. Nutrition Clinique et Métabolisme, 34, 248–253.
13. Combe C., Chauveau P., Laville M., Fouque D., Azar R., Cano N., Canaud B., Roth H., Leverve X., Aparicio M., 2001. Influence of nutritional factors and hemodialysis adequacy on the survival of 1,610 French patients. American Journal of Kidney Diseases, 37, 81–88.
14. Ondele A.-P., Ka E.H.F., Seck S.-M., Cissé M., Niang A., Diouf B., 2014. L'évaluation de l'état nutritionnel des hémodialysés de Dakar (À propos de 141 cas). Néphrologie & Thérapeutique, 10, 313:313.
15. Fouque D., Kalantar-Zadeh K., Kopple J., Cano N., Chauveau P., Cuppari L., Franch H., Guarnieri G., Ikizler T.A., Kaysen G., Lindholm B., Massy Z., Mitch W., Pineda E., Stenvinkel P., Trevinho-Becerra A., Wanner C., 2008. A proposed nomenclature and diagnostic criteria for protein–energy wasting in acute and chronic kidney disease. Kidney International, 73, 391–398.

Modelling of Large Fire Insurance Claims: An Extreme Value Theory Approach

Nelson Christopher Dzupire, Dalitso Kachusa & Samuel Gyamerah

University of Malawi

ABSTRACT

This research paper aims to develop a mathematical model that employs Extreme Value Theory (EVT) and Risk Measures to estimate and forecast significant fire insurance claims. The primary goal is to provide insurance companies with a more accurate understanding of the potential risks associated with substantial fire-related losses. The study incorporates a three-parameter Generalized Pareto Distribution (GPD) within the EVT framework to assess insurer risk concerning catastrophic fire events. The importance of evaluating fire-related financial losses for insurers is emphasized, especially given the impact of infrequent yet impactful extreme events on overall loss trends. By applying EVT techniques, including the GPD and Peaks Over Threshold (POT) method, to a historical dataset of fire insurance claims, the study effectively models the tail behavior of large losses. Parameters obtained from these models facilitate the calculation of probabilities for extreme loss occurrences, thereby enhancing risk management and pricing strategies for insurance firms. The results demonstrate the EVT approach's effectiveness in accurately modeling and estimating the risk associated with significant fire insurance claims. This research contributes to the insurance domain by presenting an enhanced mathematical and statistical framework for modeling substantial fire insurance claims. Such an approach enables insurers to better comprehend the potential financial implications of rare fire incidents, leading to more informed risk evaluation and resource allocatio.

Keywords: extreme value theory (EVT), generalized pareto distribution (GPD), fire insurance claims, risk management, 1 catastrophic events.

Classification: LCC Code: HG9970.3

Language: English

Great Britain Journals Press

LJP Copyright ID: 925695
Print ISSN: 2631-8490
Online ISSN: 2631-8504

London Journal of Research in Science: Natural and Formal

Volume 24 | Issue 8 | Compilation 1.0

Modelling of Large Fire Insurance Claims: An Extreme Value Theory Approach

Nelson Christopher Dzupire[α *], Dalitso Kachusa[σ] & Samuel Gyamerah[ρ]

ABSTRACT

This research paper aims to develop a mathematical model that employs Extreme Value Theory (EVT) and Risk Measures to estimate and forecast significant fire insurance claims. The primary goal is to provide insurance companies with a more accurate understanding of the potential risks associated with substantial fire-related losses. The study incorporates a three-parameter Generalized Pareto Distribution (GPD) within the EVT framework to assess insurer risk concerning catastrophic fire events. The importance of evaluating fire-related financial losses for insurers is emphasized, especially given the impact of infrequent yet impactful extreme events on overall loss trends. By applying EVT techniques, including the GPD and Peaks Over Threshold (POT) method, to a historical dataset of fire insurance claims, the study effectively models the tail behavior of large losses. Parameters obtained from these models facilitate the calculation of probabilities for extreme loss occurrences, thereby enhancing risk management and pricing strategies for insurance firms. The results demonstrate the EVT approach's effectiveness in accurately modeling and estimating the risk associated with significant fire insurance claims. This research contributes to the insurance domain by presenting an enhanced mathematical and statistical framework for modeling substantial fire insurance claims. Such an approach enables insurers to better comprehend the potential financial implications of rare fire incidents, leading to more informed risk evaluation and resource allocation.

Keywords: extreme value theory (EVT), generalized pareto distribution (GPD), fire insurance claims, risk management, 1 catastrophic events.

Author α σ : University of Malawi, Zomba, Malawi.
ρ: Kwame Nkrumah University of Science and Technology Kumasi-Ghana.

London Journal of Research in Science: Natural and Formal

I. INTRODUCTION

In the course of a lifetime, exceptional occurrences can emerge that are entirely unprecedented. These occurrences are unexpected and are likely to repeat in the future. For instance, we can consider the historical China floods of 1931 or the 2004 Indian Ocean disaster, along with the recurring catastrophic floods in the lower Shire region of Malawi and the devastating effects of Cyclone Fredd in 2023 where lives and properties where lost. Such events lead to significant infrastructural harm, including damage to buildings, roads, bridges, and power lines. This brings about disruptions in essential services such as transportation, communication, and utilities, coupled with the unfortunate loss of numerous lives. These rare events do not only cause great damage and loss of lives but also their effects are widespread throughout all sectors of the economy including the financial sector of which insurance companies are of great concern [19]. Hence, modelling the behaviour and the distribution pattern of these extreme and unusual events is of great importance in electing early warning systems and risk management applications. Extreme events such as catastrophic floods, fires and disease outbreaks do not occur frequently. However, their occurrence result in huge losses and since they rarely occur, many people do not take time to insure against them. A couple of studies and insurance companies have over the years

tried to compile and analyze data to enable them handle these catastrophic events [3, 16, 7, 18]. Yet, they have challenges in putting necessary reserves and appropriate level of reinsurance which could later on lead many insurers insolvent when catastrophic losses reoccur. Inadequate loss reserves often stand out as a frequent cause of insolvency [5]. A number of researchers have modelled the impact of surgency of insurance claims on the operation of insurance companies. For instance, the work of [2] modelled catastrophe claims with left truncated severity distributions and modelled event frequency with a non-homogeneous poissoin process and later used the model for forecasting. Similarly, [10] studied claim severity of extreme fire insurance claims for tariffication using extreme value theory (EVT) and generalised linear models (GLM). They then suggested that GLM do not work adequately for extreme claims and revealed that peaks over threshold methodology from extreme value theory (EVT) using a two-parameter generalised pareto distribution (GPD) as an accurate distribution for large insurance claims. On modelling rare and catastrophic events and their impacts in finance and insurance applications, many studies have achieved promising results by using different approaches. For instance, in a study by [20], large motor insurance claims in Kenya was modelled using the extreme value theory. Their study concentrated on the right tails of the underlying distribution (extremely large observations) and they fitted a generalised pareto distribution (GPD) which is a family distribution in EVT. Their empirical findings revealed that modelling extreme outcomes under EVT theory outweighs other methods of estimation such as econometric methods, as EVT is known for its ability to model the tail area of the distribution where extreme outcomes are located much better. Similar results were obtained by [11] who tried to investigate the tail behaviour of the extreme outcomes in the US stock market using EVT. The study concluded that, S&P 500 daily return data can also be characterized by GPD. However, the commonality in these above studies is that they all used two parameter GPD in modelling the extreme outcomes. Likewise, [13] modelled large flood insurance claims in Zimbabwe using frequency and severity models, their study presented a framework for choosing the most suitable probability distribution which they later fitted it to the past claims data and the parameters were estimated using maximum likelihood method (MLE). According to their findings, Pareto and Negative Binomial model provided the best fit to claims severity and frequency respectively. In the same pursuit, [15] estimated the risks of extremely large fire insurance claims using a Markov Chain monte Carlo approach. They proposed a Bayesian method using Markov Chain Monte Carlo techniques to calculate probabilities of large fire losses and demonstrated its potential advantages for actuarial and risk evaluations. Amongst emerging researchers, [14] modelled the frequency and severity of auto insurance claims using statistical distributions. Their paper presented a methodical framework for choosing a suitable probability model that best describes automobile claim frequency and loss severity as well as their application in risk management. Their findings from empirical analysis indicated that claims severity distribution is more accurately modeled by a skewed and heavy-tailed distribution. In a recent investigation conducted by [8], an examination was carried out on the behavior of extreme returns within the South African Industrial Index (J520) spanning the years 1995 to 2018. The study leveraged the Generalized Extreme Value Distribution (GEVD) to assess and estimate extreme risk measures. Their research outcomes revealed that across distinct quarterly return periods (8, 20, and 40 quarters), the approximated values for extreme losses were 9.28%, 13.65%, and 17.03% respectively, whereas the potential levels of extreme gains during these same periods were noted as 9.81%, 11.63%, and 12.68%.

Due to increasingly severe world catastrophes in the last two decades the property insurance industry has paid out over $125 billion in losses [17]. In 2004, property insured losses resulting from natural catastrophes and man made disasters, excluding the tragic tsunami of December 26, amounted to $42 billion, of which 95% was caused by natural disasters and 5% by man-made incidents such as fire. These huge billion-dollar figures call for very accurate models of catastrophe losses. Even small discrepancies in model parameters can result in underestimation of risk leading to billion-dollar losses to either insurer or the reinsurer. Therefore, employing suitable mathematical and statistical models, along with a thorough analysis of catastrophic data and precise estimation of claim frequency and

severity distributions, holds the essential solution for accurately assessing costs and the probability of financial distress for insurers [9]. Even though the methods used in existing literature are helpful, there has been no studies on linking a three-parameter GPD under EVT and measures of risk such as Value at Risk (VaR) and expected shortfall (ES) for estimating probabilities and magnitude of large event outcomes in Malawian Insurance industry. Hence, the motivation behind this investigation lies in the need to comprehend and analyze the patterns underlying the severity of fire-related losses arising from significant insurance claims. The primary objective is to develop a robust model that captures the intricate dynamics of such losses and further assesses the potential for encountering exceedingly rare and severe fire-related losses. The pursuit of this research stems from its potential to equip insurance firms with valuable insights. Specifically, this inquiry can empower insurance companies to predict the potential magnitude of losses that might be incurred across a specific customer base within a defined timeframe. These predictions hold substantial value in guiding the processes of pricing and risk management for insurance firms operating in the non-life sector.

In this paper we present a modelling framework for insurance losses resulting from catastrophic fires in the property insurance industry, which will aid in forecasting insurance risk and liabilities. By doing this, we also seek to derive distribution model of fire loss under EVT, fit fire claims to the loss distribution model for estimating probabilities and magnitude of large fire loss and then forecast expected insurance loss due to risk of fire loss. The results of this study will provide academicians and other researchers with a strong foundation in a wide range of mathematical and probabilistic methods for risk modelling in general insurance, model-based pricing, risk sharing, ruin theory and credibility. Insurance regulators around the world, like the Reserve Bank of Malawi through Insurance Act 2017, requires that every commercial building be insured against collapse, fire, earthquake, storm and flood. Henceforth, Modelling fire loss severity will help insurance companies to make a framework for new product development and make data-driven projections of future fire losses. The rest of the study is organized as follows: chapter two explains the Methodology adopted in the study. Chapter three gives the Empirical Results and Discussions. Finally chapter four gives Conclusions and Recommendations of the study.

II. MATERIALS AND METHODS

The research relied on fire loss data, encompassing claim amounts, extracted from Reserve Bank of Malawi (RBM) and NICO General Insurance. NICO was chosen due to its prominence as the largest General Insurer in Malawi based on market capitalization. The Reserve Bank of Malawi (www.rbm.mw) served as the regulatory authority for the country's insurance sector. Our focus centered on fire insurance claim data, specifically examining claim amounts disbursed (referred to as claim-size). The data collection period spanned from January 2005 to December 2021. The modeling process centered on a 10-year dataset spanning 2011 to 2021. Data organization and analysis were conducted using Microsoft Excel and the R programming package.

2.1 Model Specification

[20] used Extreme Value Theory(peaks over threshold modelling) for modelling large motor insurance losses due to accident claims of Kenindia Insurance Company in Kenya. They fitted a two-parameter GPD under EVT and revealed that it gives a more satisfactory fit to large motor insurance claims. The purpose of this study is to model the risk of large losses in an insurance portfolio due fire damage in commercial property. In light with this, the study adopted and refined the Extreme Values Model used by [20]) by extending the model to a three-parameter GPD. The two-parameter GPD model used by [20] is specified as the function $G_{\xi,\beta}(x)$ defined as follows:

$$G_{\xi,\beta}(x) = \begin{cases} 1 - \left(1 + \frac{\xi x}{\beta}\right)^{-\frac{1}{\xi}}, & \text{if } \xi \neq 0 \\ 1 - \exp\left(-\frac{x}{\beta}\right), & \text{if } \xi = 0 \end{cases} \quad (1)$$

where:

$\beta > 0$ is the scale parameter

$x \geq 0$ when $\xi \geq 0$ and $0 \leq x \leq -\frac{\beta}{\xi}$

ξ is the shape parameter

X represents the motor claim amount.

In EVT we consider a random variable say X and fix a threshold u and focus on the positive part of $X - u$ (since we are focusing on the upper tail, where large outcomes are located). This distribution—that is, $F_u(x)$ in EVT theory is given by;

$$F_u(x) = Pr(X - u \leq x)|X > u) = \frac{F_x(X) - F_x(u)}{1 - F_x(u)}, for\ all\ X > u \quad (2)$$

The key result in EVT is that as the threshold u $\to \infty$ $F_u(x)$ converges to GPD, $G_{\xi,\beta}(y)$;

$$G_{\xi,\beta}(x) = \begin{cases} 1 - \left(1 + \frac{\xi x}{\beta}\right)^{-\frac{1}{\xi}}, & \text{if } \xi \neq 0 \\ 1 - \exp\left(-\frac{x}{\beta}\right), & \text{if } \xi = 0 \end{cases} \quad (3)$$

where $\beta > 0$ is the scale parameter; and $x \geq 0$ when $\xi \geq 0$ and $0 \leq x \leq -\frac{\xi}{\beta}$

In the present study the model was re-specified by using a **three-parameter GPD under EVT framework** and incorporating risk measures such as value at Risk and Expected Shortfall for estimating risk of extreme fire loss in an insurance portfolio. This will enhance the accurancy of the estimates as compared to 2 parameter GPD, with the added location parameter. The three-parameter GPD in this study is specified as follows;

$$G(X; u, \xi, \beta) = \begin{cases} 1 - (1 + \frac{\xi(x-u)}{\beta})^{-\frac{1}{\xi}}, & \xi \neq 0 \\ 1 - exp(\frac{-x-u}{\beta}), & \xi = 0 \end{cases} \quad (4)$$

where X = claim amount or fire loss random variable, u = location parameter β= scale parameter ξ = shape parameter

The generalized Pareto distribution (GPD) approach is based on the idea that EVT holds sufficiently far out in the tails such that we can obtain the distribution not only of the maxima but also of other extremely large observations [4].Nevertheless, this theorem fits our study since we are attempting to analyze rare and large event outcomes, which in this case are catastrophic fires leading to huge insurance loss. Extreme Value Theory (EVT) is concerned with the mathematical and statistical analysis of extreme events hence a perfect fit to the present study.

2.2 Parameter Estimation and Derivation of Three-Parameter GPD

In this study the derivation of the parameters of GDP loss distribution will be done using the maximum likelihood estimation (MLE). MLE is commonly applied for estimation in a variety of problems. According to [1], MLE yields better estimates as compared to other methods like, least squares technique and methods of moments. They argued further that MLE method fully utilizes all information about parameters contained in the data.

Suppose random variables (fire claim amounts) $X_1, X_2, ..., X_n$ form a random sample from a pdf $f(x|\theta)$. We define the joint density function $f(x_1, x_2, ..., x_n|\theta)$ as the likelihood function. The likelihood function depends on the unkown parameter θ (or a vector of parameters), is always denoted as L(θ);

$$L(\theta) = f(x_1, x_2, ..., x_n|\theta)$$

$$l(\theta) = logL(\theta) = log\prod_{i=1}^{n} f(x_i|\theta)$$

$$l(\theta) = \sum_{i=1}^{n} logf(x_i|\theta) \tag{5}$$

The goal of maximum likelihood estimation (MLE) is to find the values of the model parameters that maximizes log likelihood function over the parameter space. Thus, estimating parameter θ with MLE principle gives;

$$\theta_{MLE} = argmax_\theta \sum_{i=1}^{n} logf(x_i|\theta) \tag{6}$$

The density function for the three-parameter Generalized Pareto Distribution (GPD) is given by:

$$f(y; u, \xi, \beta) = \begin{cases} \frac{1}{\beta}\left(1 + \frac{\xi(x-u)}{\beta}\right)^{-\frac{1}{\xi}-1}, & \text{if } \xi \neq 0 \end{cases} \tag{7}$$

Here, the tail index is denoted as $\alpha = \frac{1}{\beta}$, and the study focuses on the case where $0 < \xi \leq 1$.

The transformation used is $\frac{z}{u} = 1 + \frac{1}{\beta}(x-u)$ or $Z = \frac{\xi u}{\beta}x + u\left(1 - \frac{\xi u}{\beta}\right)$. This leads to the expression $x = \frac{\beta}{\xi u}z + u - \frac{\beta}{\xi}$, with a Jacobian of $(\frac{\beta}{\xi u})$ for $\xi > 0$. Consequently, the density of the transformed variable follows a Pareto distribution with density $f(z) = \alpha\left(\frac{u^\alpha}{z^{\alpha+1}}\right)$ for $z \geq u$ and $\alpha > 0$.

The Type I Pareto distribution is defined as $f(x : \alpha, \lambda) = \alpha\frac{\lambda^\alpha}{(x+\lambda)^{\alpha+1}}$ for $z \geq u$ and $x \geq 0$, where α is the shape parameter and λ is the scale parameter.

The log-likelihood function for Maximum Likelihood Estimation (MLE) is given by:

$$L(\alpha, \lambda) = \prod_{i=1}^{n} \alpha\frac{\lambda^\alpha}{(x_i)^{\alpha+1}} \tag{8}$$

Maximizing the log-likelihood function entails adjusting λ to $\lambda = \min\{x_i\}$, ensuring that λ is not larger than the smallest value of x in the dataset.

The parameter estimate for α is determined by equating the derivative of the log-likelihood function to zero, yielding:

$$\frac{1}{\alpha} + \log(\lambda) - \frac{1}{n}\sum_{i=1}^{n}\log(x_i) = 0 \tag{9}$$

This results in the expression:

$$\alpha = \frac{n}{\sum_{i=1}^{n}\log\left(\frac{x_i}{\lambda}\right)} \tag{10}$$

For a Generalized Pareto Distribution estimated from a Type I Pareto distribution, the Maximum Likelihood Estimators (MLE) for ξ and u are:

$$\xi = \frac{1}{n}\sum_{j=1}^{n}\log\left(\frac{z_j}{u}\right)$$

$$\beta = z_{(1)}$$

Whare the mean and variance of GPD estimated from these parameters are:

Mean $= u + \frac{\beta}{1-\xi}$ for $\xi < 1$

Variance $= \frac{\beta^2}{(1-\xi)^2(1-2\xi)}$

2.3 Determination of Threshold (u)

Several methods have been proposed to determine the optimal threshold. The most common approach is the eyeball method where we look for a region where the tail index seems to be stable. More formal methods are based on minimizing the mean squared error (MSE) of the Hill estimator (i.e., finding the optimal point), but such methods are not easy to implement [4]. Hence, a more easier and reflective method to determine u, is the mean excess loss function e(u), defied as the average excess of the random variable X over the threshold u [9]. Hence, this study will employ mean excess plot to determine threshold. Here we shall plot the mean excess function (MEF) defined as;

$$e(u) = E[X - u | X > u] \tag{11}$$

$$e(u) = \frac{1}{n_u} \sum_{i=1}^{n_u} (x_i - u) \tag{12}$$

where u is the threshold value, and n_u denotes total number of values that which exceed the threshold in the same line of thought, [6] argued that the mean excess function of the GPD is a linear function of threshold u, they further claimed that the reasonable way to determine the threshold u, is to find values over which the sample mean excess function is approximately linear.

2.4 Generalized Pareto Distribution (GPD) and Risk Measures Estimation

The distribution function of the three-parameter GPD is expressed as:

$$G(y; u, \xi, \beta) = \begin{cases} 1 - \left(1 + \frac{\xi(x-u)}{\beta}\right)^{-\frac{1}{\xi}}, & \text{if } \xi \neq 0 \\ 1 - \exp\left(\frac{-x-u}{\beta}\right), & \text{if } \xi = 0 \end{cases} \tag{13}$$

Let $V = X - u$, which represents the excess loss over the threshold u. The probability that the random variable X exceeds the threshold is given by $1 - F(u)$, and the probability that $X > u + v$ given that $X > u$ is $1 - G_u(V)$.

Therefore, the unconditional probability that $X > u + v$ will be obtained by:

$$F(X > u + v) = [1 - F(u)].[1 - G_u(V)]$$

According to Lee (2012), $[1 - F(u)]$ can be estimated by the empirical estimator $\left(\frac{k}{n}\right)$, where n is the total number of observations and k is the number of observations exceeding the threshold value u. Hence, the probability $Pr(x > u + v)$ will be given by:

$$\frac{n_u}{n} = \frac{k}{n}\left(1 + \xi\left(\frac{x-u}{\beta}\right)\right)^{-\frac{1}{\xi}}$$

This can be further simplified to:

$$= \frac{k}{n}\left(1 + \xi\left(\frac{x-u}{\beta}\right)\right)^{-\frac{1}{\xi}}$$

Such that the tail estimator for the distribution function will be given by:

$$F(x; u, \beta, \xi) = 1 - \frac{k}{n}\left(1 + \xi\left(\frac{x-u}{\beta}\right)\right)^{-\frac{1}{\xi}} \tag{14}$$

2.4.1 Value at Risk (VaR) of GPD

Value at Risk (VaR) is the 100th percentile of a of an insurance portfolio due to the risk of fire loss distribution (Klugman, 2013). It is defined as the will be calculated as follows:

$$F(VaR) = p$$

$$p = 1 - \frac{k}{n}\left(1 + \xi\frac{(VaR - u)}{\beta}\right)^{-\frac{1}{\xi}}$$

$$\frac{k}{n}\left(1 + \xi\frac{(VaR - u)}{\beta}\right)^{-\frac{1}{\xi}} = 1 - p$$

$$\left(1 + \xi\frac{(VaR - u)}{\beta}\right)^{-\frac{1}{\xi}} = \frac{n}{k}(1 - p)$$

$$1 + \xi\frac{(VaR - u)}{\beta} = \left(\frac{n}{k}(1 - p)\right)^{-\xi}$$

$$\xi\frac{(VaR - u)}{\beta} = \left(\frac{n}{k}(1 - p)\right)^{-\xi} - 1$$

Therefore,

$$VaR = u + \frac{\beta}{\xi}\left(\frac{n}{k}(1 - p)\right)^{-\xi} - 1 \tag{15}$$

2.4.2 Expected Shortfall (ES) on GPD

Expected Shortfall (ES), also known as Tail Value at Risk (TVaR), is an extension of VaR. It captures the average loss given that the loss is greater than VaR (Klugman, 2013). At p% level, it may be defined as the expected loss in the worst p% cases. For instance, $ES(0.1)$ is the expectation of the worst 10 cases out of 100 cases (Lee, 2012). Mathematically, the expected shortfall of an insurance portfolio due to the risk of fire loss in this study will be calculated as follows:

$$ES_p = E[\text{loss given that loss } > VaR_p]$$

$$= \frac{\int_p^1 VaR_u(X)du}{1 - p}$$

If X is continuous at $VaR_p(X)$, then:

$$ES_p = E[X/X > VaR_p(X)]$$

$$= \pi_p + \frac{\int_{VaR_p(X)}^{\infty}(X - \pi_p)f(x)dx}{1-p}$$

For the GPD case, the expected shortfall will be estimated as follows:

$$ES_p = VaR_p + \frac{\beta + \xi(VaR_p - u)}{1-\xi}$$

$$= \frac{VaR_p(1-\xi) + \beta + \xi(VaR_p - u)}{1-\xi}$$

$$= \frac{VaR_p - \xi VaR_p + \beta + \xi VaR_p - \xi u}{1-\xi}$$

$$= \frac{VaR_p + \beta - \xi u}{1-\xi}$$

Therefore,

$$ES_p = \frac{VaR_p}{1-\xi} + \frac{\beta - \xi u}{1-\xi} \tag{16}$$

2.4.3 Study Assumptions

The study assumptions encompass three key aspects: firstly, the continuous and independently identically dis tributed nature of claim amounts (X_s, $s > 0$); secondly, the absence of claim handling expenses in the data, focusing solely on paid fire losses; and thirdly, the adherence to extreme value theory (EVT) principles, indicating that the data is not normally distributed. In accordance with this theory, we therefore tested normality of data, and we found out that our data was indeed not normally distributed hence consistent for modelling.

III. EMPIRICAL RESULTS AND DISCUSSIONS

This section presents and discusses the empirical findings of the analysis and modelling of large fire insurance claims and estimation of risk measures based on three parameter GPD under extreme value theory. For analysis of the modelling procedure the study used quantitative claim size data collected from RBM and NICO ranging from 2011 to 2021. Some basic data cleaning was applied using Ms Excel where claim records with missing values and duplicates were removed. The data obtained were exported to R statistical package for further analysis.

3.1 Exploratory Data Analysis

Descriptive analyses are important since they provide the foundation upon which correlation and experimental studies emerge. They also provide clues regarding the issues that should be focused on to help for further studies [12]. Therefore, the descriptive statistics of the data used in this study is calculated to get a fair idea about the data before the analysis. Table 1 presents the Number of Observations, Mean, Kurtosis, Skewness, Minimum and Maximum Values of claim amounts paid. There are 846 observations of the variable claim amount. The average claim payment is MK2,168,100. Minimum and Maximum observations are MK25,000 and MK59,113,780 respectively. The value of the Skewness is greater than zero, this indicate the existence of fat tails/heavy tails in the data. There exist large observations (outliers) in the right tail of the distribution curve which is consistent with the underlying assumption of Extreme Value Theory (EVT). Likewise, Kurtosis is greater than 3, this means data is not normally distributed hence we can proceed for analysis based on the assumptions of the EVT. 13

Mean	2168.10
Standard error	117.95
Median	1060.46
Mode	2500.00
Standard deviation	3430.77
Sample variance	11770205.49
Kurtosis	96.94
Skewness	7.31
Range	59088.78
Minimum	25.00
Maximum	59113.78
Count	846.00

Table 1: Descriptive Statistics

Besides noting that our data is not normally distributed from descriptive statistics, we further tested for normality using a diagnostic test, Pearson chi-square test for normality at 5% significance level. We therefore obtained a p-value less than the significance level leading to rejecting null hypothesis. The test revealed that our data was indeed not normally distributed and inline with EVT assumption as shown in Table 2 below.

Table 2: Normality Test

Test	Hypothesis	Alternative Hypothesis	Test Statistic	P-Values
Pearson Chi-square	Data is Normal	Data not Normal	1623.9	2.2×10^{-16}

In Figure 1, we observe that fire loss data is skewed to the right and uneven variability of claim observations as seen on x-axis,(that is, data being heteroskedastic). This gives the insurance company a hard time to predict expected losses and returns as they are operating on extreme values of making a profit or loss hence more risky in case of huge fire loss. We also observe that the distribution of claims is positively skewed, suggesting that small fire losses occur quite frequently and very large losses occur less frequently but they are catastrophic.

According to [4], a more useful visualization of data can be obtained using logarithmic scale for the x-axis (or even both axes). This is performed by plotting the Empirical Complementary Cumulative Distribution Function (ccdf), that is, the empirical probability of the claims exceeding any given threshold, sometimes also referred to as the Survival function as shown in Figure 2. This (Figure 2) shows the empirical distribution of claim settlements. The tails are nonlinear implying the Pareto behaviou (power law) and extreme value theory can be confirmed. Extreme Value Models are known to be heavy tailed. According to EVT theory, extreme observations in a given sample data follow the tail of an EVT distribution called Generalized Pareto Distribution GPD. Hence, there is a possibility that our data of large fire insurance claims follow the tail of a GPD as evidenced by the Pareto behaviour in the data.

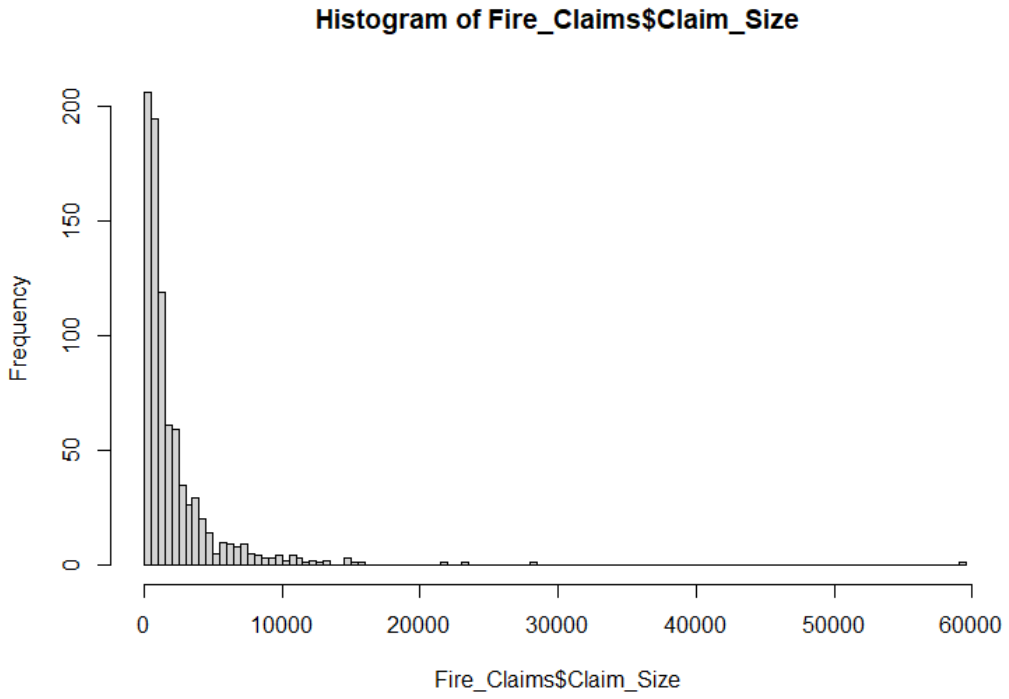


Figure 1: Histogram of Fire Losses

3.2 The Mean Excess Function and the Determination of the Threshold

Now that we established that the data is fat-tailed and follows a power law, we turn to fitting a GPD distribution to the threshold exceedances. However, before performing that we need to determine an appropriate threshold (a starting point where we shall assume any claim beyond it as being extreme/large). In the figure 3 below, we plotted Mean Excess Function to confirm convergence of

GPD to any given threshold. The resulting plot looks fairly linear across the whole spectrum of losses. Nonetheless, a small kink just below MK5, 000,000 is observed indicating that smaller losses follow a somewhat different law/distribution. A fairly linear region can be observed between 0 and MK5,000,000; above MK5,000,000 the data becomes sparse. Therefore, a threshold of MK5,000,000 was considered as a reasonable choice that is consistent with Mean Excess Function under EVT.

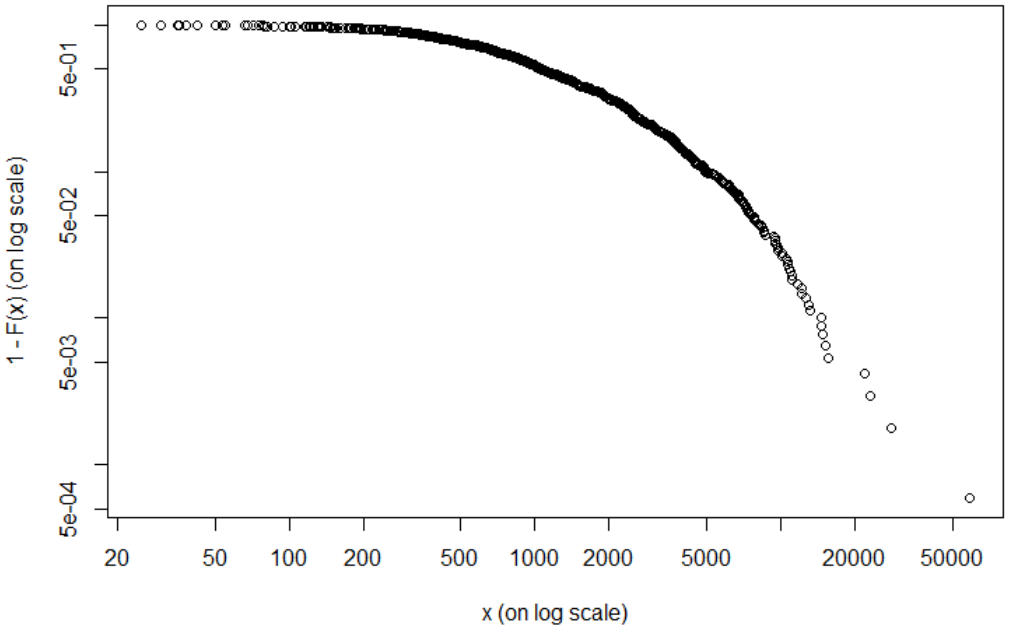


Figure 2: Complementary Cumulative Distribution Function

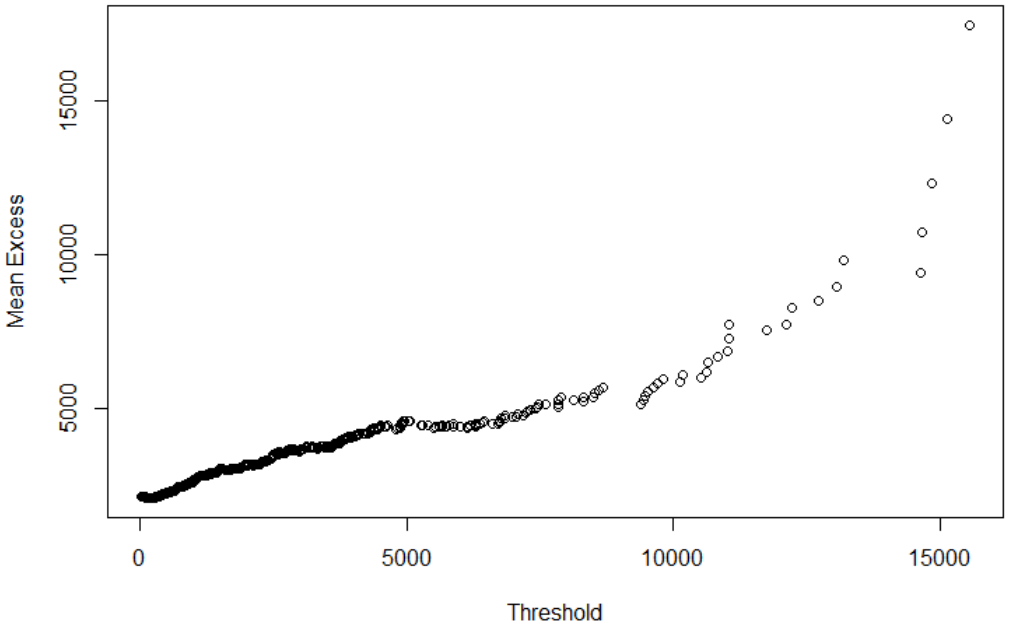


Figure 3: Mean Excess Function Plot against Thresholds

Since the empirical distribution was non-linear implying the Pareto behaviour, we were justified to fit a Generalised Pareto Distribution (GPD) to the tails of fire loss data. The data was fitted to a GPD model using Maximum Likelihood Estimate as shown in Figure 4. The parameter estimates are U = 2167, ξ = 0.1938 and β = 3612. 76 as shown in Table 3. The shape parameter ξ is greater than 0 implying heavy tailed distribution followed by the data. The distribution for the excesses shows a smooth curve (see

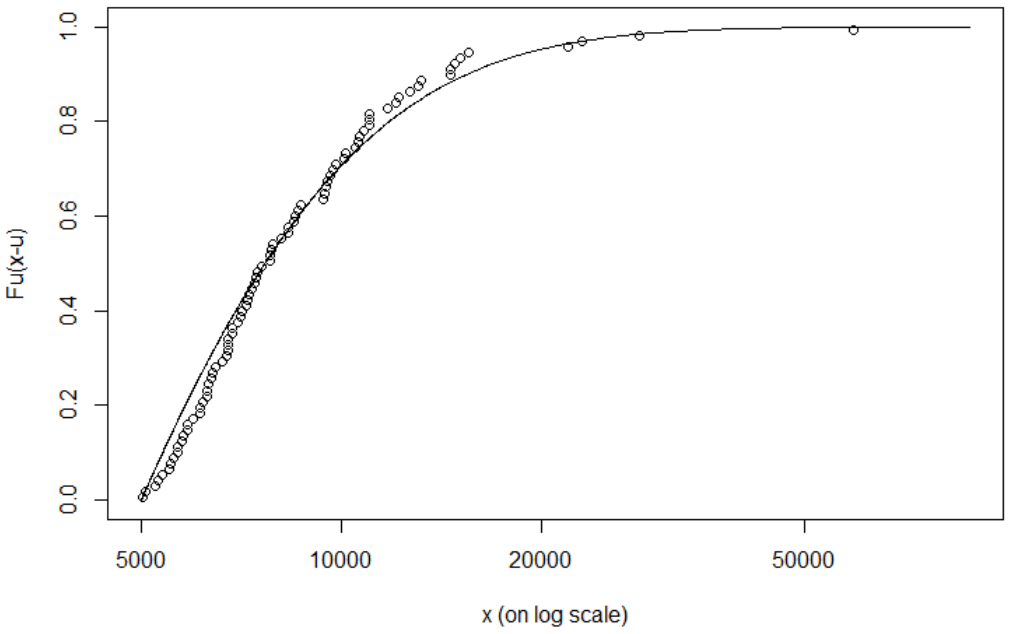


Figure 4: Excess Distribution and Fitted GPD

Table 3: Model Parameters Estimation

Model	Location (U)	Shape (ξ)	Scale (β)
G(X: U, ξ, β)	2167	0.1938	3612.76

Therefore, the estimated three-parameter GPD model using MLE method becomes;

$$G(X;u,\xi,\beta)=\begin{cases}1-\left(1+\frac{0.1938(x-2167)}{3612.76}\right)^{-\frac{1}{0.1938}}, & \text{if } \xi\neq 0\\ 1-\exp\left(\frac{-(x-2167)}{3612.76}\right), & \text{if } \xi=0\end{cases} \tag{17}$$

To measure the goodness of fit between the observed data and the theoretical distribution. The quantile-quantile plot (QQ-plot) serves as a valuable tool for initially evaluating the suitability of a parametric distribution's fit. In the context of Financial and Insurance scenarios, where data sets often exhibit fat-tailed behavior, the QQ-plot proves particularly useful [4]. A well-suited parametric distribution should lead to a linear graph in the QQ-plot, as demonstrated in Figure 5. This visualization verifies the excellent fit of the Generalized Pareto Distribution (GPD) to the data, substantiating its efficacy for predictions. Furthermore, the QQ-plot aids in the identification of outliers within the dataset.

Additionally, an Anderson-Darling (AD) test was performed to assess the goodness of fit as shown in Table 4. The resulting p-value exceeded the 5% significance level, leading to the non-rejection of the null hypothesis. This outcome supports the conclusion that the data indeed adheres to the GPD within the context of Extreme Value Theory (EVT). The establishment of a good fit is pivotal; it empowers us to infer that the insurer is equipped to manage substantial claims by leveraging risk estimates, thus ensuring financial stability even in the face of significant challenges.

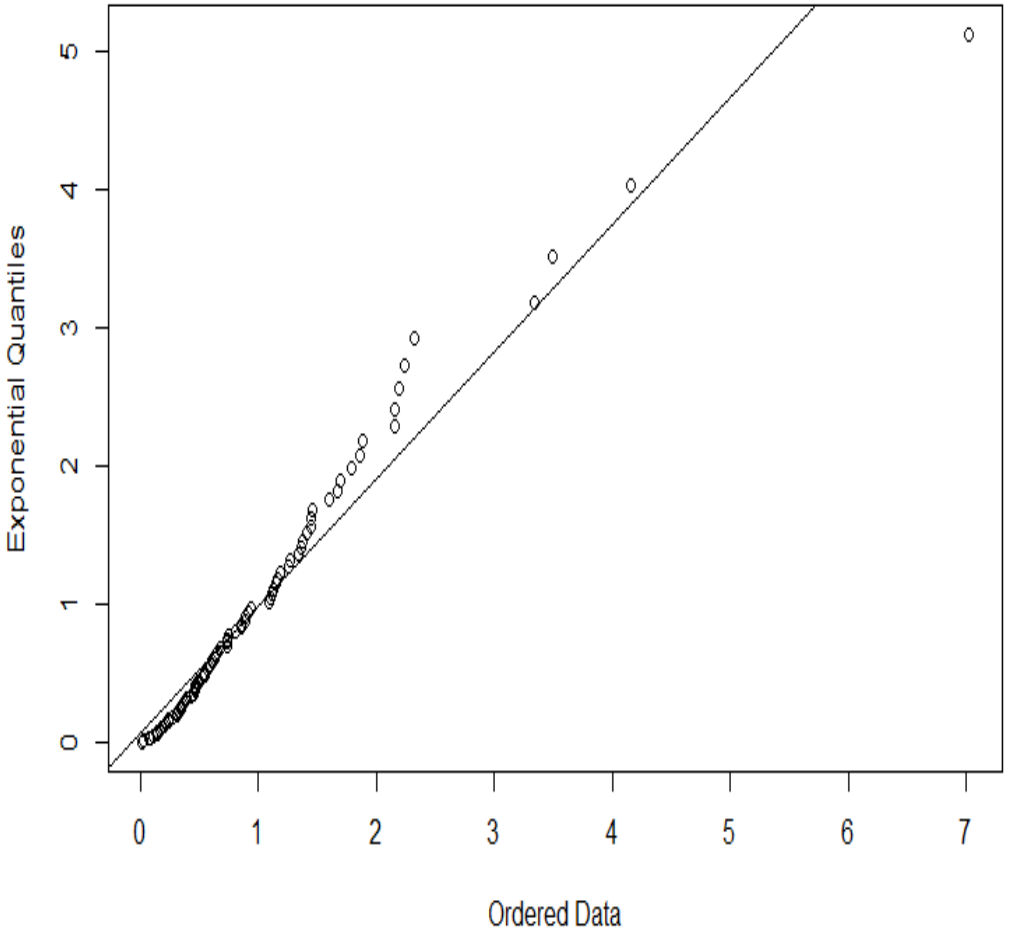


Figure 5: Quantile-Quantile Plot (QQ-Plot) of Residuals

Table 4: Goodness of Fit Test

Test	Hypothesis	Alternative Hypothesis	Test Statistic	P-Values
A-D	Data follow GPD	Data does not follow GPD	4.02	0.659

3.3 Risk Measures

With the GPD model successfully fitted to fire loss data, we can now employ it to assess the risk associated with higher quantiles, as well as insurers' capital value at risk, and the expected losses within a specified time frame. For instance, our estimated 99% Value at Risk stands at MK15,437,440 in the most unfavorable scenario, accompanied by a lower interval of MK13,156,630 and an upper interval of MK19,201,590. This prediction encompasses the projected loss that the company should anticipate in their claims handling for the upcoming fiscal year.

This holds notable significance within the realm of operational risk management, particularly in adherence to regulatory requirements. Calculating extremely high quantiles (99%) aids in evaluating potential losses and gauging the company's solvency under exceedingly adverse conditions. Consequently, such assessments help in determining the company's resilience in the face of catastrophic scenarios, allowing for early detection and necessary action. As depicted in Figure 6, the Tail Loss alongside the Estimated 99% VaR exemplifies these insights effectively.

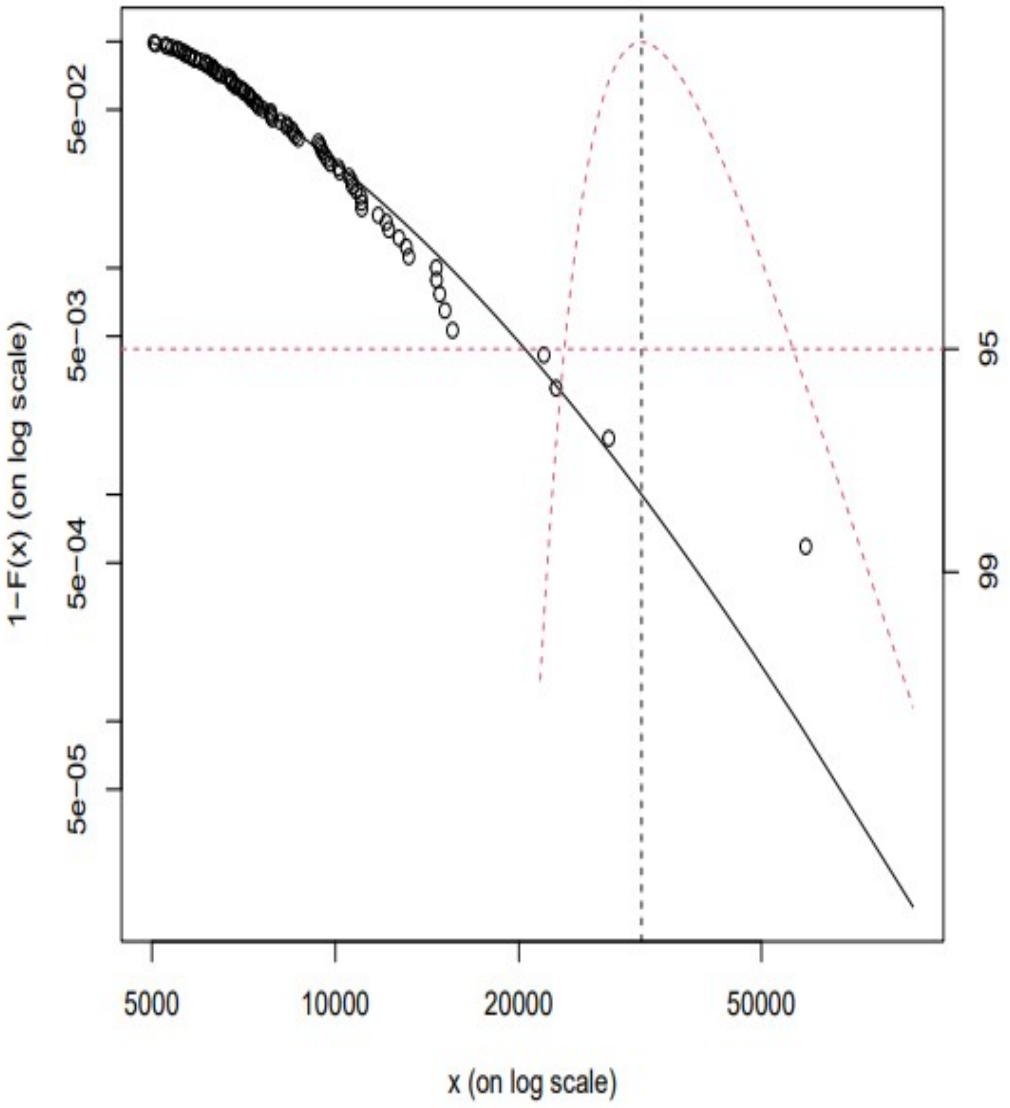


Figure 6: Tail Loss with Estimated 99% Value at Risk (VaR)

Even though Value at Risk (VaR) offers an estimation of the highest potential loss at the designated confidence level, i.e. 99%, it lacks insight into the scale of losses that could surpass the VaR threshold. Expected Shortfall (ES) overcomes this drawback by assessing the average value of all losses surpassing the VaR threshold. ES tell us about the average expected loss given that the loss amount is greater than VaR with certain probability level. For example, ES(0.05) with confidence level of 95% is defined as the expectation of the worst 5 cases out of 100 cases provided the loss is greater than VaR(0.05). Using a confidence level of 95% the ES is MK12,762,850 revealing that there is 5% probability that minimum loss would be equal to MK12,762,850 or greater or we are 95% confident that the maximum loss would be equal MK12,762,850 or less if loss exceeds VaR calculation in our next financial year.Table 5 below, reports the estimates of VaR and expected losses at different confidence levels as estimated by a three-parameter GPD.

Table 5: Value at Risk and Expected Loss Estimates (Interval Estimate (MK'000))

VaR		Lower CI	Estimate	Upper CI
	90%	4853.09	4970.04	5302.19
	95%	7038.21	7645.84	8439.94
	99%	13156.63	15437.44	19201.59
ES	90%	8469.46	9443.91	11202.59
	95%	11065.51	12762.85	16145.44
	99%	17923.64	22427.06	35467.68

The estimated 95% VaR is MK7,645,840 and the estimated 95% Expected shortfall is MK12,762,850. This means that assuming that 95% VaR level of MK7,645,840 is exceeded then the expected loss is MK12,762,850. The resulting graph displays both the 95% VaR (first vertical dashed line and its profile likelihood curve) and 95% Expected shortfall.

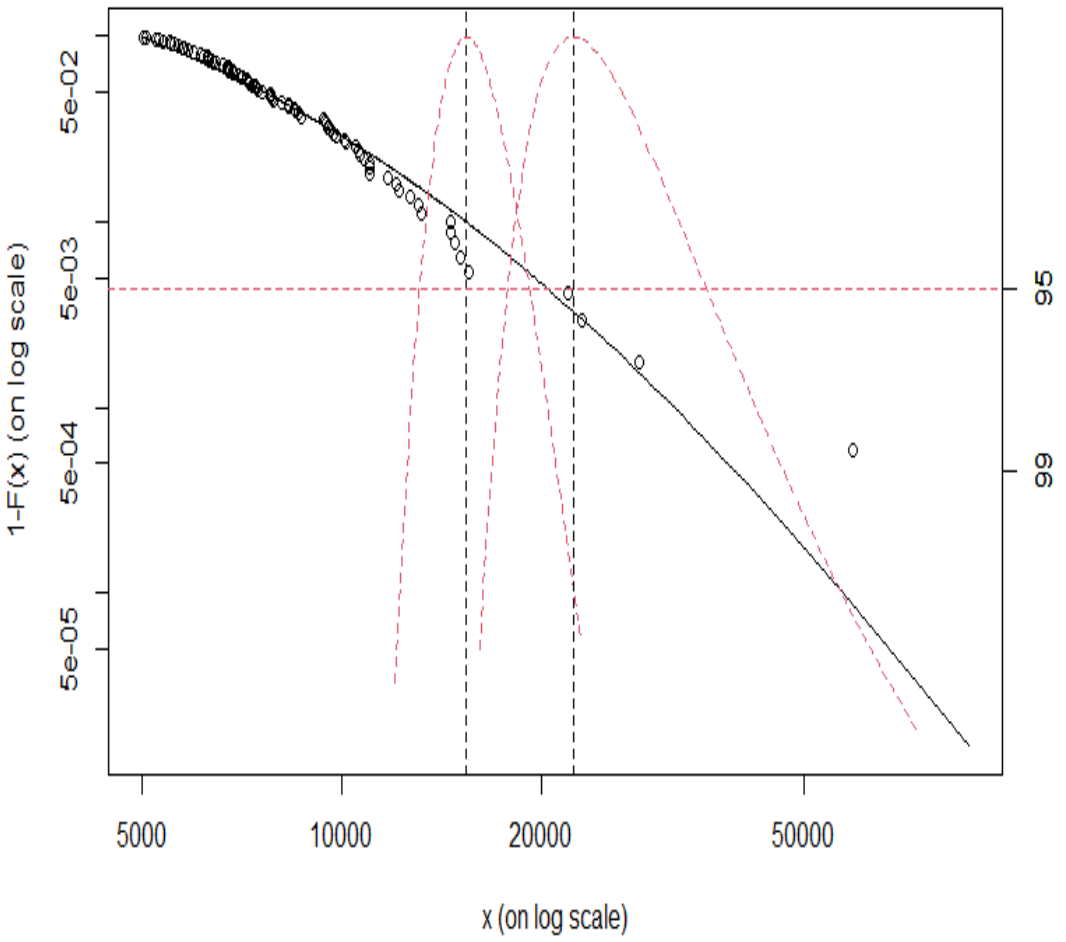


Figure 7: Estimate of 95% Value at Risk and Expected Shortfall

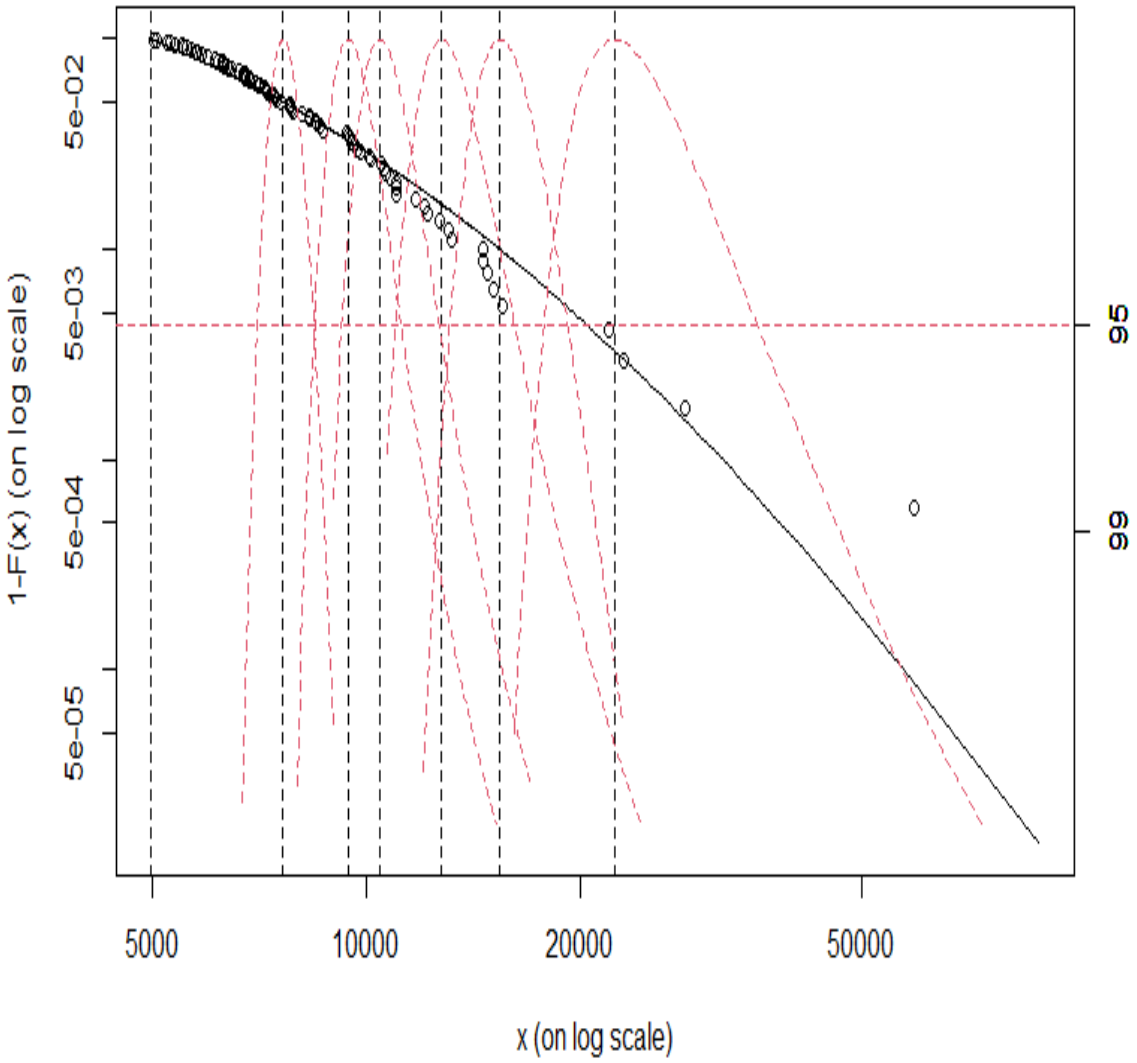


Figure 8: Estimates of 90%, 95%, and 99% Value at Risk and Expected Shortfalls

IV. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The study's primary objective was to develop a mathematical model employing Extreme Value Theory (EVT) and Risk Measures to estimate and predict significant fire insurance claims. This aimed to offer insurance companies a more precise grasp of potential risks linked to substantial fire-related losses. The study established a three parameter Generalized Pareto Distribution (GPD) within the framework of EVT for estimating insurer risk due to catastrophic fire incidents. The significance of assessing fire-related financial losses for insurers was highlighted, es pecially considering the infrequent but influential extreme events that can distort overall loss patterns. By applying EVT techniques, including the GPD and Peaks Over Threshold (POT) method, to a dataset of historical fire insur ance claims, the study accurately modeled the tail behavior of large losses. Parameters derived from these models enabled the calculation of probabilities for extreme loss events, thereby supporting enhanced risk

management and pricing strategies for insurance companies. The findings showcased the efficacy of the EVT approach in accurately modeling and estimating the risk associated with substantial fire insurance claims. The research contributes to the insurance field by offering an improved mathematical and statistical framework for modeling significant fire insurance claims. Through this approach, insurers can better comprehend the potential financial consequences of rare fire incidents, facilitating more informed risk assessment and resource allocation. In summary, this study's methodology and findings have significant implications for managing and mitigating the risks associated with fire related losses in the insurance sector.

In terms of modeling significant fire insurance claims through the extreme value approach, our recommendations encompass several key points. It is advisable for insurers to employ the three-parameter Generalized Pareto Distri bution (GPD) within this approach, enabling a robust assessment of risk associated with substantial fire insurance claims. Moreover, insurance companies are encouraged to allocate capital for potential large losses, guided by the Value at Risk (VaR) and Expected Shortfall metrics calculated from the three-parameter GPD under the Ex treme Value Theory framework. Leveraging insights derived from this methodology, companies can then formulate well-informed strategies for pricing and capital reserving that align with the distinct risk profile of fire insurance policies. In addition, we recommend that, future research should include other methods for estimating VaR of fire loss such as Historical method and compare results to Extreme VaR and also, should extend univariate EVT models to multivariate EVT models that may capture a broad spectrum of covariates of fire occurence influencing fire losses to commercial property.

ACKNOWLEDGEMENTS

The authors would like to thank the Mathematical Sciences department of the University of Malawi.

List of Abbreviations

The following table below lists abbreviations in the manuscript:

Abbreviation	Meaning
EVT	Extreme Value Theory
GPD	Generalised Pareto Distributions
POT	Peaks Over Threshold
GLM	Generalised Linear Models
GEVD	Generalised Extreme Value Distribution
ES	Expected Shortfalls
VaR	Value at Risk
RBM	Reserve Bank of Malawi
MLE	Maximum Likelihood Estimation

MSE	Mean Square Error
MEF	Mean Excess Function
ccdf	Complementary Cumulative distribution function
AD	Anderson Darling test
Q-Q plot	Quantile-Quantile plot

Declarations

Availability of Data

Data will be made available upon request.

Competing interests

The authors declare that there are no competing interests.

Funding

The authors received no funding from any any agency.

Author's contributions

The manuscript concept design and supervision was done by Nelson Dzupire, coding and analysis was done by Dan Kachusa, and finally the manuscript development was done by Samuel Gyamerah.

Ethical Approval section

This is not applicable.

REFERENCES

1. Jean-Philippe Boucher, Michel Denuit, and Montserrat Guill´en. Risk classification for claim counts: a com parative analysis of various zeroinflated mixed poisson and hurdle models. *North American Actuarial Journal*, 11(4):110–131, 2007.
2. Anna Chernobai, Krzysztof Burnecki, Svetlozar Rachev, Stefan Truck, and Rafał Weron. Modelling catastrophe ¨ claims with left-truncated severity distributions. *Computational Statistics*, 21:537–555, 2006.
3. Louis Anthony Cox, Jr. Community resilience and decision theory challenges for catastrophic events. *Risk Analysis: An International Journal*, 32(11):1919–1934, 2012.
4. Jon Danielsson. *Financial risk forecasting: The theory and practice of forecasting market risk with implementa tion in R and Matlab*. John Wiley & Sons, 2011.
5. Georges Dionne and Denise Desjardins. A re-examination of the us insurance market's capacity to pay catas trophe losses. *Risk Management and Insurance Review*, 25(4):515–549, 2022.
6. Souvik Ghosh and Sidney Resnick. A discussion on mean excess plots. *Stochastic Processes and their Applica tions*, 120(8):1492–1517, 2010.
7. Sarah B Henderson, Kathleen E McLean, Michael J Lee, and Tom Kosatsky. Analysis of community deaths dur ing the catastrophic 2021 heat dome: Early evidence to inform the public health

response during subsequent events in greater vancouver, canada. *Environmental Epidemiology*, 6(1), 2022.
8. Owen Jakata and Delson Chikobvu. Extreme value modelling of the south african industrial index (j520) returns using the generalised extreme value distribution. *International Journal of Applied Management Science*, 14(4):299–315, 2022.
9. Stuart A Klugman, Harry H Panjer, and Gordon E Willmot. *Loss models: from data to decisions*, volume 715. John Wiley & Sons, 2012.
10. Christian Laudag´e, Sascha Desmettre, and Jorg Wenzel. Severity modeling of extreme insurance claims for ¨ tariffication. *Insurance: Mathematics and Economics*, 88:77–92, 2019.
11. Franc¸ois M Longin. The asymptotic distribution of extreme stock market returns. *Journal of business*, pages 383–408, 1996.
12. Olive Mwihaki Mugenda and Abel Gitau Mugenda. *Research methods: Quantitative & qualitative apporaches*, volume 2. Acts press Nairobi, 2003.
13. James Kiprotich Ng'elechei, Joel Cheruiyot Chelule, Herbert Imboga Orango, and Ayubu Okango Anapapa. Modeling frequency and severity of insurance claims in an insurance portfolio. *American Journal of Applied Mathematics and Statistics*, 8(3):103–111, 2020.
14. Cyprian Ondieki Omari, Shalyne Gathoni Nyambura, and Joan Martha Wairimu Mwangi. Modeling the fre quency and severity of auto insurance claims using statistical distributions. 2018.
15. Wan-Kai Pang, Shui-Hung Hou, Marvin D Troutt, Wing-Tong Yu, and Ken WK Li. A markov chain monte carlo approach to estimate the risks of extremely large insurance claims. *International Journal of Business and Economics*, 6(3):225, 2007.
16. Gabriel Raviv, Barak Fishbain, and Aviad Shapira. Analyzing risk factors in crane-related near-miss and accident reports. *Safety science*, 91:192–205, 2017.
17. Swiss Re. World insurance: Riding out the 2020 pandemic storm. *sigma*, 4:1–34, 2020.
18. Lukasz Scislo. High activity earthquake swarm event monitoring and impact analysis on underground high energy physics research facilities. *Energies*, 15(10):3705, 2022.
19. Lin Wang and Ali M Kutan. The impact of natural disasters on stock markets: Evidence from japan and the us. *Comparative Economic Studies*, 55:672–686, 2013.
20. Simon Kinyua Weru, Antony Waititu, and Antony Ngunyi. Modelling energy market volatility using garch models and estimating value-at-risk. *Journal of Statistics and Actuarial Research*, 2(1):1–32, 2019.