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Demographic Crises in China & Japan

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Discovering Thoughts, Inventing Future

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Comparative Study of Contemporary Demographic Crises in China and Japan

By Meirkhanov Dastan
SDU University

Abstract- The demographic crisis is among the major global issues that concern the scientific community. Some countries, such as China and Japan, are already experiencing their multifaceted impacts, while others, like Kazakhstan, have yet to face them. Given the relevance of this issue, the present thesis explores the contemporary demographic crisis from a comparative perspective, focusing on China and Japan as case studies. Although there are a significant number of related articles about the demographic crisis, in particular its cause, the political, social, cultural, and economic effects, and case studies of different states, there has been a lack of in-depth analysis from a comparative framework. Especially, there are few studies connecting the similarities and differences of the demographic crises between China and Japan. Thus, this thesis seeks to address this gap in the literature by applying a comparative study.

China and Japan share the same cultural circle and are close to each other, which enables us to do a comparative analysis of these two countries. The result reveals the complexity and interconnectedness of similar and different patterns that lead to demographic deterioration in these East Asian countries. The study employs a mixed method where most collected data comes from qualitative sources (secondary data) and a minorly portion from quantitative sources (official statistics provided by the governments of China and Japan).

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Comparative Study of Contemporary Demographic Crises in China and Japan

Meirkhanov Dastan

Abstract- The demographic crisis is among the major global issues that concern the scientific community. Some countries, such as China and Japan, are already experiencing their multifaceted impacts, while others, like Kazakhstan, have yet to face them. Given the relevance of this issue, the present thesis explores the contemporary demographic crisis from a comparative perspective, focusing on China and Japan as case studies. Although there are a significant number of related articles about the demographic crisis, in particular its cause, the political, social, cultural, and economic effects, and case studies of different states, there has been a lack of in-depth analysis from a comparative framework. Especially, there are few studies connecting the similarities and differences of the demographic crises between China and Japan. Thus, this thesis seeks to address this gap in the literature by applying a comparative study.

China and Japan share the same cultural circle and are close to each other, which enables us to do a comparative analysis of these two countries. The result reveals the complexity and interconnectedness of similar and different patterns that lead to demographic deterioration in these East Asian countries. The study employs a mixed method where most collected data comes from qualitative sources (secondary data) and a minorly portion from quantitative sources (official statistics provided by the governments of China and Japan). For the theoretical framework, the thesis applies the demographic transition, demographic dividend, and dependency ratio theory as they directly relate to the cases of China and Japan. Following that, the thesis discusses the importance of the contemporary demographic crisis to China's emergence and its global role. Consequently, the research study presents recommendation options to partially alleviate the consequences of demographic aging in China by referring to Japan's experience.

Introduction

The 21st century has brought about remarkable technological and societal advancements, such as globalization, the widespread use of smartphones, and rapid internet development. However, this century also brought some serious negative challenges, like terrorism, global warming, pollution of different sorts, and finally demographic decline, or, commonly referred to as demographic crisis. The significance of this global issue comes with its new patterns, demographic decline, or growth, for most of world history depended on external factors, like plagues, diseases, war, natural disasters, and so on. And the ratio between fertility and mortality was more or less balanced, both exhibited high death and high birth rates. Later, the improvements in the quality of healthcare and hygiene allowed humanity to decrease the high death rate among infants, which sparked population growth, even raising concerns in the related scientific communities that humanity might "overpopulate" itself in the future. In contrast, the current state of affairs shows the exact opposite result - we are facing not overpopulation, but depopulation, at least, the statistical projections firmly show that. The depopulation term in this thesis refers to the decline in the country's population size, either due to low replacement level, high mortality rate, or immigration. In this study, we focus on the demographic crises in two East Asian countries, namely Japan and China, and compare their unique characteristics that lead to this challenge, try to find similarities and differences between them, and give suggestions to the People's Republic of China regarding this problem by referring to Japan's long experience in this field.

While Japan has been experiencing aging of its population for several decades and is considered to be a pioneer in this category, China is only beginning to confront the full consequences of its aging population and declining fertility rates. Given the shared geographical proximity and cultural circle of these East Asian countries, a comparative perspective becomes practical. This leads us to the main research questions: What are the similarities and differences of contemporary demographic crises in China and Japan? How have Japan's policies addressed its demographic crisis? What is the impact of the demographic crisis in China on its global role as an emerging power?

As objects of this study are to find out the similarities and differences of demographic crises between China and Japan, with the following recommendation policies for China, both research methods are used, majorly qualitative and minorly quantitative, such as comparative method, secondary data, media reports, research articles, and statistical indicators from authoritative sources such as the UN's Department of Economic and Social Affairs, World Population Prospects, the Statistics Bureau of Japan, and China's National Bureau of Statistics like 7th National Population Census.

The thesis is based on one of the social sciences theories - the demographic transition and the

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demographic dividend. The demographic transition theory describes humanity's population transformation from the historical high birth rate and high death rate to low birth and death rates as societies develop. Though the dependency ratio is not a theory, this thesis connected it with the demographic dividend in one theoretical framework, as both these concepts complement each other and were a driving force for certain demographic policies made by China and Japan. In this sense, the more detailed explanation will be given in the main body.

The thesis findings confirm that there are both comparative and contrasting patterns and factors that have shaped the demographic crises in China and Japan. One such factor is the Confucian culture, which plays out as both a bane and a boon in terms of human capital development in both states. Another common pattern is also observed in population-related policies, such as China's One-Child Policy and Japan's liberalization of abortion laws, where the underlying motivation for these measures was primarily economic. Whereas the contrasting patterns have been attributed to the differences in the political systems, China, as a hierarchical authoritarian state, enables more direct and strict enforcement mechanisms compared to Japan's democratic framework of non-interventionist and indirect encouragement strategies. A noteworthy difference also lies in how the demographic decline is perceived, whereas China largely frames it as an economic challenge, Japan, on the other hand, has come to see it as an existential crisis, although, used to interpreting it as a temporary phenomenon. Based on the collected data, this thesis proposed the following recommendations to the People's Republic of China in addressing its demographic crisis: advance the capabilities of senior talents, improve the quality of human capital, and follow up on the lessons and policies from Japan, such as the rural revitalization policies, and reshape the understanding of this demographic crisis.

This research thesis is also subject to several limitations and shortcomings. Firstly, the reliance on secondary data, such as research articles and official sources, might not provide enough depth of analysis, as was discussed and reviewed by other researchers. Secondly, the focused comparative analysis of Japan and China offers a well-focused approach, yet it also significantly narrows the scope, which might be detrimental in suggesting policy recommendations. Lastly, the lack of primary research methods, such as interviews, surveys, limits the scope of this thesis as there is no updated available information on the younger generations' attitude and reluctance to have bigger families for comparative analysis. As a result, it is not possible to evaluate whether there are similar perspectives among working-age people in China and Japan.

I. Literature Review

The demographic crisis is a worldwide phenomenon, affecting every nation either currently or expected to face it in the foreseeable future. Understanding the root causes of these shifts is crucial, as their implications extend to economic performance, national security, and social and political stability. East Asia, one of the world's most populous and economically significant regions, warrants particular attention. This review focuses on the demographic challenges faced by the People's Republic of China (PRC) and Japan, examining their causes, consequences, and policy responses. The importance of the demographic crisis lies in the changes in the structure of consumption. As was analyzed, the age between 18 to 50 is the highest period when people consume the greatest variety of consumptions be it livelihood protection, acquisition of assets, cultural entertainment, children's education, etc., but due to the aging of the population, it is most likely that half of our daily consumption will decrease or disappear, with that many industries and entertainment that target young and the middle-aged people like bars, theme parks will face shrinking of capital (Luo, 2023).

Currently, we are living in an aging and shrinking world, even though until the mid-2080s, the Earth's population will continue to increase from the current 8 billion to approximately 10.3 billion, and then will gradually decline as per the data from the World Population Prospects (UN Department of Economic and Social Affairs, 2024). In this report, key messages were that the overall estimated projections made by the United Nations are becoming more pessimistic, as the current estimations of the world's population are expected to be about 6% smaller than a decade ago. Secondly, one in four people globally is living in one of the states whose population has already peaked in 2024, which are major developed and developing countries such as China, Japan, the Russian Federation, Germany, etc. With the projection that in the next thirty years, the total population will decrease by about 14% in those states, significantly affecting some of the countries in the Balkan region, such as Albania, Bosnia and Herzegovina. Thirdly, the global fertility rate stands at 2.25% per woman, with half of the countries facing the replacement crisis as the birth rate in those countries is below the replacement rate of 2.1 per woman. At this moment, one-fifth of countries are facing what is called an "ultra-low" fertility crisis, which includes China, and the UN estimates that for the "ultra-low" fertility countries, it is unlikely that countries in this category will return to the replacement rate of 2.1 children per woman. Lastly, the 2070s will become the turning point for the global population as the number of elderly people will surpass that of children under the age of 18,

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and those countries whose populations have already peaked will experience this shift even sooner.

The accuracy of demographic data of the People's Republic of China has further complicated the issue of evaluating and analyzing the projections of the state of China's population and where it will go. Eberstadt (2019), in his article, considered the limited value of China's population data, where he argued that the current statistical data faces many "errors" and "instability" as a legacy of the Maoist era, where due to mass misreporting by ordinary people to avoid Beijing's harsh population control and politicization of demographic rhythms of life resulted in the loss of about 30 million people according to the United Nations Development Programme 2010. Čajková and Čajka (2021) similarly pointed out that the prediction of China's population was based on wrong and distorted data that might have been the result of political elites knowingly or unknowingly modifying the facts. They primarily referred to the book "Big Country with an Empty Nest" by Yi Fuxian (2013), which concluded that Chinese population statistics were based on false and exaggerated data since 2000 and that the actual size of the Chinese population may be 100 million smaller than what the National Statistical Office states. Further complications were added by Wenxuan Luo (2023), who made a comprehensive analysis with a similar statement that the 2016 National Population Development Plan (2016-2030) assumption is wrong or optimistic, which predicted China's population to be 1.42 billion in 2020. However, the result was different than this prediction. In addition, the United Nations (UN) also overestimated in 2019 the population growth of China. Nine scenarios existed for China's population. The medium scenario assumes total fertility rates of 1.70, also 1.72, with 1.73 for 2015-2020, further 2020-2025, plus 2025-2030, respectively. Although the UN World Population Prospects of 2022 lowered China's future population projection parameters, a general trend of slowly increasing total fertility in China from 2023 onwards remained (World Population Prospects, 2019). However, China's total fertility rate was around 1.15 in 2021 and fell to less than 1.1 in 2022, and it is predicted to decline further as the fertility build-up effect disappears.

Historically, East Asia used to be the region with the highest fertility rate, but currently, it has the lowest birth rate in the world. In China, countermeasure policies such as the two-child policy and the three-child policy are very ineffective in solving the issue of young people being reluctant to have children. Babaev (2023) stated that the high cost of housing, education, and healthcare, coupled with changing cultural attitudes toward family size, has dampened efforts to encourage larger families. However, this reluctance to have children is not unique to China but is also evident in other East Asian countries, such as Japan and South Korea. If in Japan, young people are low in the desire to have children, then in South Korea, they oppose it, as shown in South Korea's statistics, where the fertility rate has fallen to 0,78, the lowest among all nations. China, having a lower fertility rate than Japan, is closer to South Korea in this regard. Wenxuan Luo (2023) proposed that the reason behind it is not purely economic, like the high cost of living, real estate, education, etc., but rather cultural. In this sense, he referred to the Confucian culture that is predominant in countries with Chinese influence, where Confucianism is in fundamental conflict with the modernization of society, a cultural/economic model that is being imported from Western countries. The Confucian patriarchal-traditional model of the "Chinese family" emphasizes early marriage and childbirth, the belief that "the more sons, the more happiness," and the notion that "men are superior to women" Čajková & Čajka, 2021). This stands in contrast to the principles of a market-oriented economy, which advocate for later marriage and childbirth, gender equality, and increased labor force participation by women, with its principles that affected the status of marriage. This has transformed people from "natural" beings to economic beings, with fertility being an economic choice. At the macro level, it has become a conflict between individual rational choice and the overall needs at the national level (Luo, 2023). This choice has significantly changed the marriage patterns, as in the example where the first marriage of Chinese women averaged 23.57 years in 1998, while in 1970, it was 20.8 years (Čajková & Čajka, 2021). Another issue of the modernization of society is the speed of modernization, which has been happening rapidly in East Asia. According to Luo (2023), they had to face many problems in a short period that had accumulated over a long period in other countries, such as high housing costs, low welfare, and "996 work" (work from 9 a.m. to 9 p.m., six days a week).

The demographic challenges that China faces are undoubtedly traced back to the implementation of population policies in the form of the "one-child" policy. The necessary stimuli for such a policy were partially justified by Professor Ma Yinchu from the University of Beijing, who, in his book "A New Population Theory," proposed a reduction in overcrowding and a method of ensuring appropriate population growth in the country. To better promote the one-child policy, different tools were used by the authorities of the PRC, such as various posters, slogans, newspapers, television, and radio advertisements. Their advantage was that they were able to attract people's attention thanks to their visual elements and low-cost effectiveness. Another section was a "rewards and repressions" system supporting families with one child. Families with one child were given better standards of life, like better options with housing, better healthcare services, and a higher salary (Čajková & Čajka, 2021). In this case, females and mothers were eligible for paid "maternity leave",

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whereas, for the second child, the state did not give any benefits. At worst, families were obligated to pay an "offense" fee for the third child and other sanctions for not complying with the one-child regulations. Because of these strict regulations of the population policy, nearly 200 million children were conceived unborn in China between 1975 and 1995 (Čajková & Čajka, 2021).

Many researchers discussed that one of the troubling legacies of the one-child policy is the "squeezing marriages", where the inequality of gender will lead to millions of men struggling to have a spouse (Eberstadt, 2019). By 2010, Xizhe Peng (2011) noted that due to parents' strong preference toward male children, prenatal sex determination resulted in a sex ratio of 118 males for every 100 females. In certain provinces, the disparity of SRB (sex ratio at birth) reached 130, and in some localities even exceeded 150 (Eberstadt, 2019). In a certain Chinese village, the ratio of second-born children has reached 100 girls to 250 boys (Čajková & Čajka, 2021). Traditionally, in East Asian countries, the family formation was influenced by the Confucian ethos called the "universal marriage norm", which encouraged continuing the family lineage through the male line (Eberstadt, 2019). But now in most of those countries, like Japan, South Korea, Taiwan, Hong Kong, etc., these practices are disappearing, and China will also face this type of issue due to the gender imbalance. Counterintuitively, the effect of "gender imbalance" might also have a positive spill-over effect. Gary Becker and Richard Posner (2009) have speculated that China's shortage of females would ultimately raise their "value" in a beneficial way. Unfortunately, however, this so-called increase in women's worth has largely resulted in kidnapping, sex trafficking, and other human rights abuses. Presently, there is no viable strategy for "squeezing marriages". Some regions, like Hong Kong, have dealt with their female shortages by "importing from abroad," but China is facing a scale issue. Mainland China would need a huge number of voluntary women for its relatively poor innerlands (Eberstadt, 2019).

Eberstadt (2019) also raised an additional possible consequence of surplus in China's male population. For example, he cited the author of the Bare Branches thesis, Valerie Hudson (2002), who argued that a surplus of males tends to create domestic and international tensions. Conversely, Feng et al. (2001) contended that throughout China's history, customs and institutions have long been adapted to this type of demographic anomaly. And, according to Eberstadt (2019), in the foreseeable future, China may indeed be rising, but its growing power and wealth will coexist with an increasing number of frustrated young men facing worsening personal prospects. And their expectations will be influenced not by history and institutions, but by the marriage opportunities remembered within their lifetimes, where China's marriage imbalance might serve as an independent variable.

Many studies like the works of Čajková & Čajka (2021), Banister (1984, 1998), Feeney & Feng (1993), and Greenhalgh (1986) predicted that, if population growth continued at the same rate, with 3 children per family, then by 2000 there would be 1.4 billion people in China, and by the middle of the 21st century the total population of China would have been 2.92 billion people. In the alternative assumption of 2 children per family, then the population of China would grow to 1.22 billion in 2000 and increase to 1.54 billion by 2050 (Čajková & Čajka, 2021). Indeed, China's population increase started in 1950 due to the improvement in the healthcare system that decreased the crude death rate from 25 per thousand in the 1950s to about 7 per thousand today, coupled with the average fertility rate of 5.8 births per family in 1970 (Peng, 2011). Since 2000, the aging of the population has been ongoing, with the proportion of elderly people above 65 increasing from 7% to 8.9% by 2010. The articles of Zheng (2021) and Akimov et al. (2021) both studied the 2020 Seventh Population Census in the PRC with the noteworthy result of an ever-increasing proportion of elderly people that reached nearly one-fifth of the total population. The outlook for elderly people is expected to increase by nearly 150% by 2040 (Eberstadt, 2019). The United Nations population projection of May 11 estimates that by 2050, the proportion of people at the age of 60 and over will reach 33.9%, which means every third citizen of the PRC is expected to be senior.

Another focus that many researchers have reflected on like the works of Nielsen and Fang (2007), Kang (2023), Babaev (2023), Luo (2023), Čajková & Čajka (2021), Pathak (2023) were the impact of demographic decline on the economy and economic growth in general. Bruni (2011) discussed the impact of the demographic crisis on the labor market with the shift from an unlimited labor force to its shortage within the 2023-2048 time period, with varying degrees per different scenarios. According to The Replacement Migration Report of the United Nations Population Division, *"among the demographic variables, only international migration could be instrumental in addressing population decline and population aging in the short to medium term"* where many developed countries like the US, the EU member states, Australia and Russia are already relying on external migration flow to fill the labor shortage, and China will be no exception. Others studied the dependency ratio and demographic imbalance as a primary factor in the relationship between demography and the economy like Eberstadt's article titled "China's Demographic Outlook to 2040 and Its Implications", where he argued that the demographic dividend in China has already cashed and that the dependency ratio of China in 2040 will be identical to

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1982. However, their importance diverges since nearly all the population of non-working age at that time consisted of kids, while in 2040, most will be older adults. On the other side, Kang (2023) noted the positive impact of China's one-child policy on economic growth by reducing the youth DR that allowed the less financial burden of childcare, thereby enabling higher levels of savings and increased investment.

Japan, on the other hand, has been experiencing a demographic crisis for at least half a century (from the 1970s). And, this demographic decline was labeled as "shoushika". This term "shoushika" itself was first coined by the Japanese government in 1992 to describe the declining number of younger generation needed to replace the older generation in the population structure. (Respatiadi et al., 2024). Still, only in recent years, there seems to be a shift in the dealing approach, where the Japanese government aims to no longer prevent the crisis itself but mitigate its effects (Tkaczyński et al., 2023). They noted that there seemed to be a lack of clear and specific national demographic policies for many years, where they assumed that Japan has been unable or unwilling to find a comprehensive response to the issue at hand, perhaps due to the short-sightedness of the political players and the long-term nature of the demographic crisis. The deeper statistical analysis showed us that the "symptoms" of demographic decline showed themselves as early as the 1920s. The authors proposed that the partial decline in the fertility rate was explained by the liberalization of abortion law in Japan since the initiation of the law in 1948, which resulted in one million abortions per year between 1953 and 1963 (in 1960, there were 1.60.,041 births to 1.063.256 cases of abortion). The reason for the implementation of such a law in the conservative society of Japan was purely economic, with the example of the widespread popularity of the 2+2 family model. Among the quoted reasons for the termination of the pregnancy are: the cost of child support (30.1%) and the cost of the child's education (29.6%). Tkaczyński et al. (2023) noted the growing trend of later marriages with an increase in the average age of men and women getting married and people who consciously chose not to marry, and its relevance to the birth rate, but despite that, the fertility rate among people in formal relationships remains constant. With this, the author proposes that one of the reasons for the demographic changes is due to the increasing number of "new single people" (nyūshinguru).

Starting in the 1980s, the average age of young people marrying began to rise in Japan, particularly for men. At the same time, the proportion of men remaining unmarried by age 50 also increased. In 1970, only 1.7% of men were unmarried by that age; by 1990, this figure had risen to 5.6%. According to estimates from Japan's Bureau of Statistics (2021), the rate had already reached 23.4% by 2015. Tkaczyński et al. (2023) concluded that there were serious gaps in understanding the issue of the demographic decline, firstly, only starting in the early 1990s demographic decline seriously reached the Japanese people, secondly, according to McDonald (2006), the reason for such poor consideration of the issue in 1970-1980s was due to the belief that low fertility rates were only short-term phenomenon. Thirdly, there was the illusory belief that the introduction of certain family-oriented policies would automatically translate into the anticipated effects, or that the ramifications of low fertility rates could be tackled by immigration policy, which was not considered an effective remedy (Tkaczyński et al. 2023). That latter specific idea, nonetheless, has not been earnestly considered in Japan until now. This is due to a certain lack of broad public acceptance of the use of that "lifeline". Lastly, Tkaczyński et al. (2023) stated that the existing policies and solutions are not regarded as effective and long-term solutions, which leads to the conclusion that Japanese society needs a cultural change. Such a transformation would reflect the serious consideration and understanding among the Japanese public about demographic aging.

Similarly, in their recent research, Kaneda et al. (2024) emphasized the need for a broader approach, suggesting that addressing social issues like gender expectations and workplace culture could be essential for a sustainable policy to address Japan's demographic challenges. Their analysis indicates that even significant policy interventions, including more child allowances and other benefits, are expected to have only a minor effect on fertility rates. Despite allocating resources amounting to about 1% of GDP (around 5 trillion yen), the projected rise in fertility rates remains limited to just 0.05–0.1 percentage points. Additionally, closing the gender gap in domestic labor to match the OECD average could contribute another 0.1 percentage point increase in fertility. Japan's demographic research, grounded in evidence-based policymaking, suggests that much more substantial changes will be necessary to tackle these challenges. Kaneda et al. (2024) proposed that dealing with the issue requires much more than simply fiscal measures; deeper social factors, along with established gender norms, current workplace culture, as well as rising housing costs, must also be mindfully deliberated. The preceding administration of Prime Minister Fumio Kishida should assess the immediate effect of its policies on birth rates, along with an assessment of their long-term social implications. Certain policies, such as remote work options and reduced overtime, can particularly encourage flexible work environments. These policies afford employees additional time for family life and establish a deeply supportive atmosphere for child-rearing. Studies from the U.S. and Germany have shown that such measures significantly boost fertility intentions, particularly among highly educated women. Japan's

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demographic crisis may ultimately require comprehensive workplace reforms and greater male participation in household responsibilities. While these changes will take time, evidence-based analysis suggests they could meaningfully contribute to population growth. Much like economic policies, such reforms offer a sustainable, culturally relevant solution that demands urgent attention.

Respatiadi et al. (2024) emphasized the role of women in society in Japan. As women in Japan gain greater access to education and professional careers, many are choosing to prioritize their careers over traditional family roles. The social construction of modern Japanese women's roles, influenced by policies such as Womenomics, has encouraged women to participate more in the workforce but has inadvertently led to a decline in marriage and birth rates. Economic considerations also play a major role, as raising children in Japan is perceived as costly, contributing further to the decline in birth rates (Respatiadi et al. 2024).

One of the lessons from the Japanese experience that Luo (2023) recommended to the PRC is the increase of the retirement age from 60 to 65, as in Japan. In another article by Čajková and Čajka (2021), the authors also noted the current retirement age in China of 60 years old for men and 50 years old for women working in companies, and 55 years old for women officials. They argue that it is ineffective and unrealistic in contemporary China with its high level of life expectancy. The author remarked that a particular policy made by the Japanese government, the "Angel Plan", was developed in 1994 to accommodate the falling fertility rate. According to this policy, Japan's kindergartens are free, and families receive a monthly allowance of 150 euros from the fourth month of pregnancy until the end of secondary school (Luo, 2023). Alternatively, he proposed following the example of Japan, investing more in education to improve the workforce quality to mitigate the consequences of demographic changes, which has successfully helped Japan capture the second demographic dividend of the aging demographic transition and has contributed to economic growth. Similarly, Nielsen and Fang (2007) also proposed more extensive investments in human capital through education and vocational training to maintain economic growth in the face of a shrinking labor force.

Additionally, Hakatani (2023) explored the importance of critically examining and assessing Japan's demographic crisis, emphasizing the experience, wrongdoings, successes, and failures made by this East Asian country. Japan is well-known for having the longest period of aging and an aged population. Therefore, sharing lessons learned from the experience of pioneer countries could significantly contribute to the challenges of the late stages of demographic transition, as many nations from different regions will soon walk the same path as Japan and other aging countries. Similarly, Mo & Wei (2020) in their book "Scientifically Understanding and Responding to the Challenge of Aging in China" highlighted key recommendation points for developing effective strategies for overcoming demographic aging in China. One such is what they term the "late-developing advantages". Since demographic transitions and aging occurred much earlier in most developed countries, with Japan being at the forefront of this trend, Mo & Wei (2020) argued that China can learn from the successes and failures of developed countries while considering its national characteristics and circumstances. This, furthermore, adds the necessity to thoroughly examine the demographic crises in China and Japan from the lens of a comparative framework, as both countries are close culturally, economically, and regionally, they can be an aspiration reference to each other.

The demographic crisis is a complex topic that needs continuous research and attention to be addressed properly. Many scholars dedicated their research to the effects, historical patterns, causes, and potential solutions to the later stages of demographic transition. In the case of China, much of the research focuses on the impact of the demographic transition on economic stability and growth, while in Japan, the dilemma of the aging population has become an existential issue, where Japan is no longer trying to solve the demographic crisis but to mitigate its effect as much as possible. However, there is a noticeable lack of comparative articles that discuss the demographic crises in China and Japan. In most cases, when evaluating China's demographic crisis, other countries like Japan were given the secondary point of reference of what should or should not be learned from, rather than engaging in a direct comparative analysis. Therefore, this work will examine the demographic transition toward the aging of the population in China and Japan comparatively by identifying the similarities and differences in social, political, and cultural contexts that directly or indirectly led to the demographic transition between these two Eastern Asian countries.

a) Theoretical Framework

i. *Demographic Transition Model*

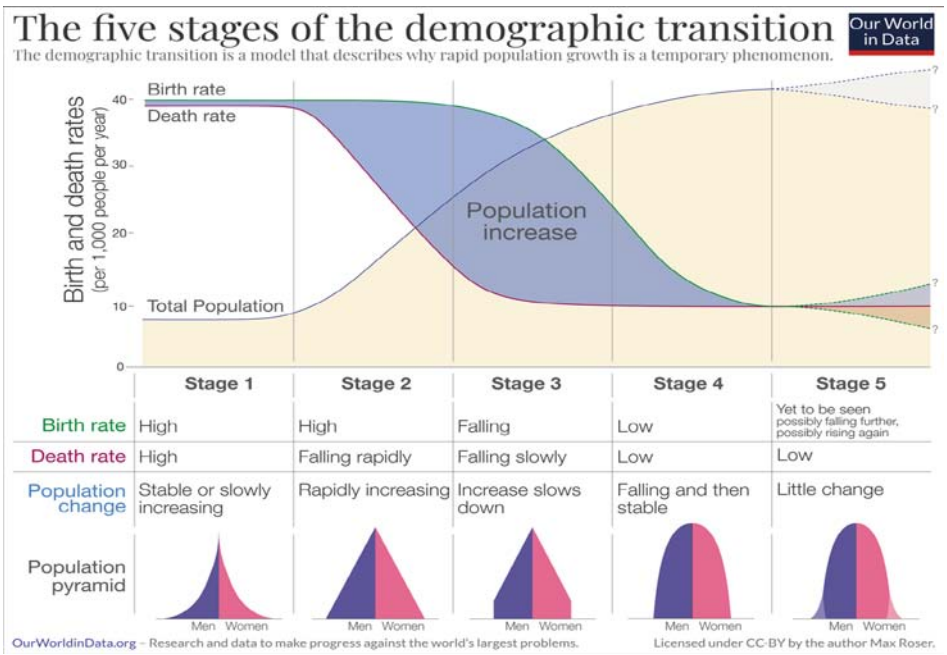
The present thesis is grounded in the demographic transition model theory, which indicates that changes in population size, whether increasing or decreasing, are not random events that occur without warning, akin to natural calamities such as famines, earthquakes, tsunamis, or diseases, but instead represent a rational stage in the progression of human society. Demography as an area of research has a lengthy past, stretching back to ancient eras, but contemporary demographers emerged only in the 17th century in the United Kingdom. The initial demographers analyzed baptism and burial statistics to investigate the

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mortality rate among individuals and their ages at death, aiming to ascertain the average number of men in military service and the childbearing age of women. In the 19th century, as mortality rates dropped, a focus emerged on fertility rates, highlighting the necessity to examine the other aspect of demographic studies, such as fertility levels. The variations in mortality and fertility rates are effectively clarified by the "demographic transition," with the timing of shifts in mortality and fertility being the key elements of the demographic transition. Based on the information from “Our World in Data” (2023), there are five phases of transition represented by population pyramids (see Figure 1):

1. Throughout most of humanity’s history, societies birthed as well as killed at high rates, thus populations grew little over time. A wide base of the population pyramid is indicative of a high birth rate, but high mortality rates are the cause of narrowing near the top, particularly in the case of children.
2. In the demographic transition's second stage, mortality rates begin to fall because health improves, but birth rates stay at high levels. More children are surviving cause rapid population increases now. Yet it is a unique time. In this era, large families with a full complement of surviving children have become quite typical.
3. After this point, birth rates fall, and population growth decreases. Fertility drops for many reasons, because the economy as well as society shift, and because living conditions improve, with gender typically changing, women have more opportunities, children are less valuable, and even more expensive.
4. This concluding stage fully marks the ending of rapid population growth, because birth and death rates constantly remain quite low, and that leads to nearly stagnating population growth. The population pyramid has taken on a somewhat box-like shape. This is reflected by essentially similar cohort sizes among younger ages. The size decreases in a way that is visible at older ages.
5. Currently, some ambiguity exists in regard to the growth rate for the population because it is tied strongly to the fertility of people. According to some expert research, women develop as well as are at advanced stages of life, fertility might rebound, also that stabilizes or even raises population numbers in the future. However, if fertility rates remain under 2 children per woman, long-term population decline is likely to occur.

From this table, it can be seen that the dynamics of the birth rate is only a temporary phenomenon, since a decrease in mortality is always followed by a decrease in the birth rate, and with a time difference. This pattern is regularly observed in all societies, regardless of their culture or religion. Additionally, the level of development is also another key indicator explaining the continued decline in fertility and mortality rates. But that comes about first four stages, yet what possible 5th stage represents is yet to be known, specifically regarding the birth rate. It might fall further, it might increase again, it all depends on how people will handle this social phenomenon.



Source: Adapted from https://ourworldindata.org/demographic-transition Copyright 2023 by Max Roser

Figure 1: Representation of the Five Stages of the Demographic Transition

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ii. *Demographic Dividend and Dependency Ratio*

Another significant theory this thesis is based on the economic theory of demographic dividend, which refers to economic growth due to the change in age/population structure. Usually, it occurs due to the fall in mortality and fertility rates. A country that switched from both high fertility and mortality rates (rural agrarian economy) to low mortality and fertility (urban industrial society) receives an "economic dividend" or increase in productivity among the working population. With the low birth rate, the number of young dependents (children and youths who have yet to participate in productive activities) grows smaller relative to the working population. This frees the economy's resources as there are fewer people to support and more people in the labor force, and gives room for more investments in other sectors, which in turn accelerates economic growth. According to Kenton (2024), there are two types of demographic dividend periods - the first lasting around five decades or more, which in later stages ends with the growing percentage of elderly people. When the older working population faces a retirement period, they have a strong incentive to accumulate passive income to sustain themselves. These assets are usually invested in domestic and international enterprises and investment vehicles, this is referred to as the second demographic dividend, which continues to be earned indefinitely. The dependency ratio is a statistical indicator that measures the proportion of dependents—individuals aged 0 to 17 and those over 65—relative to the working-age population, defined as those aged 15 to 64. While not a theoretical framework itself, the dependency ratio effectively complements the demographic dividend theory, serving as both a supportive metric and a reinforcing point of analysis. It is sometimes referred to as the total or youth dependency ratio and is used to understand how the burden is placed on those of workforce age by those of non-working age. According to the data from the World Bank, in China, the dependency ratio is 46.5%, and in Japan, it is 70.1%, which means that for every 100 people of working age, there are more than 46 and 70 seniors and children who have to be supported, respectively. China and Japan are examined as comparative case studies to better understand these trends and their policy implications. By analyzing their successes and failures concerning the theoretical frameworks, potential policy options can be derived to address future population challenges.

II. Discussion

a) *Similarities between Demographic Crises in China and Japan*

i. *The Confucian Culture*

The Culture, particularly Confucian values, is the first and most important factor that unites China and Japan. Confucianism traces its origin back to Kong Qiu, or Master Kong (Kongfuzi), who lived 551 - 479 BCE, whose name was later romanized and is now known as Confucius in the Western World. Littlejohn (2011) in his "Introduction to Confucianism" book referred to the words of Zongsan Mou (1909-1995) about Confucianism as a "religion of ethics" where the central goal was to "become a sage within" a process of alleviating of themselves through the cultivation of virtue, morality, nobleness, knowledge, emotions to the point of becoming a different kind of being. According to the author, such transformation is not exclusively internal or external, but rather about creating a new balance or harmony. Externally, it means changing the interaction and being with others, bringing the best out of them, learning from them, helping them, and moving forward along with them. Internally, it is about cultivating wisdom, harmony, virtue, morality, and peace. In the era of the Han Dynasty (206 BC-AD 220), the traditions of Confucianism were fully adopted by the ruling class and intellectuals (Kim, 2009). Confucianism also laid down the role of the cosmic order: Heaven and earth (the physical stage); material things; male and female (life stage); husband and wife (social life stage); father and son (patriarchal stage); sovereign and subject (the political stage); high and low; and propriety and righteousness (the constitutional stage, and the moral stage). Additionally, filial piety and loyalty to social order were emphasized by Confucianism as the key to social stability (Kim, 2009).

To maintain a focused analysis and understanding of Confucianism and its vast impact on East Asia, we will focus on its impact in a way that directly correlates with its role in the demographic crises currently unfolding in China and Japan. Throughout the long history of Confucianism, it has been supplemented, adopted, redefined, and rethought. The political, public, and economic development of the Confucian traditions of patriarchal authority, filial piety and loyalty in the extended family-like social relations, thrift, hard work, and most of all, respect for scholarship and learning, and bureaucratic privilege, have all been deeply integrated into East Asia. Japan stresses the importance of group harmony and social cohesion, called "wa", where the employees are inspired to regard themselves as family members and the workplace as one big family with the CEO as a family head. Also, due to the cultural context of Japan, Japanese Confucianism features inclusivity and subjectivity in its pursuit of "truth", rather than the "goodness" of classical Chinese Confucianism, which stresses morality, harmony, stability, and ethics. (Yan & Pan, 2010). As for China, social behavior and relations revolve around Guanxi (personal connection). Guanxi is about the exchange of favors between two or more people, usually of unequal status, in which a weaker partner asks for a favor from a stronger partner without the need to reciprocate equally (Alston, 1989). Though there seem to be different variations across East

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Asian countries, they all trace back to Confucianism social values, which stress the "unequal" or "hierarchical" regulations for harmonious order (Kim, 2009). During the nineteenth and early twentieth centuries, Japan adopted the Western modernization model (Meiji era) and disregarded the Confucian model up until the end of the Second World War. In China, during Mao's era, Confucianism was attacked in the course of the communist modernization process. However, later on, Confucianism was praised as the backbone of belated, but rapid economic take-off and sustainable industrialization in Japan, then South Korea, Taiwan, Hong Kong, and Singapore - collectively known as newly industrialized countries (NICs), and now in China (Berger, 1986, 1988, Tu, 1984, 1996, Tai, 1996). After Mao's era, when China rose to prominence in the global market, it reevaluated and revived Confucianism as one of the core diplomatic strategies for promoting China's "soft power". For one, more than 120 Confucius institutes have been opened around the globe to promote Chinese culture and language, with the first being opened in South Korea, Seoul, in 2004.

Surprisingly, the connecting point between Confucianism and Demographic Crises in China and Japan is its opposing or recently discovered encouraging roles in the modernization process in East Asia. Luo (2023) argued that the demographic crisis in China is not solely rooted in economic factors but is also deeply tied to cultural aspects. He highlights explicitly that Confucian values as fundamentally at odds with the Western model of modernization. This argument holds weight, as scholars such as Bellah (1957, 1968), Eisenstadt (1968), Morishima (1982), Weede (1996), and Bell & Hahm (2003) have attributed the lack of economic development (modernization) in East Asia to Confucianism as a primary reason. In particular, the paternalistic models of family and social relations, coupled with the importance of "pedagogic" attributes in training and selecting the governmental elites of Confucianism, have been regarded as both a stagnation and an outstanding success of economic development in East Asia. For example, Yoshihara Kunio, a famous Japanese Development economist, states that the best way to speed up economic development is through a strong government or a "Developmental State" which *educates* the population and initiates a dynamic private sector (Yoshihara, 1977, 1994, pp. 196–197, 202; Berger, 1997, p. 269). This, in return, requires highly developed educational institutions, which refers to the characteristics of Confucian "pedagogic" ideas, which again, centralized government, strong educational institutions, hierarchical social order, strong belonging of a person to a company/organization, etc.

Paradoxically, it seems the same Confucian ideas (particularly pedagogic ones) became one of the main reasons for the demographic deterioration in China and Japan. Pedagogic ideas of Confucianism became the driving force of the development of the vast human resources in China and Confucian-influenced countries (such as Japan) with its characteristics of memorization, high competition, test-oriented education, exam-driven promotions, meritocracy, repetition, and the use of education as a means to attain advancement in the social hierarchy. Nevertheless, this pedagogic system has its drawbacks, first of all, personality limitations. This system is mostly suitable for people with good memory, hard work, resilience, and good at examinations. Kim (2009) argued that over time, this type of elitism created rigidity in Korea, with typical characteristics of arrogance, insularity, and cronyism that can corrupt Confucianism's principles of egalitarian educational opportunity and meritocratic selection. Currently, educational and general immigration from China and Korea, for example, to English-speaking countries shows that there is strong public demand for alternative "internationalized" education at all levels in East Asia. By the core Confucian principles, comes yet another setback in the form of the high pressure and competition that deprives the East Asian youth of the motivation to constitute a family, not to mention the prospects of establishing larger families. This is why I believe that the Confucian pedagogic values, despite increasing the quality of human resources in China and Japan, played a crucial role in the demographic crises in these countries.

ii. *The One-child Policy and Liberalization of Abortion Law*

Notably, both China's one-child policy and Japan's liberalization of abortion laws exhibit parallels in their underlying economic rationale, suggesting that demographic interventions in both countries were significantly influenced by broader economic objectives. The abortion law initiated in 1948 by the Japanese government was regarded as at least partially responsible for the decline in the birth rate since 1950 (Tkaczyński et al., 2023). The criteria for the termination of pregnancy for Japanese women were as follows:

1. Pregnancy or giving birth may seriously jeopardize the mother's health due to physical or financial factors.
2. The pregnancy resulted from rape, or the woman became pregnant without having the ability to consent or resist.
3. The pregnancy can only be terminated by the mutual consent of both the woman and her husband. However, such consent is not required in the case when the father is unidentified, unable to express his will, or when the woman is unmarried.

In the first decade of its implementation (between 1953 and 1961), around one million abortions were performed per year. The year of 1960 was unusually high with abortion rate compared to other years, i.e., 1.606.041 births to 1.063.256 abortions.

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Another aspect that contributed to the overall decline in the 1960s is the optimality of the 2+2 family model that gained widespread popularity due to economic reasons. Over time, the abortion rate decreased, yet so did the birth rate - in 2020, it was 840.835 to 141.433, respectively. Unsurprisingly, the younger age groups have a higher share of abortions, i.e., the 20-29 age group accounts for around half of all abortions in 2020. However, it seems Japan, like China, is also experiencing the unreliability of data regarding demographic representations in the official statistics. Both Norgren (1998) and Tkaczyński et al. (2023) argued that there are underreports of abortion due to the taxation on it, which implies a much higher number of actual abortions compared to the official statistics.

In China, a similar, more extreme encouragement policy was proposed, known as the "one-child policy," which was implemented in 1979 by Deng Xiaoping, the second Chairman, in an attempt to increase industrial development through the demographic dividend and by decreasing the dependency ratio (increase in working-age population to that of non-working, e.g. children and elderly people). Another consequent reason was the probability that the excessive population could have hindered the economic development of China (Kang, 2023). Indeed, this concern seemed viable, as without such a policy, it was predicted that the Han population (Chinese people) as of 2015 would have increased by 520 million. Although this data was questioned by many foreign researchers, who saw it as blindly exaggerated, Daniel Goodkind considered the cases of Vietnam and India as the best comparison standards. The reason why these two countries were taken into comparison is that they implemented family planning policies in similar years, with Vietnam's customs, culture, and ideology closely related to China. So, by Vietnam's models, China's population would have reached about 1.7 billion in 2015 and 1.9 billion by 2060. And if the Indian model is followed, China would have been 2.3 billion in 2015 and a frightening 3.3 billion by 2060 (Goodkind, 2017). Another interesting statement was that China's family-planning policy had positively affected the greenhouse gas emissions (Stephenson et al., 2010). even to the point of saying that the one-child policy is the 4th largest contribution to green emissions reduction by 1.3 billion tons of carbon dioxide (Fofana, 2021). With the addition of these statements, Qing (2024) believes that the one-child policy was a historical necessity to stabilize economic growth and human resources at that time, but with it also came the side effects of changes in society's and family structures, gender imbalance, and inequality. Nevertheless, the author believes that the implementation of the one-child policy was effective and strict, even excessively in some regards, which I follow as well. As for the proper implementation of this controversial policy, families had birth quotas for the number of children, which was one, with heavy penalization for "above quotas", and local governments were given incentive contracts for those who succeeded and heavy penalties for those who failed. Interestingly, the prohibition of 2nd child was intended for the ethnic majority of Han (Chinese) people, but for ethnic minorities, there wasn't such a prohibition. In some cases, even 3rd child was allowed, e.g., in Xinjiang and Tibet Provinces, minority women could have as many as four children without any restrictions (Li & Shi, 2025).

To sum up, the Japanese abortion law and China's one-child policy, in a sense, followed the same intention - economic stabilization through better family planning encouragement policies, which both proved to be effective, but with both unique unexpected side effects due to the differences in political environments, which is another subtopic I would like delve into next as differences.

b) Differences between Demographic Crises in China and Japan

i. *Authoritarian System vs Democratic System*

The democratic system and the Authoritarian system belong to different, mostly opposing spectrums of political regimes. Decision-making, power struggle, and priorities differ depending on the type of system. Japan, for example, adheres to the democratic system; China, on the other hand, has an authoritarian system. And each system has a set of distinctive features that make it different from the other.

Although generally speaking, there is no textbook universal definition of democracy, some attempts have been made to give some patterns in modern democracies. Like Kahn (2024), who claims that modern democracies mainly rely on three distinctive normative patterns: 1) rights that uphold the dignity of the individual; 2) law as a manifestation of commitment to public reason; 3) elections as the means for selecting representatives. Another interesting suggestion implies that democracies enable progress through "experiments in living". In other words, a new wave of populism, or similar movements, is not detrimental to the sustainability of democracy, but instead beneficial, as by distributing basic powers indiscriminately, it gives the most vulnerable a fulcrum to initiate changes in practice. This error-trial approach gives in the long term invaluable experience for moral beliefs and practices (Fuerstein, 2024). Japan's model of democracy is mostly seen as a representation of a successful democracy, with strong institutions, the rule of law, a free press, and regular elections. One of its distinguishing features is hybrid forms of governance. On the one hand, it has elements of the US system, like a supreme court and a written constitution; on the other, it features the UK with a constitutional monarch as a nominal head of the state and government (Nilsson-Wright & Wallace, 2022).

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In the general term "authoritarian regime" in the broadest sense, it includes every form of "undemocratic" rule. The most striking difference is that authoritarian systems do not sustain the institutions of elections, participation, separation of powers, plurality of parties, and political competition, fundamental rights, control of power, and so on. But in political science, it is one among three classical types of political rule. Namely, authoritarianism, totalitarianism, and democracy are called "the classical triad". With the end of the Cold War, there are fewer and fewer totalitarian systems in the world, which is why authoritarian and democratic regimes usually take the majority of the spotlight among current researchers. Unlike the vague conception of "democracy", the definition of authoritarianism is advanced by Juan Linz with four defining characteristics: 1) limited, non-responsible, political pluralism - limited presence of multiple political actors, often without genuine competition or accountability; 2) the absence of an elaborate and guiding ideology, having instead "distinctive mentalities" - instead of a fully developed ideology, such regimes rely on vague principles or pragmatic worldviews to guide governance; 3) the absence of both intensive and extensive political mobilization - citizens are not actively engaged or encouraged to participate broadly in political life; 4) the exercise of power within formally ill-defined, but quite predictable, limits by a leader or a small group - authority is concentrated in a leader or group, operating within loosely defined institutional frameworks that, in practice, follow predictable patterns (Schlumberger, 2017). China has been an authoritarian state since its foundation in 1949, and became one of the prime examples of an authoritarian system, having survived many drawbacks and backlashes from its repressive policies, be it the "Great Firewall", surveillance of the populace, political ideologies, and control of the media. This has aroused envy among many authoritarian regimes at China's successes.

Generally speaking, there are many systematic differences between China and Japan. For example, China is a single-party state, which is the Communist Party of China (CPC) with communist ideology. But what this research wants to emphasize is the efficiency differences in responding to challenges by authoritarian systems and democratic ones. For reference purposes, I would like to take the example of how different political systems tackled the issue of COVID-19, specifically democratic and authoritarian regimes. Interestingly, in the case of anti-COVID-19 measures, both regimes had a similarity in narrative - both democratic and authoritarian systems used countermeasures against the pandemic to infringe citizens' rights at a small price for decisive actions. With authoritarian systems going a little bit further, and using the countermeasures as a way to consolidate their power. For one, during that time, tracking of civilians by credit cards and CCTV was legalized in South Korea, Taiwan, Singapore, and China. In essence, the empirical evidence suggests that authoritarian countries have had better health outcomes compared to democratic countries, through strict, hardline governmental intervention in the social life of their citizens, which was accompanied by human rights violations and repressive tactics (Ha et al., 2024). Ironically, while examining the similarities between China's one-child policy and abortion law in Japan in the framework of economic and demographic perspectives, it became evident that the means of attaining similar dependency ratio outcomes were vastly different, likely due to their contrasting political structures. Japan, as a successful case of a democratic state, preferred a more non-interventionist way to encourage responsible family planning through the legalization of abortion. China, on the other hand, with its strong governmental control, preferred more immediate actions, which resulted in the one-child policy. In conclusion, the variation in political systems indeed affects the subtle way of handling challenges, as was seen in the case of the COVID-19 pandemic, as well as in the contrasting approaches in managing demographic issues, such as decreasing the dependency ratio and demographic dividends between China and Japan.

ii. *Existential Crisis vs Economic Crisis*

One of the interesting points from my observation of the literature review is the striking interest among scholars and researchers regarding the impact and consequences of China's unfolding demographic crisis on economic development. A wide range of studies, such as those by Nielsen and Fang (2007), Kang (2023), Babaev (2023), Luo (2023), Čajková & Čajka (2021), Pathak (2023), Mo, L., & Wei, Y. (2020), Qing, Y. (2024), (Cai, 2020), (Petrikov, 2025), (Soo et al., 2023), (Ma, 2022), (Mi, 2022) and more have disseminated in their scientific articles how China's upcoming demographic crisis will likely to profoundly affect the economic trajectory of PRC. These studies have explored various issues, including the development of the market in the post-demographic dividend period, the outward foreign direct investment, the challenges of urbanization, the disappearance of rural areas, the slowdown in GDP, depression, gender imbalance, inequality, high cost of living, and so on. However, it should also be noted that the demographic crisis exerts its most immediate and pervasive influence on the state's socio-economic environment. As such, it has become an undeniable subject of concern across different disciplines, ranging from demographers, macro-micro economists, sociologists, politicians, analytics, social activists, human rights activists, influencers, entrepreneurs, industry businessmen, religious preachers, public health experts, and IGOs, NGOs, IOs, etc. Nevertheless, I believe there was excessive attention toward the economic impact that disregarded the social implications of demographic

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changes in China, both from the academic and governmental perspectives.

In the case of Japan, its roots also lie in the economic fields. If we refer back to the implementation of liberalization of abortions in 1948, the driving force behind it was purely economic. Interestingly, until the 1990s, the demographic decline in Japan was considered a temporary phenomenon, a transitory and changeable challenge akin to natural disasters that happen occasionally. Thus, the hidden danger of this crisis was dormant in the eyes of the public and politicians. There was also overconfidence in the introduction of certain family-planning policies that they would produce the expected outcome soon (Tkaczyński et al., 2023; McDonald, 2006). However, as the situation continued to deteriorate despite the implemented countermeasures, the people's and the government's perspectives also shifted. The crisis came to be viewed not as a temporary phenomenon, but as an anticipated transition, one whose effects must be mitigated and whose reality must be adapted to.

III. The Impact of the Demographic Crisis on China's Emergence and its Global Role

Foreign and domestic affairs are deeply interconnected with each other, or rather, are extensions of each other in the extremely globalized 21st century. The many factors that dictate a country's stance in the global society are related to domestic circumstances like geopolitical conditions, military strength, human resources, strategic location, political stability, ethnic harmony, and the wealth of its land. In this light, the first thing that needs to be considered when discussing the causal effect of demographic decline on China's emergence and its global role is internal challenges brought by it. As this thesis explores this topic through comparative analysis, it is necessary yet again come to Japan's experience. Buchmeier & Vogt (2023), for their case study, took the reference of Japan, where they have noticed three demographic effects on the political system: participation, representation, and policy effects (see Figure 2). The participation effect causes the overrepresentation of elderly people and under-representation of young adults; in other words, it marginalizes young people. In Japan, this is already happening; 57% of voters (59.6 million) are older than 50, and only 43% (44.4 million) are under the age of 50. The representation effect demonstrates the dominance of elderly politicians in the parliament and the government. And, the policy effect which prioritizes the needs of elderly people, and undermines the needs of youth and children, in the example of Japan, the social expenditures toward the older generation account for almost 9% of its GDP, whereas the families and children enjoy only 1.6%. Interestingly, McClean (2021) has found that the younger mayors tend to make more long-term investments in welfare, whereas older mayors tend to provide short-term benefits to elderly people.

Thus, "politics made by the old for the old" has become one of the most pressing issues in contemporary Japan. Although China's political regime differs from Japan's, its experience and closeness to China can still serve as a valuable indicator for China to begin its campaign for more balanced participation, representation, and policymaking between younger and older generations. As China rapidly ages and its old dependency ratio continues to rise, its welfare expenditures are projected to rise significantly, from the current 6% of GDP to 10% or more, like Japan (Ko & Leahy, 2025). This sharp increase in spending will likely constrain China's ability to invest in major international initiatives, such as the Belt and Road Initiative (BRI), as well as infrastructure, market development, and extractive industries in African and Central Asian countries. Another potential consequence of China's demographic aging to its possible emergence is increased social instability. The disproportionality between males and females (118 to 100) might play a significant destabilization factor in China's future decision-making. In this sense, I follow the opinion of Eberstadt (2019), who speculated that the frustrated young, middle-aged, and elderly males who could not find a partner for themselves might become an independent variable that would require extra attention from the authorities. Coupled with the work of Buchmeier & Vogt (2023), these demographic challenges could become a major destabilizing factor for China's future global role.

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Political domain	Effects of demographic transition on democratic systems	
Electoral system	***Participation effects*** Younger generation's underrepresentation as voters	Young adults as numerical minority among the electorate
		Electoral abstention of younger voters
		Malapportionment of voting districts
	Representation effects Younger generation's underrepresentation as representatives	Young adults as numerical minority among MPs, cabinet members, and political candidates
		Structural and cultural hurdles to youth's active political involvement
		Uncontested elections
Policy making	***Policy effects*** Policy bias toward specific age groups	Social policy (e.g., social welfare spending)
		Environmental policy (e.g., climate change)
		Fiscal policy (e.g., public debt)

Source: This graph summarizes the three effects of the demographic transition on democratic systems, from "The Aging Democracy: Demographic Effects, Political Legitimacy, and the Quest for Generational Pluralism" by Y. Buchmeier and G. Vog, 2023, published by Cambridge University Press, Copyright 2023, by the authors.

Figure 2: Effects of Demographic Transition on Democratic Systems

IV. Recommendations

a) Advance the Capabilities of Senior Talents

One of the important consequences of demographic transition to later stages is the ever-growing number of senior citizens that will eventually come close to that of the working age population, or even match it in the distant future. In Japan, according to Statistics Bureau of Japan, Ministry of Internal Affairs and Communications (2025), as of 2025, 29.3% (36,250,000) of the population is 65 and over with the 9.1 million senior workers employed which equals to around 25.3% of total number of Japanese people of 65 or above. The group between 65 and 69 takes roughly half (52%) of the total number of employed senior workers (9.1 million). In China, from the seventh national population census data (2020), persons in the age group of 60 and above accounted for 18.70 percent (264.02 million) of the total population, which showed an increase by 5.44 percent compared to the previous decade, which is expected to continue in the foreseeable future. Therefore, it is essential to develop sustainable strategies to support this demographic shift. Investing in the retraining and requalification of senior citizens appears to be a promising short-term solution with tangible benefits.

b) Improve the Quality of Human Capital

With one recommendation comes another intangible one: improvements in human capital, digitalization, and automation. That recommendation is nothing new since prior researchers have already discussed how investments in human capital are needed now. For better work competitiveness, especially in those fields, the requalification of senior workers comes hand in hand with advancing human capital. That action is a key one, especially in all of those fields. It is likewise important to note the worry that digitalization plus automation could dominate workplaces, leaving some people without employment. Concerning Japan's experience, where it innovates in these fields, Kikuchi et al (2024) revealed in the subsequent research that evidence does not support the claim that automation reduces overall employment rates. Rather, automation shifts employees out of routine work in manufacturing toward service jobs, while establishments and sales simultaneously increase their share of the manufacturing sector. Finally, the shift within labor demand seems more concentrated for younger generations. This shift can also have an effect on workers without a college education.

With these valuable references from Japan's experience, the basis for the initial stage, as well as further research, is more than possible. In 2024, China enacted the National Preschool Education Law. This law is going to take effect on June 1, 2025, and people do see it as being key for ensuring children's future education all across the country. This law ensures the right to quality education, healthcare, and social services regardless of their parents' status (hukou status). UNICEF welcomed such measures as a comprehensive step for a family-friendly society in China. Although such policies are expected to have a positive impact on Chinese society, it is crucial to maintain a vigilant and critical approach during their execution. As this shift in perspective has yet to be fully adopted, continuous monitoring and evaluation are essential to identify potential shortcomings or missteps. This proactive stance will help ensure that this and future related policies do not remain symbolic or ineffective, but instead translate into meaningful and sustained societal change.

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c) Lessons and Policies from Japan

This subsection emphasizes the practical examples of Japan's policies for the evaluation. Primarily, this thesis focuses on Japan's recent rural revitalization policy. Policies aimed at revitalizing rural areas are not a new phenomenon; at some point in its development process, one country or another experiences an increasingly unequal rural-urban division. The work of Guo & Li (2024) showed that, in China, there have been around 70 rural revitalization policy texts between 2018 and 2024, where the authors identified five frameworks that focused on ecological, cultural, talent, organizational, and industrial revitalization. Additionally, the work of Zhou (2019) also supported the notion of following Japan's rural revitalization experience and applying it to China's context. Firstly, the similarities between these two Asian countries make it possible. Secondly, Japan's success in rural revitalization has been attributed to the effective allocation of resources and enactment of laws as the priority, industrial revitalization as the foundation, urban-rural integration as the goal, environmental protection as the bottom line, and top-level design. Thirdly, Japan is one of the few countries with the smallest urban-rural gap, thanks to the aforementioned policies. And lastly, Japan's experience fills the main weakness of China's rural revitalization policies - that is, environmental protection, and by analysing the main measures and characteristics of Japan's experience, it can serve as a good reference for an eco-livable and friendly rural area.

Another significant recommendation derives from this thesis observation of how the scientific community, and scholars, particularly, regard the infant demographic crisis in China from an economic perspective. While economic backlash is the immediate and direct consequence of the demographic crisis, like labor shortages and slowed growth of GDP, it represents only part of the problem. Other profound and lasting societal implications of it include increased loneliness, rising rates of singlehood, and exacerbation of gender inequality. Although these dimensions have been acknowledged in academic literature, they have not received commensurate attention in policymaking or public discourse. The implemented policies and financial subsidies to young parents by governments of different states suggest that this narrow view is mainstream among policymakers. Japan approved the "Direction on Strategy for Children's Future" plan in 2023 under Prime Minister Fumio Kishida, in which the government plans to spend 3 trillion yen (20 billion US dollars) on combating the demographic decline with the emphasis on increased allowance for childbearing and expanding economic assistance. China, similarly, introduced "Several Measures on Accelerating the Improvement of the Birth Support Policy System" in 2024, which includes grants, maternity insurance coverage, and so on. Thus, we must recognize the permanence and multidimensionality of demographic transition, not as a temporary phenomenon. Accordingly, an even more realistic and pessimistic perspective is important to adopt. This mindset shift would enable policy responses to be more comprehensive, timely, as well as effective, and aim at economic stabilization and broader social sustainability.

V. Conclusion

The topic of demographic transition and its painful stages is a multidimensional issue that can be studied from different perspectives, many of which focus on the pressing short-term issues related to the economic impact of population decline. Other popularly studied impacts include social changes, like redistribution of pensions, welfare, late marriages, smaller households, singlehood, and so on. There is also a political impact, with the increasing disparity in representation of younger and older generations. Other researchers examined the current state of the issue through statistical analysis. Alternatively, there is also a relatively less explored comparative perspective of the challenges of the demographic decline. This thesis contributes to understanding the similarities and distinct differences between the demographic crises in China and Japan by employing a comparative framework for analysis. To achieve it, the study has answered the following questions: What are the similarities and differences of contemporary demographic crises in China and Japan? How have Japan's policies addressed its demographic crisis? What is the impact of the demographic crisis in China on its global role as an emerging power?

The present study presented the various demographic similarities and differences between China and Japan, including similarities like Confucian culture, which essentially played a double-edged role in these countries. On the one hand, the Confucian ethical ideas, albeit with some regional differences, played a crucial role in the economic development of China and Japan. Pedagogic teachings in particular greatly contributed to the level of education in China and Japan; nonetheless, the same pedagogic ethics of high pressure, competition, and the importance of quality education demotivated the younger generation to have large families. The similarities between the one-child policy and the liberalization of abortion law lay in the similar logic behind them - the need to decrease the dependency ratio and gain the privilege of the demographic dividend. The less the dependency ratio, the less the need for welfare, childcare, and kindergarten, and by this, the working-age population increases, which supplies a larger workforce that can produce a near-immediate positive impact on the economy through participation and taxes.

One should note that every observed China and Japan's contemporary demographic crises similarities

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and differences are interconnected and represent a continuation of one another. Accordingly, the differences like the authoritarian system in China and the democratic system in Japan are interconnected with the said one-child policy and liberalization of abortion law, as China is an authoritarian state, it is expected that it will enforce a more direct and linear policy to control the demographics. Japan, with its democratic regime, prefers a more subtle way to moderate its population changes. Another distinction is how China and Japan perceive and interpret population aging. As was discussed in the relevant chapter, many contemporary China interested scholars and authorities regard the challenge purely from an economic perspective. Japan, in this sense, sees it as an existential threat. It is noteworthy, however, that initially, Japan also had not taken this phenomenon seriously, and regarded it as a temporary issue, which might explain the current trends in China as well.

Taking the gathered data from similarities and differences as a basis, the thesis proposed the following recommendation policies to China: the need for advancing the capabilities of senior talent; improving the quality of human capital, especially in the field and advanced technologies; shifting the understanding of the demographic crisis; learn lessons and policies from Japan.

In conclusion, the study contributes to the scientific field by exploring the demographic crises in China and Japan from a less-explored comparative perspective. The finding demonstrates that China's demographic transition is already underway, with far-reaching implications for its economic trajectory, social stability, and geopolitical influence. Rising welfare expenditures, a shrinking workforce, and a surplus male population point toward mounting internal pressures that could constrain China's external ambitions. In this context, Japan's experience underscores the importance of holistic, inclusive, and culturally sensitive policymaking.

VI. List of Abbreviations

DC	Demographic Crisis
DD	Demographic Dividend
DR	Dependency Ratio
DT	Demographic Transition
EA	East Asia
GDP	Gross Domestic Product
PRC	People's Republic of China
SRB	Sex Ratio at Birth
UN DESA	United Nations Department of Economic and Social Affairs
WPP	World Population Prospects

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LNG in India's Energy Transition: Balancing Geopolitics, Sustainability, and Economic Growth

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Abstract- This paper is descriptive in nature and examines various aspects of the Energy Sector as related to LNG. India's energy sector must critically balance rising energy demands, environmental concerns, economics, and energy security. With the government's goal to increase the share of natural gas in the energy mix from 6% to 15% by 2030, Liquefied Natural Gas (LNG) has emerged as a critical energy component. LNG is a method for transporting natural gas over long distances when pipelines are not feasible. The article examines LNG's expanding role in India's energy portfolio, focusing on several key aspects, including economic advantages, energy security, and generating local employment through the development of LNG infrastructure. Environmentally, LNG significantly reduces air pollutants and CO_2 emissions. Challenges to LNG adoption are also considered, including infrastructure deficits, regional accessibility issues, price volatility, and competition from renewable energy sources. The article concludes by discussing the future of LNG in India's energy mix, recommending further investment in infrastructure, stable LNG pricing, and policy measures to support LNG's role as a transition fuel. It also recommends steps for the Government and the LNG industry to maximize the use of this form of energy. By addressing these challenges, LNG can play a strategic role in enhancing India's energy security, environmental sustainability, and economic resilience.

Keywords: *natural gas, LNG, CO_2 emissions, energy transition, LNG Carrier, pipelines.*

GJHSS-H Classification: *LCC: HD9581.I4*

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LNG in India's Energy Transition: Balancing Geopolitics, Sustainability, and Economic Growth

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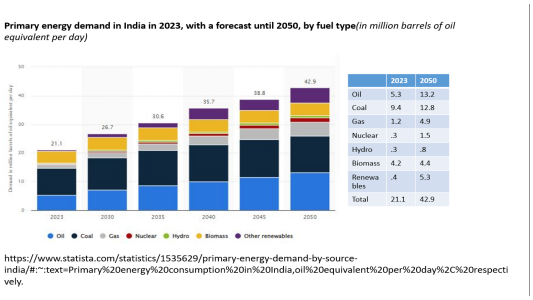
Abstract- This paper is descriptive in nature and examines various aspects of the Energy Sector as related to LNG. India's energy sector must critically balance rising energy demands, environmental concerns, economics, and energy security. With the government's goal to increase the share of natural gas in the energy mix from 6% to 15% by 2030, Liquefied Natural Gas (LNG) has emerged as a critical energy component. LNG is a method for transporting natural gas over long distances when pipelines are not feasible. The article examines LNG's expanding role in India's energy portfolio, focusing on several key aspects, including economic advantages, energy security, and generating local employment through the development of LNG infrastructure. Environmentally, LNG significantly reduces air pollutants and CO_2 emissions. Challenges to LNG adoption are also considered, including infrastructure deficits, regional accessibility issues, price volatility, and competition from renewable energy sources. The article concludes by discussing the future of LNG in India's energy mix, recommending further investment in infrastructure, stable LNG pricing, and policy measures to support LNG's role as a transition fuel. It also recommends steps for the Government and the LNG industry to maximize the use of this form of energy. By addressing these challenges, LNG can play a strategic role in enhancing India's energy security, environmental sustainability, and economic resilience.

Keywords: natural gas, LNG, CO_2 emissions, energy transition, LNG Carrier, pipelines.

I. Introduction

India, as one of the world's fastest-growing economies, faces a rising demand for energy to fuel its industrial growth, urbanization, and economic development. Historically dependent on coal, oil, and biomass, the country's energy mix has led to challenges related to air pollution, energy security, and sustainability. This reliance on fossil fuels has made it crucial for India to adopt cleaner energy sources as it works towards achieving its Net Zero pledge.

As a cleaner and more efficient energy source, LNG has the potential to diversify India's energy imports, reduce pollution, and provide a stable supply to meet its ever-increasing energy needs. The Indian government has set an ambitious goal of increasing the share of natural gas in the energy mix from 6% to 15% by 2030. [1] This article explores the impact of LNG on India's energy landscape, highlighting its economic, environmental, and geopolitical implications. It examines the role of LNG in reducing dependence on oil imports, lowering coal imports for the power sector, enhancing energy affordability, and mitigating emissions. It also addresses challenges such as infrastructure limitations, price volatility, and competition with renewable energy sources. By understanding LNG's position in India's energy basket, we can appreciate both its immediate benefits and its potential as a bridge to a cleaner energy future. [2]



Source: Primary energy demand by fuel type India 2023-2050., https://www.statista.com/statistics/1535629/primary-energy-demand-by-source-india

Figure 1: Primary Energy Demand in India in 2023

Figure 1 illustrates the growth in demand for LNG in India's energy mix over the years, projecting an increase to 4.9 million barrels of oil equivalent per day in 2050, compared to 1.2 million barrels of oil equivalent per day in 2023. [3]

II. Role of LNG in India's Energy Transition

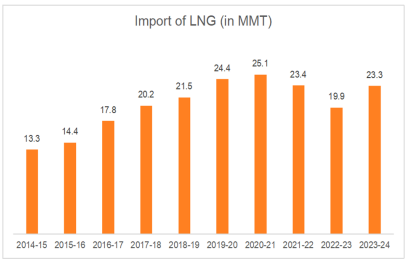
LNG is natural gas liquefied at -160°C. During the liquefaction process, natural gas is purified to a very high level, enhancing its combustion properties. Natural gas, particularly in the form of LNG, is universally recognized as a cleaner fuel compared to traditional fossil fuels such as coal and oil. One of its main advantages is its significantly lower emissions profile. When burned, natural gas produces about 50% less carbon dioxide (CO_2) than coal and around 20-30% less than oil, aiding in the reduction of greenhouse gas emissions that contribute to global warming. Additionally, it emits negligible amounts of sulfur dioxide (SO_2) and other pollutants that are major contributors to air quality issues, especially in urban areas. [4]

Quoting the statement of IEA Director of Energy Markets and Security, Keisuke Sadamori, "India's gas

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market is entering a new phase of growth, supported by significant infrastructure. The prospect of higher gas demand in India coincides with an expected wave of new global LNG supply. However, it will require careful planning and market coordination to ensure supply security and to help gas compete in a price-sensitive market," [5]



Source: Petroleum planning & Analysis cell: https://www.ibef.org/blogs/strengthening-india-s-lng-ecosystem-investigating-collaborative-efforts-to-boost-lng-infrastructure [7]

Figure 2: Import of LNG

In 2023-24, 23.3 MMT of LNG was imported to India from many gas-surplus countries, mostly after long-term contracts. Advancements in LNG infrastructure, including regasification terminals and pipelines, have made natural gas accessible to a wider range of sectors, supporting its use as a bridge fuel during the transition to renewable energy sources. LNG infrastructure in India is helping exports of LNG. Thus, restriction on the use of only locally available gas is negated. While methane leaks from natural gas extraction and distribution pose an environmental challenge, strict regulations and advanced technologies for leakage detection can mitigate these risks, further positioning natural gas as an essential component of sustainable energy strategies.

LNG is economically competitive compared to other fossil fuels, primarily due to its cost efficiency, stable pricing methods, and versatility across sectors. For industries such as power generation, fertilizers, and transportation, LNG is very suitable with lower costs than oil and coal. It also has a high energy yield per unit. Additionally, LNG usage incurs lower environmental compliance costs. The global LNG market's growth has stabilized the cost of energy imports, particularly for oil. India benefits economically by reducing its reliance on volatile oil markets through diversified LNG imports from Qatar, the U.S.A, and Australia. As global demand for cleaner fuels grows, LNG's cost competitiveness in the energy mix ensures a balanced and sustainable economic future.

LNG infrastructure plays a pivotal role by providing the flexibility and scalability required to meet the growing energy demand across diverse sectors. Key components of this infrastructure include regasification terminals, which convert imported LNG back to gaseous form for distribution, along with an expanding network of pipelines. These pipelines transport natural gas to power plants, industrial hubs, and urban areas, creating a nationwide distribution system. Expanding this network supports government goals to increase the share of natural gas in the energy mix and promotes less polluted cities.

III. Government Policies and LNG Infrastructure in India

Demand for LNG is growing in urban areas and industries. To achieve the goal of 15% LNG in India's energy mix by 2030, the government has introduced a series of initiatives and investments. These include expanding LNG infrastructure, such as terminals, pipelines, and city gas distribution networks.

The focus is on developing LNG regasification terminals along India's Western coast in the states of Gujarat and Maharashtra. These terminals facilitate large-scale LNG imports, enabling India to diversify its energy sources and reduce its dependency on oil and coal. The government is also encouraging investments in new terminals along the Eastern coastline to expand LNG access and storage capabilities.

In addition, the expansion of the national gas pipeline network is crucial for transporting natural gas to industries and urban centers across the country. Many private players are being awarded contracts for laying these additional pipelines. Initiatives like the Pradhan Mantri Urja Ganga Project also aim to supply natural gas in underserved regions. Moreover, investments in city gas distribution systems and compressed natural gas (CNG) stations support the use of cleaner fuel in urban areas for households, transportation, and commercial use. Finally, the government policy on the use of CNG in public transport increases demand for LNG at ports.

The Indian government encourages the growth of LNG imports and infrastructure, recognizing LNG's role in achieving the country's energy and environmental goals. To increase LNG's share in the energy mix, the government has reduced tariffs on LNG imports and simplified import regulations and policies that facilitate the establishment of LNG infrastructure. By lowering tariffs, the government makes LNG a more competitive option for industries such as power generation, manufacturing, and transportation, allowing them to access cleaner energy at more affordable prices.

The government has also relaxed procedures and approval systems for establishing LNG infrastructure, including regasification terminals, storage facilities, and pipelines. The Petroleum and Natural Gas Regulatory Board (PNGRB), India's key regulatory body for the gas sector, has simplified licensing processes

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and introduced open-access policies for pipelines. This enables both private and public entities to invest in and operate LNG terminals, enhancing competition and facilitating infrastructure development. City gas distribution (CGD) licenses have been expanded to cover more urban areas, promoting LNG's use as a clean fuel in residential and commercial sectors. The government's "One Nation, One Gas Grid" initiative aims to integrate the pipeline network across states, further supporting LNG's reach. Special Economic Zones (SEZs) and industrial hubs enjoy additional benefits, such as tax breaks on LNG use.

IV. LNG Terminals

India has expanded its LNG import capacity over the past decade to support its increasing energy demands. LNG terminals have been established in coastal states such as Gujarat, Maharashtra, and Kerala, with additional terminals planned for the Eastern coast. These facilities are designed to import, store, and regasify LNG, transforming it from liquid back to gaseous form so it can be distributed through pipelines to meet industrial, commercial, and residential energy needs. [10]

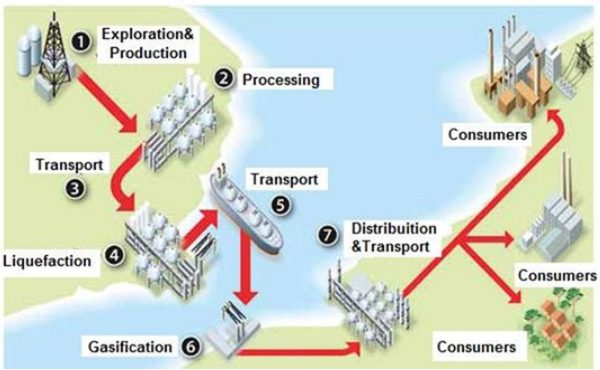


Figure 3: LNG Import and Regasification Infrastructure

The sketch in Figure 3 illustrates the complete process of LNG import and regasification infrastructure. The terminals in Gujarat, including those at Dahej, Hazira, and Mundra, are among the largest in the country and have played a pioneering role in India's LNG import infrastructure. Maharashtra's terminal at Dabhol, Jaigarh, along with the terminal at Kochi in Kerala and Ennore in Tamil Nadu, further enhances India's import capacity, supplying gas to industries and urban areas while also encouraging a shift away from coal and oil.

Dahej LNG Terminal: India's first LNG terminal, located at the port of Dahej, has a capacity of 17.5 million tonnes per annum (MMTPA) and is in the process of increasing to 22.5 MMTPA. It has storage capacity for two jetties, with the first able to handle up to 220,000 cubic meter LNG tankers and the second able to handle up to 265,000 cubic meter vessels. It is owned and operated by Petronet LNG, India's largest LNG importer.

Hazira LNG Terminal: It is owned and operated by Shell Energy India (SEI). This deep-water, multi-cargo port is situated 25 kilometers from Surat. It features a protected harbor design with a 1,000-meter approach channel, a draft of 11.5 meters, and a turning radius of 600 meters.

Dabhol LNG Terminal is owned by Konkan LNG Ltd (KLL) and was commissioned in 2013. It consists of three storage tanks, each with a capacity of 160,000 cubic meters, and has a receiving capacity of 5 MTPA, providing access to natural gas for India's southern and western states.

Kochi LNG Terminal: It is a regasification terminal operated by Petronet LNG in Puthuvype, Kochi, with a capacity to store and distribute 5 million tonnes per annum. It has a long-term contract with Australia for LNG.

Ennore LNG Terminal: It is an LNG import, storage, and regasification terminal in Tamil Nadu, located at Kamarajar Port, formerly known as Ennore Port. The facility is operated by Indian Oil LNG Private Limited, a joint venture of Indian Oil Corporation Limited (IOCL). The terminal has a capacity of 5 MMTPA.

Mundra LNG Terminal (Gujarat): A joint venture between the Adani Group and Indian Oil Corporation, this terminal has a capacity of 5 MTPA and supports industrial growth in western India.

Jaigarh LNG Terminal (Maharashtra): Developed by H-Energy (now part of the Hiranandani Group), this terminal has a capacity of 4 MTPA and features a floating storage and regasification unit (FSRU), enhancing India's flexible LNG import capabilities.

The Indian government is also focusing on expanding LNG facilities along the eastern coast, with planned projects in states such as Odisha and Andhra Pradesh. The Visakhapatnam LNG facility is in an advanced stage of completion. These new terminals will enhance energy access for the Eastern and North-Eastern regions of India.

V. Case Study of Expansion of Dahej LNG Terminal Since 2005

As the Dahej LNG terminal is India's first LNG 'Receiving and Regasification Terminal', its growth over the years directly reflects the increase in LNG usage and imports in India. It began with an initial capacity of 5 MMTPA at Dahej, Gujarat. The terminal's capacity has been expanded in phases and currently stands at 17.5 MMTPA, with further expansion planned to reach 22.5 MMTPA in additional phases. The terminal has 8 LNG storage tanks and various vaporisation facilities. In FY 2023-24, PLL handled approximately 74% of the nation's total LNG imports and accounted for roughly 34% of the

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overall natural gas consumption in the country. Details of the expansion are shown as under.

First Expansion (2009): Increase to 10 MMTPA. Due to the growing demand for natural gas in the power, fertilizer, and city gas distribution sectors, Petronet LNG undertook its first capacity expansion. By 2009, the terminal's capacity was doubled from 5 to 10 MMTPA. This phase included the construction of additional storage tanks and enhancements to the regasification infrastructure. The second jetty was commissioned to accommodate a higher number of LNG cargoes. New send-out pipelines and vaporizers were also added to manage the increased flow of regasified LNG (RLNG).

Second Expansion (2016–2017): Scaling up to 15 million metric tons per annum (MMTPA). In response to sustained industrial demand and increased imports of spot and term LNG cargoes, Dahej's capacity was further expanded to 15 MMTPA by 2017. The company added new Shell-and-Tube vaporizers, pipeline systems, and upgraded the existing unloading and storage infrastructure. This expansion enabled PLL to engage in more long-term agreements with global LNG suppliers and supply additional LNG to various sectors, including city gas, refineries, and steel plants.

Third Expansion (2019): Reaching 17.5 MMTPA. By June 2019, the Dahej LNG Terminal's capacity was further expanded to 17.5 MMTPA, making it one of the largest LNG terminals in South Asia. This expansion included the commissioning of additional regasification units, increased unloading arms, and enhancements in pipeline evacuation capacity. It also involved debottlenecking the existing facilities to optimize performance. The capacity boost was strategic, enabling India to import more LNG to meet its growing energy demand.

Fourth Expansion (2019): Reaching 22.5 MMTPA. The fourth expansion, which adds an additional 5 MMTPA of capacity, raises the overall total to 22.5 MMTPA and was scheduled for commissioning by June 2025. Petronet LNG has now delayed the launch of the expanded import capacity at the Dahej facility due to logistical challenges and security concerns following the flare-up in India-Pakistan relations. Consequently, the launch has been postponed to September 2025.

Dahej Terminal is the largest single-location LNG storage and regasification terminal in the country, handling 3538 LNG cargoes as of September 30, 2024. The terminal also offers tolling services to small and bulk customers. To cater to small customers who do not have gas pipeline connectivity, Dahej supplies LNG to these customers, which is transported via cryogenic trucks. PLL Dahej is the first terminal to start loading LNG onto trucks for supply to areas that have not yet been reached by pipelines. Today, it has four truck loading bays and serves as a hub for developing the small-scale LNG business.

The author visited the Dahej LNG terminal to gain a better understanding of LNG infrastructure in India and received a first-hand briefing from officials at Petronet LNG.

VI. Economic Impact of LNG in India

Energy Cost Saving Liquefied Natural Gas (LNG) is a much cheaper and more efficient energy source, particularly for industries with high energy demands, such as fertilizers, petrochemicals, and refineries. In recent years, LNG prices have been relatively lower than those of crude oil, driven by the global surplus of natural gas reserves and the expansion of liquefaction and regasification infrastructure. As a result, industries are shielded from the sharp price fluctuations commonly associated with oil. Fertilizer production depends heavily on natural gas as a feedstock for ammonia synthesis. Similarly, refineries, which consume vast amounts of energy for crude distillation and cracking, benefit from LNG's efficiency and lower costs. LNG's efficient combustion properties mean that it generates more energy per unit, making it highly economical for industries' output and cost management. As LNG combustion produces less wear and tear, it is associated with lower maintenance costs for LNG-powered equipment. By switching to LNG, industries gain the double benefits of cost savings and lower carbon emissions, aligning with global sustainability goals and potential regulatory incentives.

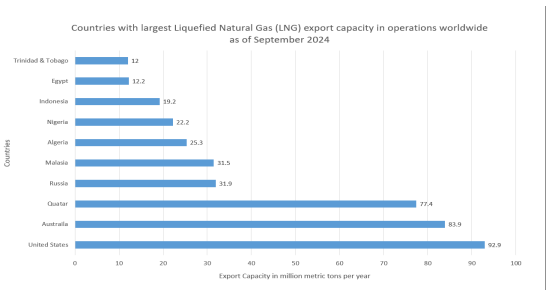
The development of LNG infrastructure enhances employment opportunities, both directly and indirectly. As the demand for LNG rises, investment in new LNG terminals, pipelines, and distribution networks becomes essential. This infrastructure development requires a diverse workforce, leading to the creation of numerous jobs across various sectors and fostering community development through both direct and indirect job creation. Most new LNG pipelines pass through remote areas; their construction and maintenance employ local manpower and construction equipment, boosting the local economy and development. The construction phase of LNG terminals involves skilled labor, including engineers, construction workers, electricians, and project managers. These projects often continue for several years, thus providing long-term employment. Once operational, LNG terminals require staff for operations, maintenance, and safety management, leading to long-term job creation.

The LNG sector also requires specialized training programs to equip the workforce with necessary skills. These initiatives promote a culture of skill development, benefiting local communities by enhancing workers' employability and contributing to the overall economic growth of the region.

LNG plays an important role in diversifying India's energy imports, significantly reducing the

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country's reliance on oil from specific regions, especially West Asia. By importing LNG, India can access a broader range of suppliers, including countries like the United States, Australia, and various nations in Africa and Southeast Asia. To compare the volumes of LNG imports, the total LNG traded in the world in 2022 was 402.8 MMTPA, with India importing 20.79 MMTPA, which accounted for 5% of the global total. During his second term, Trump is focusing on increasing LNG production due to developments in shale gas extraction techniques, particularly horizontal drilling and hydraulic fracturing (fracking), also known as the "Shale Revolution." Many other countries have very high export capabilities that India needs to exploit, as shown in Figure 4.



Source: https://www.statista.com/statistics/1262074/global-lng-export-capacity-by-country/#:~:text=The%20United%20States%20has%20the,million%20metric%20tons%20per%20year [11]

Figure 4: Countries with Largest LNG Export Capacities in Operations Worldwide

This diversification mitigates the risks associated with price volatility and supply disruptions that often accompany reliance on a limited number of oil-producing regions. As global LNG markets continue to expand, India can negotiate better terms and prices, enhancing its energy security and economic stability. Investing in LNG infrastructure further supports this diversification strategy, enabling the country to build a robust supply chain that includes import terminals, regasification facilities, and transportation networks. By tapping into the potential of LNG, India not only secures its energy future but also ensures a resilient and sustainable economy.

VII. Environmental Impacts of LNG Usage

Reduction in Air Pollution: LNG burns more cleanly and efficiently; thus, the transition to LNG as a major energy source, especially in urban areas, represents an important step toward improving air quality and reducing environmental pollution and health risks. The combustion of LNG results in lower emissions of sulfur oxides, nitrogen oxides, and particulate matter, making it an effective alternative for urban environments plagued by air pollution. Coal and diesel contain high levels of sulfur, which contribute to acid rain and respiratory problems in humans. By replacing these fuels with LNG, cities can achieve dramatic reductions in sulfur emissions, leading to improved air quality and health outcomes for residents. Nitrogen oxide emissions are a major contributor to ground-level ozone formation and smog. LNG combustion emits significantly lower NOx levels compared to other fossil fuels. Particulate matter (PM) is another major pollutant associated with fossil fuels. These fine particles cause cardiovascular and respiratory diseases. This reduction in air pollution will encourage more urban areas to switch to CNG and LPG, leading to more efficient pipelines for supply to meet demand. More demand requires better regasification plant facilities and, to complete the chain, more LNG imports. Lower CO2 Emissions. The use of LNG offers significant advantages in reducing carbon dioxide (CO2) emissions, making it an important player in the fight against climate change. While natural gas is still classified as a fossil fuel, it emits approximately 50% less CO2 compared to coal and 20-30% less than oil when combusted for energy. By transitioning from coal and oil to LNG, India can make substantial progress toward its climate goals, particularly in sectors such as power generation and transportation. This shift not only helps lower overall greenhouse gas emissions but also supports India's aim to increase the share of cleaner energy sources in its energy mix. Furthermore, LNG's role as a transitional fuel is vital for integrating renewable sources like solar and wind into the energy grid.

Methane Emissions Concerns: Concerns regarding methane emissions from infrastructure and transportation remain significant. Methane, the primary component of natural gas, is a potent greenhouse gas with a global warming potential over 25 times greater than that of carbon emissions over a 100-year period. Leakages can occur at various points in the LNG supply chain, including extraction, processing, transportation, and regasification. These emissions not only undermine the climate benefits of switching to LNG but also present challenges in accurately assessing its overall environmental impact. Even small leaks can contribute substantially to greenhouse gas concentrations in the atmosphere, particularly in regions with extensive natural gas infrastructure. To mitigate these concerns, it is crucial to implement robust monitoring and management practices aimed at detecting and minimizing methane emissions. Advanced technologies such as infrared cameras and drone surveillance can help identify leaks.

VIII. Geopolitical Implications of LNG in India's Energy Security

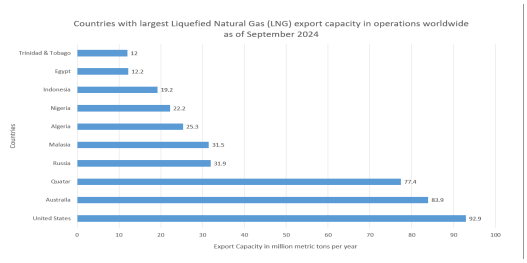
India's energy security is at a critical juncture as the nation's economy grows and energy demands surge. LNG has emerged as a vital component of India's energy portfolio, addressing the dual challenges

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of energy access and environmental sustainability. Beyond its economic and environmental significance, LNG has profound geopolitical implications, particularly in energy independence, strategic relations, international partnerships, and trade agreements. It also provides India with greater diplomatic leverage in international negotiations, especially as energy becomes a core issue in global politics.

a) *Energy Independence:* India's heavy reliance on oil imports, primarily from volatile regions such as West Asia, has long posed strategic challenges. LNG presents a way to diversify energy imports, thereby reducing vulnerability to geopolitical disruptions. By sourcing LNG from different countries, India strengthens its energy independence.

b) *Diverse LNG Sources:* India imports LNG from major exporters, including Qatar, Australia, and the United States. Each of these regions offers distinct advantages. Qatar has been a reliable supplier of LNG, with India securing long-term contracts for consistent supply. The geographical proximity of Qatar to India ensures lower transportation costs and quicker delivery times. Australia provides another layer of diversification. As a stable supplier with significant production capacity, Australia offers India an alternative source that mitigates overdependence on the Middle East. Australia has become a major trading partner in all fields of energy, thus adding to this advantage. The U.S. has emerged as a significant LNG exporter, offering India access to advanced energy technology and flexible contracts. Russia remains an important energy partner, with projects like the Arctic LNG initiative exemplifying India's willingness to explore unconventional sources to secure its energy future.

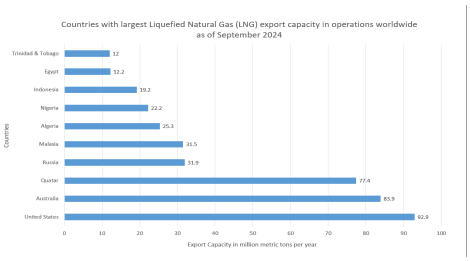


Source: https://www.iea.org/data-and-statistics/charts/lng-exports-for-a-selection-of-exporters-2014-2024 [13],

Figure 5: LNG Exports for a Selection pf Exporters, 2014-2024

As we analyze Figure 5, which shows LNG exports from the USA, Australia, Qatar, and Russia, we see that Qatar has been a regular supplier since 2014 with a long-term contract. USA exports have been consistently rising since 2016 and are currently the largest exports to India. Similarly, India has been importing large quantities from Australia.[14]

c) *Strategic Storage and Infrastructure Development:* To maximize the benefits of diversified LNG imports, India has invested in strategic storage and infrastructure. The development of LNG terminals, regasification facilities, and pipelines ensures efficient distribution and utilization. Strategic reserves of LNG further buffer against supply shocks, enhancing resilience. Figure 6 shows the storage tank capacity of LNG for various countries. India has a storage tank capacity of 3.1 million cubic meters, while Japan has the highest at 18.7.



Source: https://www.statista.com/statistics/723079/lng-global-storage-tank-capacity-by-country/ [12]

Figure 6: Storage tank capacity for LNG in 2003, by major county/territory

d) *Environmental Considerations:* As a cleaner fuel, LNG aligns with India's environmental goals. This transition not only fulfills domestic sustainability targets but also enhances India's global standing as a responsible energy consumer.

e) *International Partnerships and Trade Agreements:* India's LNG strategy is linked to its foreign policy. Partnerships and trade agreements with major LNG-exporting countries are essential for securing long-term energy supplies and enhancing bilateral relations. India has long-term contracts with Qatar for LNG imports, ensuring stable supply volumes. The U.S. has offered India flexible contracts and shorter-term agreements, including collaboration in technology transfer and joint ventures, promoting innovation in India's energy sector. Despite global sanctions and geopolitical complexities, India has sought agreements with Russian energy firms for various forms of energy. India's connections with Australia extend beyond LNG to broader energy cooperation. The two nations have pursued joint ventures in renewable energy and carbon capture technologies, complementing their LNG trade.

f) *Balancing Trade With The United States:* With seven industrial-scale LNG plants already operating and liquefaction capacity totaling more than 92 mtpa, the U.S. has emerged as one of the globe's top three LNG exporters. [6] India's LNG trade with the United States has grown substantially due to the shale gas revolution. The U.S. became the second-largest LNG supplier to India in 2024, accounting for

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about 6.6 MMT, or nearly 28% of total LNG imports. This trade is strategically important as it helps reduce India's trade deficit with the U.S., which has historically been in America's favor. In FY 2023-24, India's overall goods trade deficit with the U.S. was around $15 billion, down from previous years, due in part to energy imports. Long-term LNG contracts signed between Indian firms (like GAIL and Petronet LNG) and American suppliers such as Cheniere Energy and Dominion Energy ensure stable pricing and supply. U.S. LNG, priced off Henry Hub (a relatively stable index), is often more competitive than spot market purchases, reducing India's vulnerability to price shocks. U.S. LNG exports reach India through the Cape of Good Hope, avoiding the volatile and piracy-prone Strait of Hormuz and Suez Canal, which are chokepoints for Middle Eastern energy exports. This alternate route offers logistical and security advantages, especially during geopolitical tensions in West Asia. With Trump Tariffs war and India coming out as a major exporter to the USA, LNG imports are becoming a balancing factor that India can leverage to its advantage.

g) *Balancing Geopolitical Risks and Opportunities:* India's major shift to LNG imports opens avenues for strategic diplomacy and economic growth. It can mitigate risks through diversification, sourcing LNG from multiple regions and thereby reducing the impact of geopolitical tensions in any single area. It should focus on building strategic reserves as a buffer against supply shortages and price spikes. To ensure market flexibility, India should shift towards flexible contracts, such as spot purchases and hybrid pricing models, enhancing its ability to adapt to market fluctuations. Spot purchases from the USA are expected to increase significantly with Trump's new focus on energy imports, and India should be prepared to exploit this opportunity. Energy cooperation with countries like the U.S. and Qatar has spillover effects, fostering investments and technology transfer. Finally, by positioning itself as a major LNG importer, India can influence regional energy dynamics.

IX. Challenges and Limitations of LNG in India

a) *Indigenous LNG Vessels:* India is significantly behind in manufacturing its own LNG vessels; thus, it largely depends on hiring, which increases the cost of transportation and reduces flexibility in LNG imports. LNG vessels are primarily categorized based on the containment system they use, which includes Moss-type vessels, known for their robust design and ability to handle high pressures, and Membrane-type vessels, which feature prismatic tanks lined with a thin membrane, maximizing cargo space and improving carrying efficiency. LNG carriers generally have capacities ranging from 125,000 to 266,000 cubic meters. Larger vessels, also known as Q-Max ships, can carry up to 266,000 cubic meters of LNG, thereby reducing transportation costs per unit of cargo. As the global demand for cleaner energy grows, LNG vessels will play an increasingly pivotal role in shaping the energy landscape. India should invest heavily in shipbuilding and focus on constructing LNG carriers. [13]

b) *Infrastructure Deficits:* India's transition to LNG as a significant energy source faces challenges due to infrastructure deficits. The existing LNG infrastructure is concentrated in a few states, leading to regional imbalances. To address these challenges, substantial investments in expanding the pipeline network and constructing new terminals are essential. Encouraging collaboration between public and private stakeholders can facilitate the development of a more integrated LNG infrastructure. By overcoming these infrastructural limitations, India can unlock the full potential of LNG as a key component of its energy transition strategy, promoting cleaner energy access nationwide.

c) *Price Volatility:* The price fluctuations of LNG pose a significant challenge for India as it seeks to enhance its energy security and transition to cleaner fuels. LNG is often contracted on a long-term basis, which theoretically stabilizes prices for consumers. However, global market conditions, such as geopolitical tensions, supply chain disruptions, and shifts in demand from major consumers, can cause substantial price fluctuations. Such volatility can strain India's financial resources and disrupt its energy budget, particularly for industries that rely heavily on stable energy costs. To mitigate the impact of price volatility, India should secure long-term contracts with multiple suppliers, invest in domestic LNG production, develop strategic reserves, implement flexible purchasing strategies, and establish a buffer against sudden price spikes. With improved technologies for gas production and the USA willing to sell more gas under Trump's new energy policy, the prices of LNG imports are likely to decrease, bringing significant economic relief to India.

d) *India's Domestic Gas Production Constraints:* India faces significant challenges related to domestic natural gas production, which is currently limited and unable to meet the country's growing energy demands. The constraints in domestic production stem from various factors, including outdated technology, regulatory hurdles, and inadequate investment in exploration and infrastructure. The

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government has made efforts to attract foreign investment and improve the regulatory environment; however, India remains heavily dependent on imported LNG to fulfill its energy needs.

e) *Competition with Renewable Energy:* India has set ambitious goals to achieve a larger share of renewables, reducing reliance on fossil fuels, including natural gas, in a bid for sustainability and to meet international climate commitments. The cost of solar and wind energy has significantly declined, making them increasingly attractive for India's energy mix. This price drop challenges LNG's role, especially in sectors where renewable energy can provide a viable alternative. As awareness grows around the benefits of renewable energy, there is a stronger push for zero-emission technologies. LNG, though cleaner than other fossil fuels, is still viewed as less desirable in the long term compared to renewables.

X. Recommendations for the Government of India and the Indian LNG Industry

Infrastructure Expansion: LNG will remain the main method of natural gas transportation for years to come. While India has made significant progress, further investment in LNG terminals, regasification units, and pipeline networks is essential to accommodate rising demand. New ports and LNG terminals must be constructed. India's eastern coastline needs more such facilities.

Long Term Contracts: Natural gas, being a cheaper and more efficient form of energy, must fit properly into India's energy diversity. Although we have good relations with Qatar, the USA, and Australia for LNG imports, we need to explore newer sources and transportation routes, as well as invest in LNG infrastructure and long-term contracts in other countries. Central Asia and Africa can be explored for this.

Shipbuilding Infrastructure: Sea lanes of communication are becoming increasingly important, and therefore, a greater number of specialized ships need to be built under the 'Make in India initiative'. If LNG carrier ships are manufactured in India, it will make LNG imports more economical and diverse.

Exploring Chabahar Port in Iran for Central Asian and Caspian Gas: Chabahar Port is a port in Iran that India is developing to serve as a transit route for trade with Central Asia and Afghanistan. The port is located on Iran's southeast coast along the Gulf of Oman. Iran, the Caspian Sea, and Central Asia have an abundance of gas reserves. India can develop an LNG liquefaction and transport facility by investing its own funds, thus creating a permanent infrastructure outside India for LNG imports.

Policy Reforms: Streamlined policies and regulatory frameworks are necessary to attract investments and ensure the competitiveness of LNG in India's energy mix. SEZs may receive special incentives to develop unloading and regasification terminals. [16]

Technological Innovations: Adopting advanced technologies, such as floating storage and regasification units (FSRUs), can reduce costs and enhance accessibility in remote areas. The USA is prepared to assist us in technological advancement in exploration and drilling.

Centres of Excellence in Universities and Think Tanks: The government should fund major energy universities in India, such as Pandit Deendayal Energy University in Gandhinagar and IIT ISM in Dhanbad, to establish Centres of Excellence in Natural Gas.

Geopolitical Stability: Maintaining balanced foreign relations is crucial for securing uninterrupted LNG supplies. India's capability to navigate complex geopolitical landscapes will determine the effectiveness of its LNG strategy.

XI. Conclusion

The geopolitical implications of LNG in India's energy security extend far beyond diversification and cleaner energy. LNG serves as a bridge to a sustainable and resilient energy future. By leveraging its LNG strategy, India not only addresses its energy challenges but also strengthens its position as a global economic and diplomatic powerhouse.

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Delivery Capability as a Key Driver of PPP Geothermal Energy Project Completion: Evidence from Kenya

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Abstract- *Purpose:* This study examines how delivery capability, which encompasses technical expertise, project governance and management practices, and organizational agility, influences the Public-Private Partnership (PPP) geothermal energy project completion outcomes in Kenya. It is assumed that there is no PPP without either government support or private sector participation; rather, the issue of utmost research interest would be their effectiveness and or optimization. The current research, therefore, aims to address critical knowledge and research gaps identified in existing literature regarding the operational determinants of PPP project completion in the renewable energy sector, particularly geothermal, in the Sub-Saharan Africa (SSA) region.

Case Study: The geothermal industry in Kenya serves as a suitable choice for the case study, since the country is globally recognized as a leading geothermal energy developer in Africa. Also, there is published literature on its geothermal evolution story traceable to the 1980s.

Keywords: *public-private partnership (PPP), geothermal energy, delivery capability, project completion, renewable energy, dynamic capability theory, systems theory, project governance, technical expertise, organization agility, Kenya.*

GJHSS-H Classification: *LCC: HD9502.K4*



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Case Study: The geothermal industry in Kenya serves as a suitable choice for the case study, since the country is globally recognized as a leading geothermal energy developer in Africa. Also, there is published literature on its geothermal evolution story traceable to the 1980s.

Research Philosophy, Design and Methodology: Relying on both the positivist and pragmatic research philosophies, mixed methods were used to undertake a cross-sectional census survey of 48 PPP geothermal energy projects licensed in Kenya as of June 2023. A structured questionnaire was used to collect project data from project managers (leaders) working for both private and public sector developers. Responses were measured using an Agree-Disagree (A-D) Likert scale across the main study themes. A key informant interview guide was used to gather qualitative insights from relevant geothermal industry actors, including government officials, private investors, development financing institutions, civil society, academic and other subject matter experts. A pilot study was conducted on a PPP wind power project in Kenya. Quantitative project completion metrics were analyzed, along with qualitative insights, to assess the relative influence of delivery capability on PPP financing structure and project completion. A combination of tools was used to analyze descriptive, inferential and qualitative data sets, culminating in data triangulation.

Key Findings and Conclusion: The study reveals that delivery capability emerges as the most influential predictor of project completion, accounting for approximately 61% of the variance in successful PPP project completion outcomes; the overall model yielded a strong correlation of R-squared (R^2) of 0.663 and an adjusted R^2 of 0.652. Its effect substantially outweighs that of project financing mechanisms (40%), policy and regulatory effectiveness (26%), and environmental and other contextual factors (24%). For instance, projects with strong technical expertise demonstrated 25% faster approvals and 18% fewer completion delays. Besides, projects with robust governance structures and agile project management practices reduced contract period variations and improved budget adherence by 22%. The mediation analysis depicted similar results; this is convincing evidence that delivery capability significantly affects PPP geothermal project completion.

Novel Contributions: This research represents the first empirical study to establish the direct link between delivery capability, financing structure and geothermal PPP project completion outcomes in the SSA region. The lessons from Kenya provide policymakers with a scientific basis to prioritize bidder competency assessments in PPP procurement processes, while offering investors a framework for strategic capacity-building and project delivery investments. The study findings validate the relevance of the Dynamic Capability theory in renewable energy PPP project management practice; it outlines practical recommendations for geothermal energy development in emerging markets such as Kenya.

Opportunities for Further Research: Replicating a similar research in other country contexts for better generalizability is recommended. Future scholarly work exploring the effect of emerging technologies, such as Artificial Intelligence (AI) and blockchain supply chain solutions, on PPP project delivery capability could provide valuable insights into how digital transformation might reshape the geothermal PPP project life cycle.

Keywords: public-private partnership (PPP), geothermal energy, delivery capability, project completion, renewable energy, dynamic capability theory, systems theory, project governance, technical expertise, organization agility, Kenya.

I. Introduction

Over the last decade, geothermal energy development progress has been documented worldwide, eliciting great interest from

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governments, development financiers, scholars and practitioners alike. Understandably, the successful financing, delivery, completion and commissioning of geothermal energy projects play an enabling role in accelerating green energy transition and stimulating overall economic growth. Notwithstanding the growing adoption of PPPs, these projects remain capital-intensive and high-risk investments, especially in the Sub-Saharan Africa region. This argument complicates the ongoing debate between proponents and pessimists of the PPP models even further.

a) *Kenya is Africa's Pioneer in Geothermal Energy Development*

Kenya, a country located in Sub-Saharan Africa, is endowed with significant geothermal energy potential primarily along its Rift Valley belt, estimated at over 10,000 MW (Ouma et al., 2021). The Olkaria I (45 MW) is the pioneer geothermal power project completed in 1985 (KenGen, 2021). Geothermal energy is the core of the national sustainable and affordable energy transition strategy, contributing around 45% of the country's electricity generation mix (Energy and Petroleum Regulatory Authority, EPRA, 2022).

b) *Delivery Capability, Project Completion and Theoretical Perspectives*

The concept of delivery capability in the context of PPP geothermal projects transcends isolated notions of project implementation capacity or institutional readiness. Drawing on Dynamic Capability Theory (Teece et al., 1997), delivery capability refers to an organization's ability to reconfigure resources and adapt operational strategies in response to dynamic environments, such as geological uncertainties or regulatory shifts (Ngugi & Mugo, 2021; Kiplagat et al., 2020). Furthermore, informed by Systems Theory (Bertalanffy, 1968; Meadows, 2008), delivery capability acknowledges the interconnectedness of technical, financial, and socio-environmental components, recognizing that delays in one area (say, financial close or land acquisition or permitting) can cascade to late completion across the entire project life cycle (Sterman, 2000; Andrews et al., 2016; Ejderyan et al., 2019). This theoretical integration positions delivery capability not merely as a set of static competencies but as a dynamic, systemic enabler that mediates the effectiveness of external support and internal resources. This is crucial because, as noted by Zhang et al. (2022), inadequate delivery capability can derail even well-funded infrastructure projects with good government backing when bureaucratic inertia or policy rigidity limit adaptive responses.

c) *Research Problem: Why the Study?*

Adoption of PPPs in Geothermal Development has Recorded Mixed Performance: To effectively harness this strategic resource and join the prestigious 1000 MW Club, the government has increasingly turned to Public-Private Partnerships (PPPs) through the Independent Power Producer (IPP) model since 1999 (Olando, Mwenda, Kikwatha, & Rambo, 2024a), although with mixed results. These IPP arrangements are largely advocated for their capacity to facilitate risk-sharing, stimulate private investment, and leverage technical expertise, thereby accelerating geothermal project development (World Bank Group, 2020). Despite the strategic importance of geothermal energy and the perceived advantages of PPPs, a paltry 9% of the potential has been exploited, while many such projects face persistent completion delays or fail to reach definitive completion in Kenya (Olando et al., 2024b; Ngugi & Aduda, 2019). A recent study by Olando et al. (2024a) found that only 52% of geothermal projects in Kenya were on course, while the rest had either delayed or stalled.

Noteworthy Empirical Gaps Exist: The empirical literature has extensively explored factors such as project capital structures (debt and equity, excluding grants and hybrids), regulatory frameworks, organizational factors, and project performance, albeit in isolation and as longitudinal studies covering largely the developed or developing economies (Atmo et al., 2016; Kanyamyoga, 2020; Mburu & Karanja, 2022). However, a critical synthesis of scholarly work reveals a conceptual omission regarding the delivery capability of the involved entities. While a number of studies recognized the need for streamlined regulations and sustained political commitment (Mburu & Karanja, 2022), the operational and organizational ability to translate these enabling conditions into tangible project completion outcomes remains underexplored (Olando, Mwenda, Kikwatha, & Rambo, 2025). Geothermal is the least covered compared to hydropower and other renewable energy sources.

The Concept of Delivery Capability is Evolving: Notably, recent empirical studies have begun to identify delivery capability, defined as the wholesome organizational capacity to execute projects effectively, as a crucial but under-researched factor in PPP project completion (Olando, Mwenda, Kikwatha, & Rambo, 2025). Deficiencies in technical expertise and project management capacity often compromise the effectiveness of PPP frameworks, as evidenced in the broader Sub-Saharan African infrastructure projects (Kudtark, 2020) and explicitly in Nigeria's energy sector (Olojede et al., 2020). In the Kenyan geothermal context, these capability gaps are particularly observed in areas like drilling and reservoir management expertise, and the establishment of reliable supply chains for specialized equipment (Mwangi & Aduda, 2023; Olando et al., 2024a).

Further Research using a Hybrid Theoretical Framework is Feasible: While extensive scholarship on PPPs in

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Kenya has provided crucial insights into financial viability (e.g., Atmo et al., 2016; Kanyamyoga, 2020) and regulatory challenges (Ochieng' et al., 2021), alongside an understanding of principal-agent dilemmas and political considerations through Public Choice and Agency theories (Atela, 2019; Kanyamwa, 2021; Ochieng' et al., 2023), these perspectives often sideline the critical role of operational and organizational execution. Their focus has largely been on what policies are in place or how projects are financed, rather than how effectively they are delivered. This has led to a limited understanding of how execution capabilities somehow intervene in project completion.

Complementing the Dynamic Capability theories with the Public Choice and Agency theories (Atela, 2019; Ochieng' et al., 2023) offers valuable insights into the structural misalignments and principal-agent dilemmas that frequently plague PPPs, leading to issues like protracted licensing and land acquisition delays (Kanyamwa, 2021). However, even when these structural issues are theoretically understood or policy interventions are designed, the ultimate translation into project completion still critically depends on the delivery capability of the implementers, that is, their ability to navigate these complexities and ensure efficient execution.

d) Research Question and Null Hypothesis

The current study addresses the foregoing conceptual, methodological, and contextual gaps with the hope of providing a new window for further research on the study themes. It systematically interrogates the role of delivery capability in the completion of PPP geothermal energy projects in Kenya, aiming to answer a key research question: To what extent does delivery capability influence the technical, financial, and socio-environmental completion outcomes of PPP geothermal energy projects in Kenya?

By understanding this interaction, the research strives to identify leverage points where improvements in delivery capability can mitigate inherent PPP project risks and optimize holistic project completion. This study, therefore, tested the following null hypotheses:

$H0_1$: The influence of financing structure on the completion of public-private partnership (PPP) geothermal projects is not significant;

$H0_2$: The association between the financing structure and the completion of public-private partnership (PPP) geothermal projects is not significantly mediated by the delivery capability of developers; and

$H0_3$: Delivery capacity and public-private partnership (PPP) financing structure do not jointly affect the completion of geothermal projects in a significant manner.

II. Critical Literature Review

The successful financing, implementation and completion of PPP geothermal energy projects hinges on several critical factors that have been examined through different theoretical lenses and empirical studies. A synthesis of existing literature is presented under three main thematic areas, namely: theoretical frameworks explaining PPP dynamics; empirical findings on the nexus between delivery capability, PPP financing and project completion; as well as government assistance for geothermal development PPPs. A summary of research gaps and a conceptual model integrating the three study variables are derived from this, at the tail end. Understanding the complexities of PPP geothermal project completion in Kenya necessitates a multifaceted conceptualization of delivery capability, PPP financing structures and project completion.

a) Theoretical Framework

The study integrates viewpoints mainly from the Dynamic Capability and Systems theories, which are complemented by Public Choice and Agency standpoints. These theories help illuminate not only the structural and motivational challenges but, critically, the organizational and systemic capacities required for successful project delivery. While individually potent, their collective application highlights the gaps in understanding the practical 'how' of project completion, particularly concerning delivery capability.

Dynamic Capability theory provides crucial insights into how organizational adaptability and governance structures influence project outcomes. In the context of Kenya's geothermal sector, this theory explains how project entities that demonstrate agility in resource reconfiguration and risk management achieve better project outcomes (Ngugi & Mugo, 2021). The ability to modify operational strategies in response to geological uncertainties or regulatory changes emerges as a particularly valuable dynamic capability in this sector (Kiplagat et al., 2020). Furthermore, adaptive governance mechanisms that allow for contractual flexibility have been shown to enhance project resilience against unforeseen challenges (Were et al., 2022).

Public-private partnership (PPP) projects, particularly in complex sectors like geothermal energy, function as interconnected systems where multiple components (technical, financial, governance, and socio-political) interact dynamically (Bertalanffy, 1968; Meadows, 2008).

Systems Theory provides a valuable lens for understanding these relationships, emphasizing how feedback loops and emergent properties shape project completion outcomes (Andrews et al., 2016; Ejderyan et al., 2019). For instance, delays in permitting can trigger

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financing bottlenecks, which in turn stall progress, a reinforcing loop that underscores the systemic nature of PPP challenges (Sterman, 2000). Similarly, unexpected resistance from local communities may emerge from the complex interplay of social, economic, and political factors rather than any single stakeholder's actions.

Integration of Dynamic Capability and Systems theoretical perspectives is imperative: The Systems theory emphasizes the interconnectedness of project life cycle components, from initiation to completion, commissioning and operation phases, which is a crucial complement to the Dynamic Capability theory. This integration reveals how organizational adaptability mediates project success within complex systems. Effective PPP consortia leverage dynamic capabilities – the capacity to sense environmental shifts (regulatory changes), seize opportunities (including financing), and transform structures (adopting agile governance) – to navigate the systemic feedback loops and emergent properties identified by Systems Theory. This theoretical integration thus positions robust delivery capability as both an internal organizational competence (derived from dynamic capabilities) and a systemic enabler, explaining why even well-designed projects may falter when broader systemic factors like bureaucratic inertia or policy rigidity limit adaptive responses (Zhang et al., 2022).

Public Choice and Agency Theories offer complementary perspectives on the structural challenges inherent in PPP arrangements. Public Choice theory elucidates how political and bureaucratic considerations often create misalignments between public energy access goals and private sector profit motives (Atela, 2019). These misalignments manifest in practical challenges such as protracted licensing procedures, permitting and land acquisition delays that frequently stall project initiation (Kanyamwa, 2021). Agency Theory further unpacks the principal-agent dilemmas that arise between government bodies and private contractors, suggesting that performance-based contracts and robust monitoring mechanisms can help align stakeholder interests (Ochieng' et al., 2023).

b) Delivery Capability, PPP Project Financing and Completion

Despite recent progress, significant opportunities for gaining a deeper understanding of the operational dimensions of PPP project completion, especially in the context of the geothermal energy development sector, exist. This gap is increasingly acknowledged by recent empirical studies that identify delivery capability, defined as the organizational capacity to execute projects effectively, as a critical but under-researched factor (Olando, Mwenda, Kikwatha, & Rambo, 2025). For instance, Kudtark's (2020) broad analysis of African infrastructure projects critically reveals how pervasive deficiencies in technical expertise and project management capacity frequently undermine the very viability of otherwise well-structured PPPs, leading to inefficiencies that financial models alone cannot resolve. Parallel findings by Olojede et al. (2020) in Nigeria's energy sector further emphasize this by demonstrating how weak contractor capabilities consistently lead to costly project overruns, often overshadowing initial financial prudence.

c) Government Assistance and Geothermal Energy Development PPPs

Recent research on PPP implementation in the geothermal sector has yielded important patterns regarding financing structures and government assistance mechanisms. Studies by Atmo et al. (2016) compellingly demonstrate the efficacy of innovative risk-sharing arrangements, such as viability gap funding, in attracting private investment for infrastructure projects. Similarly, Kanyamyoga (2020) explicitly highlights the positive impact of Kenya's policy instruments, including feed-in tariffs and exploration grants, on the financial viability of geothermal ventures. However, while these studies underscore the foundational importance of financial and policy support, they also consistently reveal that such mechanisms, taken in isolation, are insufficient for project success without complementary government support manifested through streamlined regulations and sustained political commitment (Mburu & Karanja, 2022).

In the Kenyan Context, these critical capability gaps are not merely theoretical but they tend to manifest explicitly during the geothermal drilling and reservoir management phases, as well as the establishment of reliable supply chains for specialized equipment and technologies (Mwangi & Aduda, 2023; Olando et al., 2024a). This consistent pattern across contexts underscores the methodological and conceptual limitations of selected studies that do not adequately account for the 'how' of project delivery. Commissioning a focused investigation into delivery capability as a key driver is hereby justified. The strategic role of Geothermal Development Company (GDC) in de-risking early geothermal energy project development phases provides a compelling case study of effective government intervention through unbundling of institutional mandates (Ouma, 2021).

d) Summary of Empirical Research Gaps

A critical review of recent studies uncovered justifications for the modern study.

Conceptual Limitations: Restricting project financing structure to the traditional concepts of debt and equity, while excluding innovative sources such as hybrids (mezzanine finance) and grants, is not practical in the geothermal PPP space. More importantly, defining delivery capability with a limited focus on the private

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investor's capacity to finance and implement projects within budget and schedule, turning a blind eye to the governance and organization agility capabilities, seems unrealistic.

A Silo Theoretical Approach: None of the studies applied the dynamic capability and systems theories in combination, as supplemented with the agency and public choice theoretical foundations. An integrated application of these theories would yield deeper knowledge on the project management practices, especially in the geothermal PPP industry. Conversely, completion of PPP geothermal projects ought to be assessed holistically to identify the root causes of the research problem, including the financial, technical and socio-environmental metrics.

Methodological Gaps: Recent research was largely designed to collect and analyze quantitative data mined from secondary repositories over some time, such as the World Bank PPP Databases (longitudinal studies). They also relied heavily on data collected from private developers regarding the technical and geological aspects of geothermal PPPs, ignoring the voice of the public and development sector participants. Gathering a mixture of crosssectional quantitative data and qualitative insights from the key sector participants will enrich the findings of the current study.

Contextually, existing research on geothermal energy development has exposed significant knowledge gaps, especially regarding Sub-Saharan Africa, where these projects are often understudied. For example, the scope of recent studies has narrowed to developing economies, more so in the Americas, Europe and Asia. A few scholars covered project success factors and PPPs in hydropower, rather than geothermal, in Africa.

This study will therefore seek to address the foregoing research gaps and shed light on the relationship between delivery capability, PPP financing structure and PPP geothermal project completion in SSA, ultimately advancing modern knowledge of the research topic and themes. Kenya is a preferred choice due to its pioneering experience in the African content.

e) Conceptual Model

Building on the theoretical and empirical analysis, this study proposes an integrated conceptual model as presented in Figure 1.

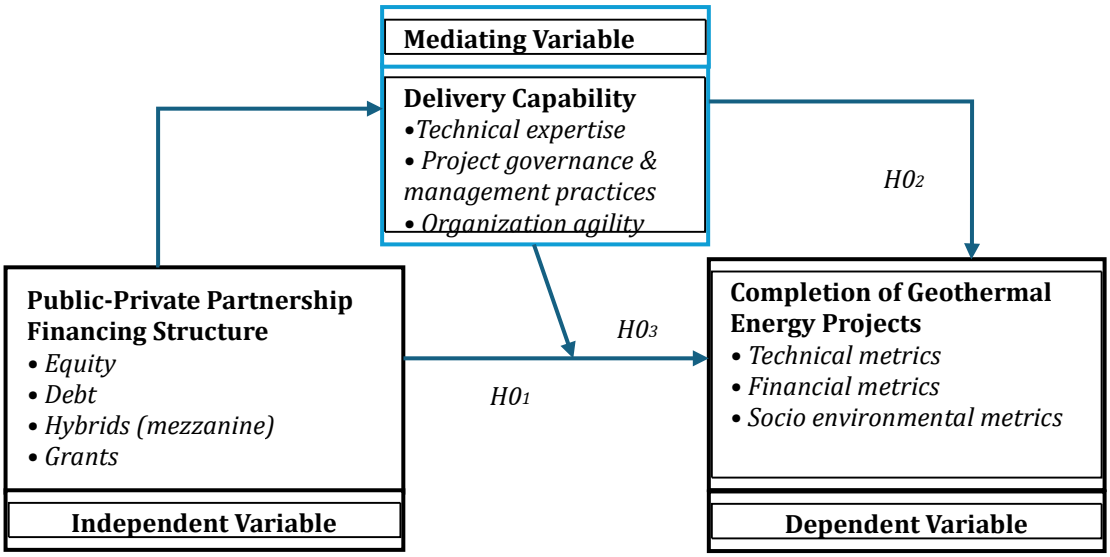


Figure 1: Conceptual Model

The model positions delivery capability as the central mediator between financing structures (input variable) and PPP geothermal project completion (output variable). It is founded on the presumption that for any PPP to work, there must be an enabling environment for private investments, implying that the government must deliberately support while the private sector takes the investment risks. For geothermal PPPs, the financing structure is usually comprised of a mixture of private and government equity, commercial loans at market-interest rates, low-interest concessional loans from Development Financing Institutions (DFIs), a hybrid of loans and equity (mezzanine), and grants from development partners and government. The conceptual framework asserts that financial resources and policy frameworks are not directly sufficient but must be transformed through operational capabilities to achieve holistic project completion. The completion outcomes are measured in terms of technical (contract period variations, Metric tons or MWs produced), financial (budget variations, key economic indicators) and socio-environmental risk mitigation (sustainable energy outcomes).

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III. Methodology

Guided by the research objective and hypotheses, a mixture of research philosophies, designs, methods and strategies was selected with good justifications for each choice. Figure 2 shows a chronology of the research process organized under three broad steps.

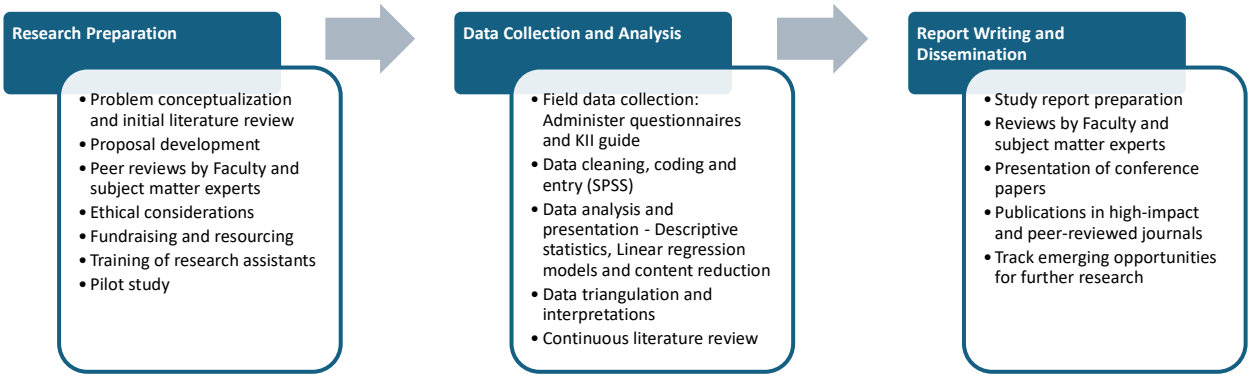


Figure 2: Research Flow Chart

a) *Research Philosophy*

The current study was founded on two schools of thought in academic research. It relied heavily on the positivist philosophical fundamentals, thereby using quantitative methods to collect and analyze field data (Wambugu et al., 2015). However, the positivists' assumption that science is limited to facts, observable and quantifiable cause-and-effect variables, excluding human factors (qualitative aspects), is a bit unrealistic in social sciences, as also observed by Hilary (2018). Cognizant of this limitation, the study also utilized the pragmatist philosophical tenets to enable the gathering of qualitative data from key informants, thereby interrogating the research problem in a more representative manner.

b) *Research Design*

This study employed a mixed-methods research design to comprehensively examine the interplay between delivery capability, PPP financing structure and geothermal project completion. The cross-sectional quantitative survey was supplemented by qualitative Key Informant Interviews (KIIs), allowing for both breadth of data collection and depth of understanding (Creswell & Plano Clark, 2018). The survey established broad patterns and tested hypothesized relationships between the study variables, providing statistical breadth and generalizability. Furthermore, the cross-sectional design was deemed effective for capturing the prevailing relationships and current state of delivery capabilities and their effect on project completion outcomes across the project profile diversity, at a specific point in time, providing valuable and actionable insights for contemporary policy and practice. The KIIs provided additional contextual insights and explanations for the observed quantitative findings, offering a deeper understanding of the practical operationalization of delivery capability within Kenya's geothermal sector.

c) *Unit of Analysis and Population*

The unit of analysis was each of the 48 geothermal PPP projects licensed in Kenya as of December 2023, as registered with the national regulator (EPRA). A population of 117 participants was targeted: 96 primary respondents drawn from the industry divide covering all 48 projects (census survey): private sector project managers (n=48) and government project team leaders (n=48), where the average of their responses for each project was considered fairly representative of the reality. Moreover, we also targeted 19 key informants, comprising senior directors purposively sampled from the lead State agencies and devolved governments hosting the projects, development and commercial financial institutions, academia and geothermal institutes, and the national renewable energy association. This industry-wide approach ensured representation across critical project phases (exploration, development, implementation, and operation) and project sizes (small-scale <50MW, medium 50-100MW, large-scale >100MW).

d) *Quantitative Data Collection from Project Managers (Team Leaders)*

We administered structured questionnaires to all the 96 primary respondents through the *Survey Monkey* platform between May and August 2024, following best practices for survey research in infrastructure projects (Saunders et al., 2019).

Operationalization of Variables: The three study variables were broken down into subvariables based on the theoretical and empirical review findings.

The PPP financing structure, as the independent variable, was operationalized to reflect its theoretical underpinnings in the capital structure theory of Modigliani and Miller (1958), specifically as applied to infrastructure projects by Yescombe (2011). The

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components were measured using Equity ratio measurement following the PPP financial modelling approaches of Farquharson et al. (2011), while the debt financing proportion was calculated using the project finance ratios recommended by Gatti (2013), and grant components were assessed through the subsidy measurement framework of Engel et al. (2013).

Delivery capability, as the mediating variable, incorporated three sub-constructs: (1) project governance framework measured through the strategic project performance indicators of Mu ller et al. (2014); (2) technical efficiency assessed using the transaction cost economics framework of Williamson (1985); and (3) organizational agility evaluated through the dynamic capabilities' measurement scale of Pavlou and El Sawy (2011).

Project Completion, as the dependent variable, employed a multidimensional assessment framework: (1) technical indicators followed the project performance indicators of the Project Management Institute (2017); (2) financial indicators used the capital budgeting evaluation methods of Brealey et al. (2012); and (3) socio-environmental indicators were verified against the ESIA evaluation criteria of the International Association for Impact Assessment (2020). This comprehensive measurement approach ensured construct validity through different established indicators (Cook & Campbell, 1979).

Measurement Instrument: A 35-item Likert-scale instrument was carefully designed based on validated measurement scales from previous PPP studies (Zhang, 2005; Osei-Kyei & Chan, 2015). The measurement of delivery capability (12 items) incorporated dimensions identified in the project management literature (Muller & Jugdev, 2012), including geothermal specific technical expertise, project management and governance structures adapted from Klijn and Koppenjan (2016), and Turner (2016) project governance model, as well as organizational agility facets developed from agile project management research by Conforto et al. (2014). The PPP financing structures (8 items) were measured using indicators derived from the World Bank's PPP financing guidelines (World Bank, 2017) and the OECD's principles for private sector participation in infrastructure (OECD, 2015). Project completion metrics (8 items) incorporated technical, financial, and socio-environmental dimensions aligned with the triple-bottom-line approach to project success (Elkington, 1997), the Sustainable Development paradigm (UNDP), and the infrastructure project performance indicators recommended by Flyvbjerg (2014).

Reliability and Construct Validity: Before full roll-out of the data collection activities, the research tools were piloted on the Ngong Wind Power Project located within the Rift Valley Region of Kenya. The questionnaire underwent rigorous pretesting with 15 industry experts, achieving Cronbach's α scores exceeding 0.82 for all constructs, surpassing the 0.70 reliability and construct validity threshold recommended by Nunnally (1978). Our 81% response rate, which was achieved through Dillman's (2007) tailored design method, including three follow-up reminders and telephone prompts, is significantly higher than typical response rates for organizational surveys (Baruch & Holtom, 2008).

e) Qualitative Data Collection from Key Informants

We used a semi-structured Key Informant Interview (KII) guide to conduct 18 interviews following the methodological guidelines of King and Horrocks (2010) for open-question interviews. The senior directors from target constituents were selected through purposive sampling to ensure representation of diverse perspectives (Patton, 2002) and achieve theoretical sufficiency (Baker & Edwards, 2012). The interview protocol was developed based on the critical incident technique (Flanagan, 1954) and drew upon the PPP implementation framework of Hodge and Greve (2007).

The KII questions explored responses on four essential themes: (1) project implementation challenges, building on the risk factor taxonomy developed by Bing et al. (2005); (2) operationalization of delivery capability, informed by the dynamic capabilities framework (Teece et al., 1997); (3) government support effectiveness, using the policy implementation lens of Pressman and Wildavsky (1984); and (4) best practice (critical) geothermal project completion indicators, applying the project success determinants identified by Chan et al. (2004). Interviews lasted 45-60 minutes, following recommendations for qualitative data collection in organizational research by Myers (2019). Audio recording and verbatim transcription procedures followed best practices outlined by Poland (2002) and recommendations on enhancing validity by Lincoln and Guba (1985). Theoretical saturation was achieved after 15 interviews (Guest et al., 2006), with three additional confirmatory interviews conducted to verify emerging patterns (Morse, 2015).

f) Quantitative Data Analysis

Quantitative data analysis followed a statistical approach to examine the hypothesized relationships between study variables. Initial descriptive analyses were conducted to characterize the sample composition and distribution patterns of all measured variables, following established protocols for data screening in social science research (Tabachnick & Fidell, 2019). Bivariate relationships between key constructs were examined using Pearson correlation coefficients, providing preliminary insights into the strength and direction of associations between PPP financing structures, delivery capability, and project completion.

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g) Qualitative Data Analysis and Triangulation

Interview transcripts were analyzed using content analysis (Braun & Clarke, 2006). An inductive coding approach identified emergent patterns, which were then mapped to the quantitative findings through data triangulation aligned to the study themes. Illustrative statements were selected to illustrate key themes about delivery capability implementation.

h) Ethical Considerations

The researchers ensured compliance with applicable Faculty regulations, national laws and best practice research ethics. All the participants provided informed consent, with options for anonymity. Data was stored on password-protected servers, with identifiers removed during analysis. Publication of these findings aims to widen the audience reach as much as possible, inform future research directions and global PPP project management practices.

IV. Findings and Discussion

Both descriptive and inferential statistics unveil noteworthy patterns in Kenya's geothermal PPP sector, directly addressing the stated hypotheses: $H0_1$: The association between the financing structure and the completion of public-private partnership (PPP) geothermal projects is not significantly mediated by the delivery capability of developers; and $H0_2$: Delivery capacity, and the finance structure of public-private partnership (PPP) do not significantly affect the completion of geothermal energy development.

Our analysis utilized both descriptive and inferential statistics to unveil noteworthy patterns in Kenya's geothermal PPPs, directly addressing the two stated hypotheses.

a) Descriptive Statistical Results and Interpretation

Delivery Capability: Project governance demonstrated particularly strong performance (mean = 3.93), closely followed by risk allocation strategies (mean = 3.68) and organizational agility (mean = 3.78). These results align with Zhang's (2005) findings on the importance of structured governance in PPP success and Osei-Kyei and Chan's (2017) work on organizational factors in project delivery.

PPP Financing Structure: Accessibility to a particular financing option presented an interesting dichotomy in our findings. Private equity demonstrated relatively high accessibility (mean = 3.98) compared to government equity (mean = 3.79), a pattern that may reflect systemic challenges in public sector financing mechanisms. Remarkably, concessional loans stand out for their cost-efficiency (mean = 4.05), confirming their established role as risk mitigation instruments in infrastructure financing as also advanced by the World Bank Group (2018).

Government Assistance: While institutional support mechanisms and policy frameworks generally perform well (mean range = 3.76-4.23), the study identifies persistent bottlenecks in land acquisition and permitting processes (mean range = 3.34-3.50). These implementation challenges coincide findings of Ika and Donnelly (2017) about operational hurdles in African infrastructure development contexts, where robust policy frameworks often encounter execution difficulties.

b) Inferential Statistical Results and Interpretation

The core empirical contribution of this study lies in dissecting the influence of the predictor variables on project completion, beginning with mediation and then examining their joint effect.

Delivery Capability's Mediation on Financing Structure and PPP Geothermal Project Completion: Testing $H0_1$ and $H0_2$

To assess the mediating role of delivery capability, a step-wise regression analysis was conducted, following the Baron & Kenny (1986) modelling strategy.

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Table 1: Model Summary for Mediation Analysis

Model	R	R Square	Adjusted R Square	R Square Change	df1	df2	Sig F Change
1	0.663	0.439	0.433		1	92	0.000
2	0.813	0.661	0.654	0.222	1	91	0.000

Table 2: Coefficients for Mediation Analysis

Model	Variable	Beta (unstandardized Coefficient)	Std Error	Beta (unstandardized Coefficient)	t	Sig.
1	Constant	.624	0.397		1.575	0.119
	PPP Financing Structure	0.875	0.103	0.663	8.492	0.000
2	Constant	-0.132	0.325		-0.406	0.686
	PPP Financing Structure	0.430	0.099	0.326	4.346	0.000
	Delivery Capability	0.633	0.082	0.579	7.717	0.000

Model 1 (Tables 1 and 2) shows that PPP Financing Structure significantly predicts project completion (Beta = 0.875, p = 0.000); it explains 43.3% variance in completion, indicating that other factors such as delivery capability, government assistance and geological conditions could account for the remaining bulk (53.7%). Thus, *we reject $H0_1$:* The influence of financing structure on the completion of PPP geothermal projects is not significant. When Delivery Capability is added as a mediator in Model 2, its effect on project completion is highly significant (Beta = 0.633, p = 0.000), while the direct effect of PPP Financing Structure on project completion is substantially reduced (Beta decreases from 0.875 to 0.430), though remaining significant. The significant Sobel test statistic (5.137, $p < .001$) confirmed the significance of this indirect effect through project execution skills. This pattern confirms that delivery capability significantly mediates the relationship between PPP financing structure and project completion, indicating that the positive impact of financing structures on completion is partly channelled through robust delivery capabilities. This evidence leads to the *rejection of $H0_2$:* The association between the financing structure and the completion of PPP geothermal projects is not significantly mediated by the delivery capability of developers. A similar, statistically significant indirect effect was observed using the Sobel test.

Combined Influence of Delivery Capability and Financing Structure on PPP Geothermal Project Completion: Testing $H0_3$

The comprehensive regression model, which includes Delivery Capability, Financing Structure, and other PPP enabling factors (government assistance), assesses their combined influence on geothermal project completion.

Table 3(a): Comprehensive Regression Results

Statistic	Value
R	0.814
R- squared ($R^{2)}$	0.663
Adjusted R^2	0.652
Significance	0.000

Table 3(b): Comprehensive Regression Results

Variable	Beta (unstandardized Coefficient)	Std Error	Beta (unstandardized Coefficient)	t	Sig.
Constant	0.243	0.364	-	1.669	0.021*
Delivery Capability	0.607	0.091	0.555	6.682	0.000***
PPP Financing Structure	0.400	0.109	0.303	3.681	0.000***
Other Enabling Factors	0.260	0.124	0.240	2.690	0.042*

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As presented in Table 3 (a-b), the overall model yielded a strong R-squared (R^2) of 0.663, with an Adjusted R^2 of 0.652. This indicates that 65.2% of the variance in geothermal project completion is explained by the joint effect of delivery capability, PPP financing structure, and government assistance (other PPP enabling factors). The model's overall significance (Sig. = 0.000) strongly confirms that delivery capability and PPP financing structure collectively and significantly affect project completion. Based on this robust evidence, we reject H03: Delivery capacity and public-private partnership (PPP) financing structure do not jointly affect the completion of geothermal energy projects in a significant manner.

c) Evidence of Delivery Capability's Strong Influence

Individually, delivery capability emerged as the strongest predictor (Beta = 0.607, $p < 0.001$), highlighting its paramount importance, compared to PPP Financing Structure (Beta = 0.400, $p < 0.001$) and other enabling factors/government assistance (Beta = 0.260, $p < 0.05$).Furthermore, the quantitative findings were enriched by stakeholder interviews, where participants highlighted how specialized geothermal expertise enables teams to navigate unique geological challenges (Karingi & Wanjala, 2018), while identifying financial and liquidity management as crucial in maintaining a project's momentum (Gatti, 2013). The analysis revealed that streamlined governance structures correlate with 25% faster approval processes (Flyvbjerg, 2014), while technical expertise among contractors and developers reduces execution time by 18% (Chan et al., 2019).

Specifically, PPP structuring skillsets and financial management proficiency showed powerful effects, with efficient fund utilization correlating with 22% improvement in budget adherence (Yescombe, 2011). Projects with optimal delivery systems demonstrate markedly superior outcomes. Technically proficient teams experience 30% fewer delays compared to less skilled counterparts (Babatunde et al., 2020), while diversified financing models achieve 80% completion rates versus 40% for underfunded projects (OECD, 2015). Robust oversight mechanisms reduce corruption risks by 35% (Transparency International, 2020), confirming Bing et al. (2005) findings about governance in PPP projects.

d) Discussion and Implications

The research reveals that successful PPP implementation in Kenya's geothermal sector operates as a complex adaptive system where delivery capability functions as the mediator between project inputs and completion outcomes. This dual theoretical thinking offers important insights that advance both academic understanding and practical management of renewable energy infrastructure projects.

Theory Building: The empirical findings provide robust support for Dynamic Capability theory (Teece et al., 1997) while simultaneously demonstrating the value of a Systems theory perspective (Bertalanffy, 1968) in understanding geothermal PPP project completion determinants. They provide empirical validation for the systems theory principle that project outcomes emerge from subsystem interactions rather than linear cause-effect relationships (Bertalanffy, 1968). The findings widen the scope of Dynamic Capability theory by quantifying how organizational adaptability intercedes between structural factors and project completion; and finally, it addresses the methodological gaps identified by Flyvbjerg (2014) by providing measurable evidence of delivery capability effects in complex project lifecycle environments.

Re-defining the Delivery Capability Concept: The dominant explanatory power of delivery capability, accounting for 61% of the variance in project completion outcomes, can be understood through the Systems theoretical concept of emergent properties (Meadows, 2008). Rather than operating in isolation, delivery capability represents the organizational agility to integrate and coordinate across technical, financial, and governance subsystems. As Sterman (2000) notes in his work on system dynamics, such integrative capabilities are especially important in complex projects, like geothermal, where various feedback loops influence outcomes. The finding that technical expertise reduces execution time by 18% aligns with inferences made by Zhang et al. (2022), alluding that specialized competencies help navigate system complexities in infrastructure projects.

From a Dynamic Capability theory perspective, these results extend Teece et al.'s (1997) framework by demonstrating how sensing, seizing, and transforming capacities operate within constrained institutional systems. The persistent bottlenecks in land and way leave acquisition processes (mean rating = 3.34) exemplify what North (1990) describes as institutional rigidities that limit organizational adaptability. This finding supports Babatunde et al (2020) argument that capability development in African infrastructure projects must account for systemic constraints. This study advances PPP theory and practice by demonstrating that delivery capability serves as the crucial mechanism through which project systems achieve successful outcomes.

A System-Wide Delivery Framework is Ideal: By integrating Dynamic Capability with systems theory perspectives, it provides both a diagnostic framework for assessing project risks and an evidence-base for strategic interventions. For policymakers and practitioners, these findings underscore the importance of moving beyond structural and contractual considerations to develop the organizational capacities

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that enable effective navigation of complex project ecosystems. As Kenya and other emerging economies continue to expand their renewable energy infrastructure, this systems-wide approach to capability development will be essential for achieving sustainable project success.

Recommendations for PPP Project Management Practice: First, procurement processes should incorporate more rigorous assessment of bidder competencies, as recommended by the World Bank's (2018) PPP guidelines. Second, capacity-building programs should adopt the systems-aware approach advocated by the OECD (2015), developing skills that span technical, financial, socio-environmental and stakeholder management domains. Third, financial models should incorporate the liquidity buffers that Yescombe (2011) identifies as crucial for managing systemic uncertainties.

V. Conclusion and Future Research Directions

This research contributes to the broader PPP literature by highlighting delivery capability as a critical success factor, particularly in the renewable energy project life cycle (Ika et al., 2021). The findings, discussions and recommendations are expected to inform policymakers, private investors, and project managers on optimizing delivery mechanisms to mitigate delays and cost overruns. By aligning with Kenya's Vision 2030, the Least Cost Power Development Plan, Green Energy Transition (Net Zero) blueprints, and the global Sustainable Development Goal 7 (affordable and clean energy), this study underscores the transformative potential of robust delivery systems in achieving sustainable energy security and coverage (UNDP, 2023). This study provides compelling evidence that delivery capability serves as the linchpin for successful geothermal PPP implementation in Kenya, fundamentally mediating the effect of financial structures and policy frameworks on project completion outcomes.

a) *Novel Contributions to the Body of Knowledge, Practice and Policy*

While reinforcing certain established principles of PPP success, the research breaks new ground by offering three significant contributions to the field.

The study provides empirical quantification of the delivery capability's predominant influence by demonstrating its ability to explain around 61% of the variance in PPP geothermal project completion outcomes.

It extends the application of Dynamic Capability theory to the geothermal energy sector, validating its explanatory power in this specific context.

It offers precise measurements of operational impacts, such as the 18% reduction in project timelines attributable to technical expertise, including geo-technical and geological skillsets and technologies.

It underscores the transformative potential of strengthening delivery capabilities within Kenya's renewable energy sector. By focusing on enhancing implementation capacity, stakeholders could unlock substantial value and accelerate the achievement of national energy transition goals.

It points to the need for a strategic reorientation in how geothermal PPPs are conceived and executed, with greater emphasis placed on building execution competencies rather than solely enhancing financial or contractual arrangements.

The findings provide an integrated diagnostic framework for assessing PPP geothermal project readiness in support of Kenya's renewable energy transition. As the global community increasingly turns to PPPs to deliver critical infrastructure, the proposed integrated framework offers timely guidance for balancing structural design with operational execution in complex renewable energy development projects. Ultimately, this study advances our understanding of what makes geothermal PPPs work in practice, moving beyond theoretical ideals to identify the concrete operational capabilities that determine success. It provides a strategic roadmap for enhancing geothermal PPP implementation effectiveness.

b) *Limitations and Opportunities for Future Research*

While this study provides valuable insights into the determinants of geothermal PPP completion in Kenya, some limitations are acknowledged. These research shortcomings suggest important directions for future study.

Generalizability: The research focused exclusively on Kenya's geothermal sector, which may limit the generalizability of findings to other renewable energy sectors or geographical contexts, as suggested by Ika et al. (2021). Moreover, the temporal scope of the research did not account for potential long-term effects of capacity-building initiatives or evolving policy frameworks.

Timelines: Longitudinal research tracking projects from inception to completion would provide valuable insights into how delivery capabilities develop over time and their longterm impact on project outcomes. Additionally, cross-country comparative studies could reveal how institutional and regulatory contexts influence the relative importance of different factors. Future research could also benefit from more granular analysis of capability development processes. In-depth case studies of successful and unsuccessful projects could reveal the micro-level dynamics of capability building and deployment.

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Technological Integration: Additional research exploring the interaction between delivery capabilities and emerging technologies, such as Artificial Intelligence (AI) for project monitoring and blockchain for contract management, could provide additional insights into how digital transformation might reshape PPP implementation.

Transferability of Capabilities Across Projects and Sectors: Further research could explore whether and how capabilities developed in one project or sector can be leveraged in others, potentially reducing the learning curve for new initiatives. Finally, studies examining the role of international partnerships in capability development could provide valuable insights for optimizing knowledge transfer in PPP projects.

These guidelines would not only address the current study's limitations but also contribute to a more comprehensive understanding of how to optimize PPP financing structures for sustainable infrastructure development in emerging economies. By building on this study's findings while addressing its limitations, future research can provide even more actionable insights for policymakers, investors, financiers, and project developers.

Abbreviations

AI: Artificial Intelligence (AI)

EPRA: Electricity and Petroleum Regulatory Authority (Kenya)

GDC: Geothermal Development Corporation (Kenya)

GEP: Geothermal Energy (Development) Project

KenGen: Kenya Electricity Generating Company

MW: Mega watt

OECD: Organization for Economic Co-operation and Development

PPP: Public-Private Partnership

UNDP: United Nations Development Programme

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Environmental Democracy: Extractive Industry in Mozambique and Possibilities for Ecological Modernization

By Adérito Tomé Alfeu

Abstract- The article "Environmental Democracy: Extractive Industry in Mozambique and Possibilities for Ecological Modernization", examines the dynamics between the expansion of Mozambique's extractive industry, the resulting environmental and social impacts, and the challenges of implementing environmental democracy in the country. The study's main objective is to explore how environmental democracy can be integrated into natural resource governance, promoting a more equitable, transparent, and participatory management model. The research follows a qualitative approach, based on literature review and documentary analysis of legislation, institutional reports, and case studies.

The main findings show that although Mozambique has a relatively advanced legal framework, the practical implementation of mechanisms for public participation, transparency, and environmental justice remains weak and inconsistent. Cases such as Nagonha highlight serious shortcomings in monitoring, compensation, and inclusion of affected communities. Furthermore, the extractive industry, while significantly contributing to GDP, has been characterized by uneven benefit distribution, marginalization of local populations, and environmental degradation.

Keywords: *environmental democracy, extractive industry, public participation, ecological modernization.*

GJHSS-H Classification: *LCC: GE190.M8*



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Environmental Democracy: Extractive Industry in Mozambique and Possibilities for Ecological Modernization

Democracia Ambiental: Industria Extrativa em Moçambique e Possibilidades de Modernização Ecológica

Adérito Tomé Alfeu

Resumo- O artigo "Democracia Ambiental: Indústria Extractiva em Moçambique e Possibilidades de Modernização Ecológica", analisa as dinâmicas entre a expansão da indústria extractiva moçambicana, os impactos ambientais e sociais daí decorrentes, e os desafios associados à implementação da democracia ambiental no país. O estudo tem como objectivo central examinar de que forma a democracia ambiental pode ser integrada na governação dos recursos naturais, promovendo uma gestão mais justa, transparente e participativa. A investigação adopta uma abordagem qualitativa, baseada na revisão bibliográfica e análise documental de legislação, relatórios institucionais e estudos de caso. Os principais resultados revelam que, embora Moçambique possua um quadro legal relativamente avançado, a aplicação prática dos mecanismos de participação pública, transparência e justiça ambiental é frágil e limitada. Casos como o de Nagonha evidenciam falhas profundas na fiscalização, compensação e inclusão das comunidades afectadas. Além disso, verifica-se que a indústria extractiva, embora contribua significativamente para o PIB nacional, tem sido marcada por desequilíbrios na repartição dos benefícios, marginalização das populações locais e degradação ambiental. O estudo propõe a modernização ecológica como uma via possível para conciliar crescimento económico com sustentabilidade, através da adopção de tecnologias limpas, reformas institucionais e fortalecimento da sociedade civil. Conclui-se que a efectivação da democracia ambiental em Moçambique exige não só reformas legais, mas também vontade política, capacitação técnica e uma governação inclusiva que valorize a participação cidadã na tomada de decisões.

Palavras-chave: democracia ambiental, indústria extractiva, participação pública, modernização ecológica.

Abstract- The article "Environmental Democracy: Extractive Industry in Mozambique and Possibilities for Ecological Modernization", examines the dynamics between the expansion of Mozambique's extractive industry, the resulting environmental and social impacts, and the challenges of implementing environmental democracy in the country. The study's main objective is to explore how environmental democracy can be integrated into natural resource governance, promoting a more equitable, transparent, and participatory management model. The research follows a qualitative approach, based on literature review and documentary analysis of legislation, institutional reports, and case studies.

The main findings show that although Mozambique has a relatively advanced legal framework, the practical implementation of mechanisms for public participation, transparency, and environmental justice remains weak and inconsistent. Cases such as Nagonha highlight serious shortcomings in monitoring, compensation, and inclusion of affected communities. Furthermore, the extractive industry, while significantly contributing to GDP, has been characterized by uneven benefit distribution, marginalization of local populations, and environmental degradation.The Study proposes ecological modernization as a potential path to reconcile economic growth with sustainability, through the adoption of clean technologies, institutional reforms, and the strengthening of civil society. It concludes that achieving environmental democracy in Mozambique requires not only legal reforms but also political will, technical capacity, and inclusive governance that values citizen participation in decision-making.

Keywords: environmental democracy, extractive industry, public participation, ecological modernization.

I. Introdução

A crescente preocupação global com as questões ambientais tem impulsionado debates acerca da relação entre desenvolvimento económico e sustentabilidade (Sachs, 2015). Neste contexto, a democracia ambiental emerge como um pilar fundamental para assegurar a participação pública e a justiça na gestão dos recursos naturais e na mitigação dos impactos ambientais (Acselrad et al., 2004). Moçambique, um país vasto em recursos naturais, tem testemunhado um crescimento notável na indústria extrativa, com a exploração de minerais e hidrocarbonetos a desempenhar um papel central na sua economia. A título de exemplo, no terceiro trimestre de 2024, o sector extrativo contribuiu com 15,72% para o Produto Interno Bruto (PIB) nacional, destacando-se como um dos principais impulsionadores do crescimento económico no sector primário (Educinvest,

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2024). Contudo, este crescimento tem sido acompanhado por complexos desafios que afectam directamente a governação ambiental, a distribuição equitativa dos benefícios e a mitigação dos impactos socioambientais no país (Castel-Branco, 2015). A interação entre a indústria extrativa e a democracia ambiental em Moçambique levanta questões cruciais sobre a capacidade do país em gerir os seus recursos de forma sustentável, garantindo a participação das comunidades locais e a protecção dos ecossistemas.

A problematização central deste estudo reside na tensão entre o imperativo do desenvolvimento económico, impulsionado pela indústria extrativa, e a necessidade de fortalecer os mecanismos de democracia ambiental em Moçambique. Questões como a transparência na atribuição de licenças, a consulta e o consentimento livre, prévio e informado das comunidades, a fiscalização ambiental e a reparação de danos ambientais persistem como desafios significativos (Hanlon & Mosse, 2010). Adicionalmente, a investigação procura explorar as possibilidades de modernização ecológica no sector extrativo moçambicano, analisando como a inovação tecnológica, as políticas de responsabilidade social corporativa e a adopção de práticas mais sustentáveis podem contribuir para um modelo de desenvolvimento menos predatório e mais alinhado com os princípios da sustentabilidade ambiental.

A justificação para este estudo reside na urgência de compreender os múltiplos desafios e oportunidades que a indústria extrativa representa para a democracia ambiental em Moçambique. A análise aprofundada desta dinâmica é crucial para informar políticas públicas mais eficazes, promover a justiça ambiental e capacitar as comunidades afectadas a exercerem os seus direitos. A relevância do tema é inegável, dado o papel estratégico que Moçambique desempenha na oferta de recursos naturais e a crescente pressão global por práticas extrativas mais responsáveis.

Metodologicamente, este estudo pauta-se por uma abordagem qualitativa, fundamentada na pesquisa bibliográfica e na análise documental. A pesquisa bibliográfica envolve a revisão sistemática de literatura científica, livros, artigos de periódicos e teses que abordam a democracia ambiental, a indústria extrativa e a modernização ecológica, com foco especial em contextos similares ao moçambicano. Complementarmente, a análise documental incide sobre relatórios governamentais, legislação ambiental, documentos de políticas públicas e estudos de caso relacionados com projectos extrativos em Moçambique, visando a extracção de dados e informações relevantes para a compreensão do fenómeno em análise.

II. Democracia Ambiental: Uma Analise Sobre a Participação Cidadã, Justiça Ambiental e Transparência

A democracia ambiental constitui um campo multidisciplinar que advoga pela integração dos princípios democráticos na gestão e protecção do ambiente, reconhecendo que as decisões ambientais afectam directamente a qualidade de vida das populações. Segundo Leff (2001), essa forma de democracia transcende a simples protecção dos recursos naturais, procurando redefinir as relações de poder na governação ambiental, com enfoque na equidade e na participação popular. Sachs (2015) reforça que a sustentabilidade só é possível com a participação activa dos cidadãos nas decisões que moldam o ambiente em que vivem. Em Moçambique, essa abordagem revela-se urgente, particularmente face ao crescimento da indústria extractiva, que frequentemente impõe decisões unilaterais com forte impacto sobre comunidades locais. Embora o quadro jurídico nacional, como a Lei n.º 20/97, de 1 de Outubro, Lei do Ambiente, e a Lei n.º 19/97, de 1 de Outubro, Lei de Terras, preveja mecanismos de consulta pública, persistem dificuldades na sua aplicação efectiva, sobretudo devido à desigualdade no acesso à informação e ao poder de decisão, como demonstrado por Meloni e Machanguia (2021).

a) Participação Cidadã na Gestão Ambiental

A participação cidadã, elemento fundamental da democracia ambiental, refere-se ao direito das comunidades influenciarem e decidirem sobre questões que afectam o seu ambiente. Esse princípio inclui o direito à informação, à justiça ambiental e ao envolvimento efectivo em processos de licenciamento, monitoria e fiscalização. No caso moçambicano, embora legalmente exigida em grandes projectos, a participação das comunidades tende a ser meramente formal, sem garantir uma escuta efectiva das suas preocupações. Como apontado por Meloni e Machanguia (2021), a aplicação prática da participação pública permanece limitada, com consultas realizadas de forma superficial e técnica, excluindo grande parte da população devido a barreiras linguísticas e ao fraco acesso a informação acessível e adequada. A ausência de canais eficazes de feedback e a falta de informações em línguas locais contribuem para a fragilidade dessa participação, que muitas vezes se resume a um ritual burocrático sem impacto real nas decisões.

b) Justiça Ambiental e Equidade

A justiça ambiental centra-se na distribuição equitativa dos benefícios e prejuízos ambientais, bem como no reconhecimento e reparação das

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desigualdades históricas que afectam comunidades vulneráveis. Em Moçambique, este princípio é constantemente posto à prova nos contextos de exploração mineira e de gás natural. Conforme observado por Meloni e Machanguia (2021), os reassentamentos compulsivos, a perda de acesso a terras produtivas, a poluição e os impactos na saúde pública são frequentes, resultando numa clara violação da justiça ambiental. As comunidades afectadas raramente beneficiam da riqueza gerada pelos recursos naturais extraídos das suas terras. Muitas vezes, as compensações oferecidas são insuficientes, não permitindo uma recuperação digna do modo de vida anterior. A Lei do Ambiente, n.º 20/97, de 1 de Outubro, reconhece o direito de acesso à justiça ambiental, mas na prática, esse direito esbarra nos elevados custos processuais e na limitada assistência jurídica, o que impede os cidadãos de reclamarem os seus direitos perante os tribunais (Meloni & Machanguia, 2021).

c) Transparência na Governança Ambiental

A transparência representa um dos pilares fundamentais da democracia ambiental e está relacionada com a divulgação acessível e compreensível de informações sobre decisões e actividades que impactam o meio ambiente. A experiência moçambicana, apesar de algum progresso institucional, ainda se confronta com profundas deficiências na implementação desse princípio. Como argumentam Meloni e Machanguia (2021), decisões sobre projectos de exploração de recursos naturais são frequentemente tomadas sem a participação ou mesmo conhecimento prévio das comunidades locais. A informação relevante, quando divulgada, apresenta-se em linguagem técnica e formatos inacessíveis à maioria dos cidadãos. Além disso, as instituições públicas e privadas envolvidas na exploração de recursos frequentemente não prestam contas dos impactos sociais e ambientais dos seus projectos. A insuficiência de mecanismos de responsabilização e o frágil acesso à justiça ambiental agravam o problema, fomentando desconfiança generalizada e alimentando conflitos socioambientais. Os autores sublinham que a ausência de uma cultura de transparência compromete não só a governança ambiental, mas também o próprio desenvolvimento sustentável.

III. Contextualização da Indústria Extrativa em Moçambique

A indústria extractiva em Moçambique tem raízes históricas que remontam ao período colonial, altura em que a exploração era pontual e centrada em minerais específicos. Durante o início do século XX, verificaram-se as primeiras explorações de carvão na bacia de Moatize, na província de Tete, bem como a extracção de ouro em Manica e pedras preciosas noutras regiões, impulsionadas por interesses da administração colonial portuguesa (Newitt,2005). Contudo, o nível tecnológico e a precariedade das infra-estruturas limitaram consideravelmente a capacidade de exploração.

Com a independência nacional, proclamada em 1975, e o subsequente período de instabilidade provocado pela guerra civil, o sector extractivo conheceu um declínio acentuado. Só com o Acordo Geral de Paz de 1992 e a estabilidade económica que se seguiu foi possível relançar de forma significativa o investimento neste sector (Newitt, 2005). A partir da década de 2000, com a liberalização da economia e a introdução de reformas legislativas favoráveis ao investimento estrangeiro, Moçambique passou a ser um destino atrativo para empresas multinacionais da área dos recursos minerais.

A indústria conheceu um crescimento exponencial com a descoberta e exploração de jazidas de classe mundial, destacando-se as areias pesadas em Nampula, o carvão mineral em Tete e o gás natural offshore na bacia do Rovuma, em Cabo Delgado. Estes projectos colocaram Moçambique no mapa das principais potências emergentes no campo da mineração e energia, atraindo investimentos bilionários. Simultaneamente, projectos como o Coral Sul FLNG iniciaram a exportação de gás natural liquefeito, enquanto a exploração de grafite e rubis diversifica cada vez mais o portfólio extractivo nacional (Newitt, 2005).

Este desenvolvimento, embora economica-mente expressivo, tem-se confrontado com fortes críticas e desafios no que respeita à justiça socioambiental. Em muitas comunidades afectadas pelas actividades extractivas, verifica-se a ausência de mecanismos eficazes de consulta e participação. Os processos de reassentamento são frequentemente marcados por falhas e deficiências estruturais, não respondendo às necessidades reais das populações. Conforme evidenciado em diversos estudos, incluindo os conduzidos por Meloni e Machanguia (2021), a legislação moçambicana, apesar de prever princípios como a consulta comunitária, a protecção dos direitos humanos e o direito à terra, revela limitações significativas na sua implementação.

Adicionalmente, o IMD (2018) expõe preocupações relevantes quanto à fraca capacidade do Estado para fiscalizar devidamente os operadores mineiros, bem como a assimetria entre os actores envolvidos no sector. As empresas multinacionais dispõem de recursos técnicos e financeiros superiores, enquanto as comunidades locais são frequentemente marginalizadas e desinformadas quanto aos seus direitos. A frágil articulação entre os órgãos governamentais, a escassa fiscalização ambiental e a quase inexistente responsabilização pelas violações de

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direitos humanos criam um ambiente propício à impunidade e à deterioração das condições de vida.

Em termos económicos, o sector extractivo tem representado um dos motores principais do crescimento do Produto Interno Bruto (PIB), com uma contribuição de cerca de 15,72% no terceiro trimestre de 2024. As receitas geradas pelas exportações e impostos têm sido canalizadas para o Orçamento Geral do Estado, sendo indicadas como instrumentos de fomento às infra-estruturas e serviços sociais. Todavia, a realidade vivida pelas comunidades onde esses projectos se implantam revela uma narrativa diferente, marcada por desalojamentos, perda de meios de subsistência, contaminação ambiental e desigualdade na repartição dos benefícios.

Neste contexto, torna-se imperativo que a governação da indústria extractiva em Moçambique seja revista sob a óptica dos direitos humanos, da democracia ambiental e da justiça social. A adopção de mecanismos transparentes, inclusivos e participativos pode permitir não apenas a mitigação dos impactos negativos da exploração, como também garantir que os benefícios desta indústria estratégica sejam equitativamente distribuídos e revertam efectivamente para o desenvolvimento sustentável e digno do país.

IV. Modernização Ecológica: Fundamentos, Potencialidades e Limites.

A modernização ecológica emerge como um paradigma sociológico e ambiental que propõe que a sustentabilidade pode ser alcançada através da inovação tecnológica, da reestruturação industrial e da reforma institucional, sem necessariamente implicar uma desaceleração do crescimento económico (Mol & Sonnenfeld, 2000). Em vez de ver o ambiente como um limite ao desenvolvimento, a modernização ecológica o integra como um fator-chave para a eficiência e competitividade. Seus fundamentos baseiam-se na crença de que as sociedades industriais possuem a capacidade e os meios para resolver os seus próprios problemas ambientais, transformando as crises ecológicas em oportunidades para a inovação e o progresso (Huber, 2004). O Estado, as empresas e a ciência desempenham papéis centrais neste processo, promovendo regulamentações mais inteligentes, tecnologias limpas e práticas de gestão ambiental avançadas.

As teorias da modernização ecológica argumentam que a crescente consciência ambiental e a pressão regulatória impulsionam as indústrias a adotar processos produtivos mais eficientes em termos de recursos e menos poluentes. Isso não é apenas uma questão de conformidade, mas também de vantagem competitiva, uma vez que a ecoeficiência pode levar à redução de custos e à criação de novos mercados (Porter & van der Linde, 1995). A teoria refuta a ideia de que a proteção ambiental é um entrave ao desenvolvimento económico, postulando que pode, na verdade, ser um motor de inovação e modernização. No contexto da indústria extrativa, isso implica o uso de tecnologias que minimizem o consumo de água e energia, que reduzam a geração de resíduos e que otimizem a recuperação de áreas degradadas, transformando passivos ambientais em oportunidades de inovação.

As potencialidades da modernização ecológica na indústria extrativa em Moçambique são consideráveis. A adoção de tecnologias de ponta, como sistemas de tratamento de água mais eficazes, tecnologias de extração que reduzem o impacto no solo e na biodiversidade, e a implementação de energias renováveis nas operações mineiras, pode mitigar significativamente a pegada ambiental do setor. Por exemplo, a utilização de drones para monitorização ambiental, *softwares* de gestão de resíduos e técnicas de recuperação de solos mais avançadas representam caminhos para uma mineração mais responsável. Além disso, a modernização ecológica pode fomentar a criação de empregos verdes e o desenvolvimento de capacidades locais em tecnologias e práticas sustentáveis, agregando valor à economia para além da mera extração bruta. A pressão por certificações ambientais e padrões internacionais de desempenho também pode incentivar as empresas a adotarem estas práticas, visando a reputação e o acesso a mercados financeiros que valorizam a sustentabilidade.

No entanto, a modernização ecológica também enfrenta limites, particularmente em contextos de desenvolvimento como Moçambique. Um dos principais limites é a dependência tecnológica e financeira de países em desenvolvimento em relação a tecnologias desenvolvidas no exterior. A aquisição e implementação dessas tecnologias podem ser extremamente caras e exigir um nível de *know-how* que nem sempre está disponível localmente. Há também o risco de um "paradoxo de Jevons" ambiental, onde o aumento da eficiência no uso de recursos pode levar a um aumento do consumo global devido à redução dos custos, anulando os benefícios ambientais (Alcott, 2005).

Outro limite crucial é a vontade política e a capacidade institucional. A modernização ecológica exige um quadro regulatório robusto e uma fiscalização eficaz, elementos que ainda apresentam fragilidades em Moçambique. A corrupção e a captura regulatória podem subverter os esforços de modernização, permitindo que as empresas contornem os requisitos ambientais (Global Witness, 2015). Além disso, a assimetria de poder entre as grandes corporações extrativas e o Estado moçambicano pode dificultar a

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imposição de padrões ambientais mais elevados, especialmente quando o investimento externo é visto como essencial para o crescimento económico.

a) Relação entre Indústria Extrativa e Desenvolvimento Sustentável

A relação entre a indústria extrativa e o desenvolvimento sustentável é complexa e ambivalente. Por um lado, a exploração de recursos minerais e energéticos pode ser um motor potente de desenvolvimento económico, gerando receitas substanciais para o Estado e contribuindo para o PIB (Educinvest, 2024). Em Moçambique, estas receitas são cruciais para financiar infraestruturas, serviços sociais e programas de redução da pobreza, alinhando-se com os Objetivos de Desenvolvimento Sustentável (ODS) da ONU, como o ODS 8 (Trabalho Decente e Crescimento Económico) e ODS 9 (Indústria, Inovação e Infraestrutura).

Por outro lado, o modelo tradicional da indústria extrativa é frequentemente associado a impactos sociais e ambientais negativos, que podem minar os pilares do desenvolvimento sustentável (Sachs, 2015). A degradação ambiental, a perda de biodiversidade, os conflitos por terra e água, e a marginalização das comunidades locais representam desafios diretos aos ODS, como o ODS 1 (Erradicação da Pobreza), ODS 15 (Vida Terrestre) e ODS 16 (Paz, Justiça e Instituições Eficazes).

A modernização ecológica oferece uma ponte para mitigar esses impactos e alinhar a indústria extrativa com os princípios do desenvolvimento sustentável. Ao promover a ecoeficiência, a circularidade e a responsabilidade corporativa, ela busca transformar o setor extrativo de um agente de degradação em um contribuinte mais positivo para a sustentabilidade. Para Moçambique, isso significa não apenas extrair os recursos, mas fazê-lo de uma forma que preserve o capital natural para as futuras gerações, que respeite os direitos das comunidades e que garanta que os benefícios económicos sejam distribuídos de forma equitativa, reduzindo as vulnerabilidades e promovendo a resiliência socio-ecológica (Castel-Branco, 2015). A transição para uma indústria extrativa modernizada ecologicamente é um caminho desafiador, mas essencial para que Moçambique consiga conciliar o seu potencial de recursos com uma trajetória de desenvolvimento verdadeiramente sustentável.

V. Mecanismos de Participação Pública nos Processos de Licenciamento e Monitoria Ambiental

A participação pública é um elemento central da democracia ambiental e da governança ambiental eficaz, visando assegurar que as vozes dos cidadãos e das comunidades sejam ouvidas e consideradas nos processos de decisão que afetam o ambiente. Em Moçambique, os processos de licenciamento ambiental para grandes projetos, particularmente na indústria extrativa, são regidos por legislação que, em tese, prevê a participação dos interessados. A Lei n.º 20/97, de 18 de Setembro, Lei do Ambiente, e o seu regulamento, o Decreto n.º 54/2015, de 31 de Dezembro, que aprova o Regulamento sobre o Processo de Avaliação do Impacto Ambiental, estabelecem os requisitos para a consulta pública e a divulgação de informações. Isso inclui a elaboração de Estudos de Impacto Ambiental (EIAs) e Planos de Gestão Ambiental (PGAs), que devem ser submetidos a um período de consulta pública, permitindo que as comunidades e outras partes interessadas apresentem as suas preocupações e sugestões. A intenção é que este processo leve à minimização de impactos negativos e à maximização de benefícios, garantindo que o licenciamento seja socialmente legítimo e ambientalmente responsável.

No entanto, a implementação desses mecanismos de participação nos processos de licenciamento e na subsequente monitoria ambiental frequentemente se depara com desafios significativos. Como evidência das graves violações de direitos humanos no contexto do desenvolvimento da indústria extractiva em Moçambique, destaca-se o caso da aldeia piscatória de Nagonha, situada no distrito de Angoche, aproximadamente 180 km da cidade de Nampula. Nagonha é uma comunidade rural com 1.329 habitantes distribuídos em 236 palhotas ao longo de uma duna junto ao Canal de Moçambique, cuja existência remonta a cerca de 40 anos. De acordo com o relatório do IMD (2018), esta comunidade caracteriza-se pela ausência quase total da presença estatal, refletindo um quadro de marginalização social e institucional.

Conforme observado, a aldeia carece de serviços básicos essenciais como escola, hospital, eletricidade, e sistemas de abastecimento de água e saneamento, evidenciando as profundas desigualdades no acesso a direitos fundamentais. É precisamente neste contexto vulnerável que a empresa Haiyu Mozambique Mining Co. Lda iniciou, em 2011, a exploração de minerais de areias pesadas na área, atividade que resultou na remoção de dunas de areia, destruição da vegetação e descarte de resíduos de mineração sobre zonas húmidas protegidas. Essas ações provocaram o encerramento de duas lagoas importantes para a comunidade — Nanthekethe e M´phutuwa — bem como a interrupção dos cursos de água que as conectavam, comprometendo o fornecimento de água potável, a disponibilidade de plantas medicinais tradicionais e as condições para a pesca, principal fonte de subsistência local.

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A degradação ambiental provocada pela mineração teve consequências dramáticas em termos sociais e econômicos. A destruição dos canais naturais de escoamento da água pluvial resultou numa inundação severa em 7 de fevereiro de 2015, que devastou 173 habitações e deixou 290 pessoas desabrigadas. Apesar da clara responsabilidade da atividade mineradora na catástrofe, tanto o Governo Distrital, o Município e o Governo Provincial negaram apoio efetivo à comunidade durante o período crítico das chuvas, conforme reportado pelo IMD (2018). Paralelamente, a Haiyu Mozambique Mining Co. Lda ofereceu uma compensação insuficiente, limitada a 4.000 meticais para as casas construídas com materiais não convencionais e 20.000 meticais para as casas convencionais destruídas, valores estes que se mostraram claramente inadequados para reparar os danos sofridos e restaurar as condições de vida da população afetada.

Este caso ilustra de forma contundente as múltiplas violações de direitos humanos ligadas à exploração dos recursos naturais em Moçambique, onde a ausência do Estado, a negligência institucional e a inadequada responsabilização das empresas extrativas perpetuam situações de injustiça social, ambiental e económica, conforme detalhado no relatório do IMD (2018).

Amnesty International (2018) reporta que as queixas incluem compensações consideradas insuficientes, atrasos nos processos de reassentamento, e a perceção de que as comunidades foram marginalizadas nas negociações. A natureza volátil da região, exacerbada pela insurgência armada que afectou directamente o desenvolvimento dos projectos, evidenciou a fragilidade da governação e a necessidade urgente de mecanismos de participação mais robustos e equitativos. A ausência de canais eficazes para a resolução de queixas e a falta de responsabilização levaram a um aprofundamento das tensões sociais.

a) Papel da Sociedade Civil e Comunidades Locais

Neste cenário, o envolvimento da sociedade civil e das comunidades locais emerge como um elemento determinante para o avanço da democracia ambiental e a responsabilização dos actores do sector extrativo. Em Moçambique, as organizações da sociedade civil (OSC) têm-se destacado não apenas pela sua função crítica na monitoria de projetos, mas também pelo papel pedagógico junto das comunidades locais.

O relatório *O Meio Ambiente em Moçambique* destaca que, embora exista um quadro jurídico que permite a participação pública, este ainda se encontra limitado na prática, devido à fraca institucionalização de mecanismos que assegurem o envolvimento efetivo das comunidades nos processos de decisão (Norfolk & de Wit, 2012). A sociedade civil, por sua vez, tem procurado preencher essas lacunas por meio da mobilização social, da tradução de informações técnicas (como Estudos de Impacto Ambiental - EIA) para linguagem acessível, e da formação comunitária em direitos ambientais.

As OSC também desempenham um papel relevante na mediação de conflitos relacionados com o uso da terra e a exploração de recursos, especialmente em contextos onde os processos de consulta pública não são devidamente respeitados. Tal como sublinhado por Serra (2012), a falta de regulamentação clara sobre crimes ambientais, aliada à morosidade da justiça, torna o apoio jurídico prestado por estas organizações às comunidades uma ferramenta vital para mitigar a assimetria de poder frente ao Estado e às grandes corporações.

Por sua vez, as comunidades locais têm demonstrado crescente consciência ambiental e capacidade de organização. Embora frequentemente expostas a riscos sociais e económicos associados aos megaprojetos, têm utilizado formas pacíficas de contestação, como petições e assembleias comunitárias, para reivindicar os seus direitos e denunciar violações ambientais. O uso de rádios comunitárias e redes de comunicação locais, mencionado por Norfolk & de Wit (2012), tem reforçado a visibilidade das suas demandas, sobretudo em áreas remotas.

A monitoria participativa — embora ainda pouco institucionalizada — representa uma prática promissora. Quando capacitadas, as comunidades podem assumir um papel direto na recolha de dados sobre os impactos ambientais e sociais dos projetos, contribuindo para uma fiscalização mais robusta e próxima do terreno.

A colaboração entre OSCs e comunidades revela-se, portanto, fundamental para a consolidação da governança ambiental em Moçambique. Esta aliança contribui não só para o fortalecimento da cidadania ecológica, como também para garantir que os benefícios do desenvolvimento extrativo sejam partilhados de forma justa e equitativa.

VI. Caminhos Para a Modernização Ecológica em Moçambique

A transição para a modernização ecológica em Moçambique, particularmente no sector extrativo, constitui um imperativo estratégico para a construção de um modelo de desenvolvimento verdadeiramente sustentável. Este caminho demanda a articulação de políticas ambientais eficazes, reformas institucionais e inovação tecnológica, para além do fortalecimento da participação social.

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a) Iniciativas de Sustentabilidade em Curso

Moçambique tem vindo a demonstrar esforços significativos no sentido de institucionalizar práticas ambientais responsáveis. A adesão à Iniciativa de Transparência na Indústria Extrativa (ITIE-M) continua a ser uma referência de compromisso com a transparência, embora com impacto ainda limitado na melhoria da governança ambiental.

Do ponto de vista jurídico, o país possui um quadro legal considerado abrangente e relativamente avançado, assente na Constituição da República, na Lei do Ambiente (Lei n.º 20/97), bem como nos seus regulamentos complementares (Serra, 2012). Estes instrumentos fornecem a base legal para medidas como a Avaliação de Impacto Ambiental (AIA), a auditoria ambiental e a responsabilidade ambiental.

Algumas empresas do sector extrativo, sob pressão regulatória, têm adotado iniciativas de responsabilidade social corporativa, incluindo programas de reflorestamento e de apoio comunitário. Ainda assim, estas ações muitas vezes carecem de fiscalização eficaz, o que levanta dúvidas sobre o seu real compromisso com a sustentabilidade.

Apesar das ferramentas legais disponíveis, a implementação continua a ser o elo mais fraco. O país enfrenta um sério défice de capacidade institucional, com escassez de técnicos qualificados, recursos financeiros limitados e fraca articulação entre ministérios e agências (Serra, 2012). A fiscalização ambiental, prevista no quadro legal, é frequentemente ineficaz devido à ausência de meios humanos e materiais, o que compromete o controlo das atividades extrativas.

A morosidade na regulamentação de dispositivos importantes da Lei do Ambiente, como os relativos à responsabilidade civil e aos crimes ambientais, contribui para a sensação de impunidade. A ausência de um código penal ambiental específico permite que várias infrações graves contra o ambiente fiquem sem tratamento judicial adequado (Serra, 2012).

Adicionalmente, a concorrência entre ministérios e a falta de clareza na delimitação de competências agravam as dificuldades de coordenação e de execução de políticas ambientais. O resultado é um ambiente institucional fragmentado e pouco responsivo às exigências da modernização ecológica.

Apesar dos constrangimentos, Moçambique possui um enorme potencial para uma transição ecológica estruturada. O país dispõe de recursos abundantes em energias renováveis, como solar e hídrica, que podem ser integradas na sua matriz energética para reduzir a dependência de combustíveis fósseis (Serra et al., 2012). O desenvolvimento de políticas públicas para os biocombustíveis e energias renováveis, embora ainda em fase embrionária, constitui um sinal positivo.

Por outro lado, a promoção de tecnologias limpas no sector extrativo, como sistemas de recirculação de água, gestão eficiente de resíduos e recuperação ambiental de áreas exploradas, pode reduzir significativamente os impactos ambientais. A legislação ambiental já prevê instrumentos para esse fim, embora a sua aplicação ainda dependa de maior capacidade institucional e de incentivos económicos adequados (Serra, 2012, p. 20).

A modernização ecológica deve ser entendida como parte de uma transição para uma economia verde mais ampla. Isto inclui o incentivo a sectores alternativos como o ecoturismo, a agricultura sustentável, a reciclagem e a valorização de resíduos. A promoção de pequenas e médias empresas (PMEs) verdes e o desenvolvimento de cadeias de valor sustentáveis podem contribuir para a diversificação da economia, reduzindo a sua vulnerabilidade à volatilidade dos recursos minerais.

Além disso, o ordenamento territorial e a gestão participativa dos recursos naturais, já previstas no quadro legal, devem ser reforçados com uma abordagem territorial integrada, incluindo instrumentos de planeamento como o Plano Distrital de Uso da Terra (PDUT) (Norfolk & de Wit, 2012). Isto permitiria maior equilíbrio entre exploração económica, conservação ambiental e bem-estar comunitário.

A modernização ecológica em Moçambique exige mais do que reformas legais: requer vontade política, capacitação técnica e um sistema de governança ambiental robusto. É necessário integrar a agenda ambiental na estratégia de desenvolvimento nacional de forma transversal e inclusiva. O ambiente deve deixar de ser um custo e passar a ser visto como alavanca do crescimento sustentável.

VII. Conclusão

A relação entre a expansão da indústria extrativa e a consolidação da democracia ambiental em Moçambique constitui uma das tensões mais significativas no actual modelo de desenvolvimento do país. Este estudo permitiu evidenciar que, embora o sector extrativo represente um motor relevante para a economia nacional, o seu crescimento tem sido marcado por desafios profundos no que respeita à justiça ambiental, à participação cidadã e à distribuição equitativa dos benefícios. Observou-se que os instrumentos legais existentes, como a Lei do Ambiente e a Lei de Terras, oferecem fundamentos importantes para uma governação mais inclusiva e sustentável, mas a sua aplicação prática continua limitada por barreiras institucionais, técnicas e políticas.

A análise demonstrou que o envolvimento das comunidades locais nos processos de tomada de decisão ainda é muitas vezes simbólico e desprovido de influência real, agravado pela fraca acessibilidade à

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informação e pela ineficiência dos mecanismos de consulta pública. Igualmente, a fragilidade na fiscalização ambiental e a baixa responsabilização das empresas têm perpetuado práticas que violam direitos ambientais e sociais. No entanto, existem sinais encorajadores, como o papel crescente da sociedade civil e as possibilidades oferecidas pela modernização ecológica, sobretudo através da introdução de tecnologias limpas, da diversificação energética e da promoção de uma economia verde.

Para que Moçambique avance no sentido de uma verdadeira sustentabilidade, torna-se imprescindível reforçar a capacidade institucional do Estado para monitorar e aplicar a legislação ambiental, melhorar os mecanismos de consulta e participação pública de forma acessível e inclusiva, e promover a integração de critérios ambientais nas decisões económicas de grande escala. É também essencial investir em formação e educação ambiental nas comunidades afectadas, como forma de ampliar a cidadania ecológica e garantir que os recursos naturais beneficiem as gerações actuais sem comprometer o futuro. O caminho para uma indústria extrativa mais justa e sustentável passa, assim, por uma reconfiguração profunda do modelo de governação ambiental, com base na equidade, na transparência e na participação efectiva.

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Efficacy and Realization of Welfare Schemes for Senior Citizens in Kolkata, North & South 24 Parganas Districts of West Bengal: A Statistical Analysis

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Abstract- The steep rise in human life expectancy has resulted in a substantial increase in older people population particularly in the age group of 80 years and above. According to the National Policy for Senior Citizens, March 2011, the Indian demographic profile shows that in 2000-2050 the population in the age group 60 years to 70 years will increase by 326% and in 80 years above will increase by 700%. It has been seen that out of the total World Elderly Population, 1/8 of them resides in India. The elderly population in India never retires in its strict sense and they continue to work as long as they are physically capable to do. As aging is inevitable and physical infirmity entrails age, this result in steep decline in earning that eventually amounts to poor savings and decline in standard of living. It has been observed that most of the senior citizens of India live in destitute, therefore old age income security is one of the greatest challenges amongst the senior citizens. A lot of aspects of their standard of living have been taken into account by the government of India to ensure their social security namely, economic, health, socioeconomic and shelter to propose adequate social security schemes.

Keywords: *senior citizens, welfare schemes, social security, statistical analysis, ANOVA, Chi-square test.*

GJHSS-H Classification: *LCC: HV1451.W4*

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Efficacy and Realization of Welfare Schemes for Senior Citizens in Kolkata, North & South 24 Parganas Districts of West Bengal: A Statistical Analysis

Sarbani Bhowmik [α], Dr. Bhupal Bhattacharya [σ] & Dr. Aditya Ghosh [ρ]

Abstract- The steep rise in human life expectancy has resulted in a substantial increase in older people population particularly in the age group of 80 years and above. According to the National Policy for Senior Citizens, March 2011, the Indian demographic profile shows that in 2000-2050 the population in the age group 60 years to 70 years will increase by 326% and in 80 years above will increase by 700%. It has been seen that out of the total World Elderly Population, 1/8 of them resides in India. The elderly population in India never retires in its strict sense and they continue to work as long as they are physically capable to do. As aging is inevitable and physical infirmity entrails age, this result in steep decline in earning that eventually amounts to poor savings and decline in standard of living. It has been observed that most of the senior citizens of India live in destitute, therefore old age income security is one of the greatest challenges amongst the senior citizens. A lot of aspects of their standard of living have been taken into account by the government of India to ensure their social security namely, economic, health, socioeconomic and shelter to propose adequate social security schemes. Likewise, the West Bengal Government as well as introduced certain welfare schemes for the ensuring the social security of the senior citizens. However, it has been observed that the benefits are not being adequately satisfying the needs of the people. This paper tries to address the factors that plays a significant role in realizing the benefits assured to the senior citizens under the various welfare schemes dedicated to their welfare and will also try to find out the factors that poses a barrier to access those rights. Statistical dataset has been collected corresponding to a questionnaire and analysis is performed based on the dataset collected which can clearly indicate the impact of different independent factors on the awareness of the scheme for senior citizen.

Keywords: senior citizens, welfare schemes, social security, statistical analysis, ANOVA, Chi-square test.

I. Introduction

One of the inevitable truths of life is aging that will bring unique challenges in its every step. It may not target the senior citizens, but it is they who gets affected the most[1]. From ancient times, it was the duty of the family to take care of the infirm senior citizens of the family that included both psychological and physical ailments but with time this ethical consideration has been fading away[2]. The rampant change in the family structure have exposed the vulnerability of the senior citizens particularly to physical and economic insecurity[3]. Subsequently, Maintenance and Welfare of Parents and Senior Citizens Act, 2007 has been enacted to ensure the socio economical and healthcare security of the senior citizens in India[4]. Likewise, India formulated two National Policies in 1999 and another in 2011 for address the needs of the senior citizens in its strict sense[5]. In light of the National Policies, the Central Government as well as the State Government have introduced a number of welfare schemes for the care and maintenance of the senior citizens that not only addresses the healthcare security but also includes financial security and social security.

a) List of Welfare Schemes introduced by Central Government

The list of welfare schemes introduced by Central Government for the socio-economic wellbeing of the senior citizens are as follows[6]-

1. Rashtriya Vayoshri Yojana, 2017 – seeks to assist the BPL senior citizens by providing assisted living aids and devices.
2. Atal Pension Yojana, 2015 - seeks to assist the workers of unorganized sector to save for their retirement as pension.

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3. Atal Vayo Abhyuday Yojana, 2021 - seeks to provide opportunities to improve the quality of life of BPL categorized senior citizens like medical care, shelter, food, entertainment.
4. Indira Gandhi National Old Age Pension Scheme, 2007 - seeks to provide financial aid to the BPL categorized senior citizen.
5. Indira Gandhi Widow Pension Scheme, 2009 - seeks to provide Social Security today BPL widowed senior citizen.
6. Indira Gandhi Disability Pension Scheme, 2009 - seeks to provide Social Security to the mentally and physically disabled senior citizens.
7. National Family Benefit Scheme, 1995 - seeks to provide financial support to BPL categorized families on account of the death of the primary breadwinner of the family.
8. Annapurna Scheme, 2000 - seeks to provide food security to senior citizens who are not covered under National Old Age Pension Scheme.
9. Scheme of Integrated Program for Senior Citizens, 1992 – seeks to improve the quality of life by ensuring basic amenities like shelter, food, medical care and entertainment opportunities.
10. Rashtriya Swasthya Bima Yojana, 2013 – seeks to provide medical insurance to the BPL categorized senior citizens in case of sudden hospitalization expenses.
11. Pradhan Mantri Jan Arogya Yojana, 2018 – seeks to provide cashless medical insurance to economically disadvantaged group of the Indian society.
12. Varishtha Pension Bima Yogana, 2003 – seeks to provide social and financial security at times of fall in income due to unforeseen market conditions to the senior citizens.
13. Post Office Senior Citizen Saving Scheme, 2015 – seeks to provide financial stability to VRS or superannuation retired senior citizens.
14. Pradhan Mantri Vaya Vandana Yojana, 2017 – seeks to provide socio economical security against future fall of market conditions to the senior citizens.
15. Antyodaya Anna Yojana, 2000 – seeks to provide food at subsidy to the BPL categorized senior citizens.

b) List of Welfare Schemes introduced by West Bengal Government

The list of welfare schemes introduced by West Bengal Government for the socio-economic wellbeing of the senior citizens are as follows[7]:

1. West Bengal Old Age Pension Scheme, 2010 – seeks to provide a sum of Rs. 1000 per month to the senior citizens residing in West Bengal for more than 10 years to ensure their social security.
2. West Bengal Widow Pension Scheme, 2010 – seeks to provide a sum of Rs. 1000 to the widowed women irrespective of age who has been residing in West Bengal for more than 10 years and has monthly income less than Rs. 1000 to ensure their adequate standard of living.
3. West Bengal Manabik Pension Scheme, 2010 - seeks to provide a sum of Rs. 1000 to the senior citizens who are physically incapacitated to work to ensure the social security.
4. West Bengal Swasthya Sathi Scheme, 2016 – seeks to provide cashless medical insurance upto Rs. 5,00,000 per year to ensure healthcare security irrespective of age and gender.

II. Research Methodology

Data has been collected through questionnaire. 50 responses have been collected from each of the three districts of West Bengal namely, Kolkata, North 24 Parganas, South 24 Parganas that amounts to a total of 150 responses. The rationale behind choosing these three districts is Kolkata has the highest density per kilometre, North 24 Parganas has the highest population and South 24 Parganas covers the largest area in the State of West Bengal as per the census data 2011. Convenient random sampling was adopted while collecting the data. The population of the survey was senior citizens above 60 years of age. Statistical analysis is being performed for those collected data to understand different aspects of in dependent variables like Monthly income, Monthly expenditure, occupation, qualification with respect to awareness of different schemes by senior citizen and also to examine the corelation between those independent factors.

III. Significance of the Study

This is pertinent to analyse how far the senior citizens particularly in the State of West Bengal are realizing the benefits of the same. This study would help to understand the efficacy of the welfare schemes as well as help to note the challenges that affects the ultimate realization of the benefits guaranteed to the senior citizens under these welfare schemes for their social security.

[7] 'Official Website of Barrackpore Sub-Division' (*Social Welfare Department*) <https://www.barrackpore.gov.in/sdobkp_socialwelfare_dept> accessed 27 December 2024

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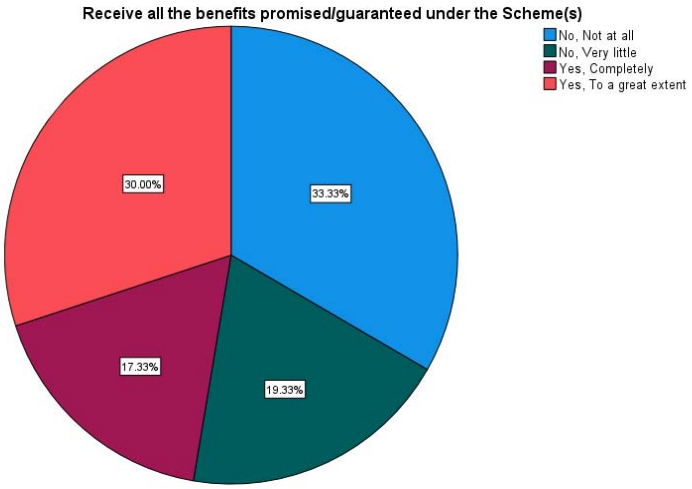


Figure 1: Senior Citizens Receiving all the Benefits Promised/Guaranteed under the Scheme(s)

Figure 1 clearly shows that out to the total 150 responses, 33.33 % of the senior citizens of West Bengal do not receive the benefits guaranteed to them under the welfare schemes and 19.33% of them receive a very little portion of the benefits assured to them. It is only 30% of them who receives the benefits in its true sense. Thus, there is a need to find out the appropriate reason for the differences in opinions.

a) Statistical Analysis

Dependent Variable: Try to access the benefits of the Schemes

Independent Variable: Qualification, Occupation, Monthly Income, Monthly Expenditure, ANOVA testing

Table 1: ANOVA for Accessing Benefit of Schemes Corresponding to Independent Variables

ANOVA[a,b]					
Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.379	13	1.183	1.098	.366
Residual	146.594	136	1.078		
Total	161.973	149			

- This present ANOVA model mainly investigates how independent variables such, as qualification, occupation, monthly income, and monthly expenditure affect the dependent variables, that is the attempt to access the benefits of the schemes.
- Here also determine the significance level of this model by examining the p-value. Mainly the regression model defines the sum of squares of 15.379 also, with the F-value of 1.098. With this, the significant value level is 0.366 also.
- On the other, side, the P-value is above the conservative beginning of 0.05 also, which also suggests the independent variables collectively do not have a statistically effective impact on the dependent variables in this ANOVA model.

*b) Chi-Square Testing (Qualification * Try to access the benefits of the Schemes)*

Table 2: Data for Qualification Related to Accessing Schemes

Crosstab						
Count						
		Try to access the benefits of the Schemes				Total
		Yes, To a great extent	Yes, Somewhat	Yes, Very little	No, Not At All	
Qualification	Below Class X	12	18	20	8	58
	Below Graduation	6	11	10	14	41
	Below Post Graduation	3	11	9	11	34
	Above Post Graduation	3	4	3	7	17
Total		24	44	42	40	150

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Table 3: Chi-square Test for Qualification Related to Accessing Schemes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.374[a]	9	.321
Likelihood Ratio	11.072	9	.271
Linear-by-Linear Association	3.744	1	.053
N of Valid Cases	150		

a. 4 cells (25.0%) have an expected count of less than 5. The minimum expected count is 2.72.

- Mainly Chi-square test investigates the relationship between the qualification as well as attempts to assess the advantages of the scheme.
- The value of the person chi-square is 10.374 the df (degree of freedom) value is 9 and the significance value is 0.321, these values also represent not any statistically significant association between the qualification and accessing scheme advantages.
- The second test shows the chi-square value of the Likelihood ratio is 11.072 and the significance value is 0.271 also, which also emphasizes the lack of significance.
- The third test also shows the chi-square value is 3.744 and the significance value is 0.053, that likely significant, whatever remains the above threshold.
- Here also the null hypothesis is met, as the chi-square value is 0.321, that also indicating no effective gap.

c) *Chi-Square Testing (Occupation * Try to access the benefits of the Schemes)*

Table 4: Data for Occupation Related to Accessing Schemes

Crosstab						
Count						
		Try to access the benefits of the Schemes				Total
		Yes, To a great extent	Yes, Somewhat	Yes, Very little	No, Not At All	
Occupation	Government Service (Retired/Working)	6	5	5	6	22
	Private Service (Retired/Working)	1	6	4	5	16
	Business	0	2	1	1	4
	Professional (Please Specify)	3	10	11	11	35
	Unemployed	14	21	21	17	73
Total		24	44	42	40	150

Table 5: Chi square test for Qualification Related to Accessing Schemes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-Sided)
Pearson Chi-Square	7.483[a]	12	.824
Likelihood Ratio	8.223	12	.767
Linear-by-Linear Association	.012	1	.914
N of Valid Cases	150		

a. 9 cells (45.0%) have an expected count of less than 5. The minimum expected count is .64.

- The results of the chi-square test also indicate the connection between the categorical variables. The person's chi-square value is 7.483 and the significance P-value is 0.824.

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- Other side, for likelihood ratio value, is 8.223 and the significance p-value is 0.767 also, both the p-values are higher than the significance value (0.05), which also represents there is not any statistically significant relationship between Occupation and Trying to access the benefits of the Schemes.
- Furthermore, 45% of cells have also an expected count of less than 5, which might impact the reliability of the test results. This investigation also suggests that this data might not be well-suited for this test.
- Here also the null hypothesis is met, demonstrating no effective association between the factors, as their p-value is higher than 0.05.

*d) Chi-Square Testing (Monthly Income * Try to access the benefits of the Schemes)*

Table 6: Data for Monthly Income Related to Accessing Schemes

Crosstab						
Count						
		Try to access the benefits of the Schemes				Total
		Yes, To a great extent	Yes, Somewhat	Yes, Very little	No, Not At All	
Monthly Income	Less than 10,000/-	15	22	22	16	75
	10,000/- to 30,000/-	3	13	11	10	37
	30,000/- above	5	9	8	13	35
	60,000/- above	1	0	1	1	3
Total		24	44	42	40	150

Table 7: Chi square test for Monthly Income Related to Accessing Schemes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.019[a]	9	.635
Likelihood Ratio	7.930	9	.541
Linear-by-Linear Association	2.116	1	.146
N of Valid Cases	150		

a. 4 cells (25.0%) have an expected count of less than 5. The minimum expected count is .48.

- This present chi-square test also investigates the relationship between the monthly income and the attempt to access the advantages of the schemes.
- The person's chi-square value is 7.019 also with a DF value of 9, as well as a significance p-value of 0.635.
- The significance p-value is greater than the level of significance (0.05), this result also represents no statistical significance between these two variables.
- Moreover, 25% of the cells have expected counts lower than 5, which represents a potential limitation in the sample.
- The hypothesis that there is not an effective association between the factors met as indicating by the higher rate of p-value.

*e) Chi-Square Testing (Monthly Expenditure *Try to access the benefits of the Schemes)*

Table 8: Data for Monthly Expenditure Related to Accessing Schemes

Crosstab						
Count						
		Try to access the benefits of the Schemes				Total
		Yes, To a great extent	Yes, Somewhat	Yes, Very little	No, Not At All	
Monthly Expenditure	Less than 5,000/-	7	17	20	9	53
	6,000/- to 15,000/-	13	20	18	15	66
	15,000/- above	4	6	4	15	29
	30,000/- above	0	1	0	1	2
Total		24	44	42	40	150

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Table 9: Chi Square test for Monthly Income Related to Accessing Schemes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.359[a]	9	.060
Likelihood Ratio	16.287	9	.061
Linear-by-Linear Association	2.719	1	.099
N of Valid Cases	150		

a. 5 cells (31.3%) have an expected count of less than 5. The minimum expected count is .32.

- This test is also helpful in investigating the relation between the monthly expenditure as well as the likelihood of trying to access the advantages of the schemes.
- The value of the person chi-square is 16.359, with this the p-value (significance value) is 0.060, which also suggests slightly above the conventional effective threshold of 0.05. This also represents a borderline non-significant connotation.
- On the other side, the likelihood ratio as well as the linear-by-linear association also represents similar results.
- Nevertheless, 31.3% of the cells have expected counts lower than 5, which might impact the test's dependability.
- This also represents that the sample size might need adjustment for perfect or accurate outputs.
- Here the null hypothesis is met, representing no significant connotation between the variables as the p-value (significance value) is above 0.05.

f) Correlation Analysis

Table 10: Corelation Analysis for All Independent Factors

Correlations						
		Qualification	Occupation	Monthly Income	Monthly Expenditure	Try to access the benefits of the Schemes
Qualification	Pearson Correlation	1	-.456**	.639**	.469**	.159
	Sig. (2-tailed)		.000	.000	.000	.053
	N	150	150	150	150	150
Occupation	Pearson Correlation	-.456**	1	-.510**	-.380**	-.009
	Sig. (2-tailed)	.000		.000	.000	.915
	N	150	150	150	150	150
Monthly Income	Pearson Correlation	.639**	-.510**	1	.625**	.119
	Sig. (2-tailed)	.000	.000		.000	.146
	N	150	150	150	150	150
Monthly Expenditure	Pearson Correlation	.469**	-.380**	.625**	1	.135
	Sig. (2-tailed)	.000	.000	.000		.099
	N	150	150	150	150	150
Try to access the benefits of the Schemes	Pearson Correlation	.159	-.009	.119	.135	1
	Sig. (2-tailed)	.053	.915	.146	.099	
	N	150	150	150	150	150

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

- This correlation model also investigates the connections between qualification, occupation, income monthly, and monthly expenditure.
- Between the qualification and the monthly income, there is also a significant relation. The correlation value between these two variables is 0.639 also.

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- The correlation value between qualification and monthly expenditure is 0.469 also, that indicates a moderate correlation between these two variables.
- There is also indicated a strong relation between monthly income and monthly expenditure. The correlation value between these two variables is 0.625 also.
- The correlation value is negative between occupation and qualification, the correlation value is -0.456 also.
- On the other hand the correlation value between "trying to access the advantages of the schemes" as well as other variables is poor and not statistically significant.

IV. Conclusion

In this case the benefit of schemes is not highly dependent on each factor like Qualification, Occupation, Monthly income, monthly expenditure etc. This is significant to understand that the other factors have less affect for the benefit of the scheme (*Table-1*). Hence, Qualification, Occupation, Monthly income, Expenditure does not able to affect the awareness of the benefit of the scheme.

Corresponding to *Table 2-9*, Chi-square test has been performed to assess the advantages of the scheme with respect to independent factors like Qualification, Occupation, Monthly income, monthly expenditure. In all cases it has been observed that these factors are not statistically significant for a person to assessing the advantages of the scheme corresponding to the data set. Therefore, it shows that the independent factors individually are not affecting the awareness of a person.

Between all independent factors, correlation is performed and it is showing significant corelation between qualification and the monthly income, monthly income and monthly expenditure which means the growth of one factor will be responsible for the growth of other factor (*Table-10*). It means the growth of qualification will rise the monthly income and the raise of monthly income will rise the monthly expenditure.

V. Recommendations

Based on the above conclusion, the following can be recommended:

1. An increase in awareness program would help the senior citizens to enlighten them on the welfare schemes dedicated to their social security[8]. Section 21 of the Maintenance and Welfare of Parents and Senior Citizens Act, 2007 explicitly talks about the publicity and awareness training of the provisions of the Act through the social media[9]. This is high time that the governmental bodies or NGOs should take interest in publicizing the provisions of the Act. Nevertheless, the schemes introduced by the State Government must be publicized in the same manner to ensure the uniform implementation of the schemes[10].
2. An introduction of a Nodal Officer or dedicated platform can again help the senior citizens to seek quick and easy access to the solutions of the problems faced by them[11]. The Maintenance and Welfare of Parents and Senior Citizens Bill, 2019 under Section 23 has suggested for the same in each district[12].
3. A uniform national helpline no. for the senior citizens can also be a great help to those who have restricted autonomy or mobility. Currently, the HelpAge India operates a toll-free helpline no. (1800-180-1253), however it is operative only in 15 states. Furthermore, the Ministry of Social Justice and Empowerment has introduced an elderly helpline no. (14567) but the service is limited to 6 states only[13].
4. A frequent survey by the local municipalities or corporations or inspections by ward counsellors can be fruitful in finding out the current distress or challenges faced by the senior citizens in that locality and such report of the survey can be presented before the State Government so that the challenges can be addressed in its true sense[14].

This needs to be borne in mind that the senior citizens are the prized possession of our society[15]. Their welfare is not only the responsibility of the State but also ours. The personals laws depict the rich culture of the Indian society. The Hindu Adoption and Maintenance Act, 1956, under Section 20 talks about the obligation of the children to maintain their infirm and aged parents[16].

[8] Bhardwaj P, 'A Critical Analysis of Senior Citizens' Rights in India' [2020] Amity International Journal of Juridical Sciences 64

[9] The Maintenance and Welfare Of Parents And Senior Citizens Act 2007, s 21(i)

[10] Abadana (a scheme for welfare and protection of senior citizens) | Social Security & Empowerment of Persons with Disabilities Department, <https://ssepd.odisha.gov.in/schemes-programmes/ schemes/abadana-scheme-welfare-and-protection-senior-citizens> accessed 27 December 2024

[11] Banerjee R, 'A Critical Analysis of The MWPSC Act in Light of the 2019 Bill and Other Decided Cases' (2021) VI NUJS Journal of Regulatory Studies 1

[12] Maintenance and Welfare of Parents and Senior Citizens Bill 2019, s 23(2)

[13] 'Elder Helplines' (*HelpAge India*, 18 November 2024) <https://www.helpageindia.org/our-work/agecare/elder-helplines> accessed 27 December 2024

[14] Kurian A and others, 'An Investigation into the Problems of the Elderly Residents of Kolkata Municipal Corporation' (2023) 8 International Journal of Innovative Science and Research Technology 2035

[15] Jaspreet Kaur Hanspal, 'Rights and Dignity of Senior Citizens A Socio - Legal Analysis' (2022) 6 Legal Research Development 19

[16] Hindu Adoption and Maintenance Act 1956, s 20

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The Mohammedan law on the other hand talks about the maintenance of not only of the infirm parents but also all aged infirm elderly relatives if they have sufficient means to maintain them[17].

In Baban Alias Madhav Dagadu Dange vs. Parvatibai Dagadu Dange[18], the Bombay High Court observed that although in General Clauses Act, the expression 'mother' has not been defined but it does not mean that it shall be restricted in its strict sense and thus if the expression 'father' can include natural as well as adoptive father, the expression 'mother' can be interpreted in its wide sense to include both natural and adoptive mother. Thus, the Court concluded that even an adoptive mother has the right to claim maintenance from her children. In Kirtikant D. Vadodaria vs. State of Gujarat and Ors.[19], the Supreme Court ruled that even a step-mother who is incapable of maintaining herself can claim maintenance from her step-son. Even a married daughter is liable to pay for the maintenance of her parents provided they are incapable of maintaining themselves as ordered by the Supreme Court in Vijay Manohar Arbat vs. Kashirao Rajaram Sawai[20]. In Dr. Ashwani Kumar vs. Union of India & Ors[21] in light of M/S Shantistar Builders vs. Narayana Khimalal Totame and Ors[22], the Supreme Court pointed out that adequate accommodation plays a significant role in the intellectual and physical wellbeing of a senior citizen, therefore besides medical care, reasonable management of old age homes are also instrumental for the wellness of the senior citizens. Since, right to life with dignity as enshrined under Article 21 of the Indian Constitution applies to all[23], the senior citizens as well reserves their due right to live their remaining period of live with heads held high in peace.

[17] Kumar R and Vishwakarma M, 'Maintenance of Elderly People: A Critical Analysis of the Existing Legal Provisions in India' (2019) 6 IJRAR- International Journal of Research and Analytical Reviews 490
[18] Baban Alias Madhav Dagadu Dange vs. Parvatibai Dagadu Dange (1980 CriLJ 256 = 1980 (82) BOMLR 116)
[19] Kirtikant D. Vadodaria vs. State of Gujarat and Ors. (1996) 4 SCC 479
[20] Vijay Manohar Arbat vs. Kashirao Rajaram Sawai AIR 1987 SC 1100
[21] Dr. Ashwani Kumar vs. Union of India & Ors CWP No. 193 of 2016
[22] M/S Shantistar Builders vs. Narayana Khimalal Totame and Ors, AIR 1990 SC 630
[23] Indian Constitution 1950, art 21

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d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Social Science Research Paper

Techniques for writing a good quality homan social science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of homan social science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.
Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

19. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

20. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

21. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

22. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



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Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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