

Paper Type: Original Article

Environmental Transformation and Climate Change Analysis

Amin Vahidi¹, Mohammad Hossein Ebrahimi^{1,*}, Alireza Shiraei¹

¹ Department of Mechanical Engineering, Faculty of Mechanical and Energy Engineering, Shahid Beheshti University, Tehran, Iran; amin.vahidi@gmail.com; mhebrahimi87@gmail.com; shiraicealireza@gmail.com.

Citation:

Received: 13 August 2025

Revised: 7 December 2025

Accepted: 8 January 2026

Vahidi, A., Ebrahimi, M. H., & Shiraei, A. (2026). Environmental transformation and climate change analysis. *Journal of Environmental Engineering and Energy*, 3(1), 35-55.

Abstract

Research showed that most terrible debacles happened because of Climate change. According to a biological perspective, global warming can cause extensive changes in the climate, biodiversity, and human existence. Today, researchers and specialists in climatology and ecological sciences accept that one of the reasons for worldwide climate change has been the increase in greenhouse gases. Human discharges of Carbon Dioxide (CO₂) come from two fundamental sources: Burning petroleum products and changing land use, like deforestation. In this exploration, the System Dynamics (SD) technique was utilized. SD strategy depends on the idea of input circles. On the off chance that the circle enhances itself, it is a positive input or building up a circle; furthermore, if rising in a variable reason itself to diminish it is a negative or adjusting criticism circle. The general SD stock and stream model was introduced in light of these ideas. The time skyline of this model reproduction is from 2020 to 2100. Assuming that ongoing circumstances continue in 2050 and 2100, global warming will be 2.38 and 5.56 °C higher than in 2020. It is devastating and makes the Earth barely tenable. Additionally, the reenactment shows that in 2100, Fossil Fuel Consumption will be 2.1 times that of 2020 in an outstanding example. In 2100, vegetation diminished from 55% to 33%. So, creatures and plants will be terminated incredibly rapidly, and Earth will be a dead planet with the latest thing. So, in the event that global warming proceeds, it will take just 10 years to arrive at an irreversible point. Assuming the human race works on 30% in public awareness about global warming impacts and policies, laws, and guidelines' adequacy on deforestation and woodland development, global warming will diminish to 41% in 2050 and 37% in 2100. So, a worldwide effort is expected to save the Earth and humanity.

Keywords: Climate change, Global warming, Fossil fuel consumption, Greenhouse gases, System dynamics.

1 | Introduction

The developing aggravation of environmental troubles, together with global warming, depletion of water resources, and the destruction of biodiversity within the subsequent century, has emerged as one of the most crucial issues for many nations and worldwide corporations [1]. These crises have unfolded to such a volume that there may be no other way for humans, however, to save themselves from the severity of those

✉ Corresponding Author: mhebrahimi87@gmail.com

doi: <https://doi.org/10.22105/jeeee.v3i1.52>



Licensee System Analytics. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0>).

modifications. If the quantity of greenhouse gases inside the ecosystem increases in an equal manner, the end result may be a good deal more than the extinction of species and rising sea levels [2].

On the eve of the 3rd millennium, the safety of the surroundings, because it is not an unusual place for human rationality, ideas, and motion to acquire sustainable improvement and a vibrant destiny wherein the rights of future generations are guaranteed, is the most crucial obligation and duty of governments [3].

The slogan for World Environment Day, "global warming and melting ice," suggests the significance of being attentive to the reality that it's a worldwide hazard to all lands, due to the fact that climate change impacts all factors of human existence. What is known as global warming nowadays is clearly a growth in the global temperature of the Earth close to its surface.

The International Panel on Climate Change (IPCC), an authoritative body on climate change and the outcomes of global warming, stated in a report: "Most of the global warming in the 20th century is because of greenhouse gases humans have produced." [4]. The panel no longer ruled out the position of herbal elements together with sun volcanoes; however, it stated the outcomes will be traced back to the early 1950s, whilst the sector was no longer industrialized. About 20% of the sector's greenhouse gases come from deforestation, as cleared woodland areas are frequently used for grazing farm animals, elevating animal feed, or producing biofuels.

Global warming has many ugly outcomes in the lives of people and animals. As the Earth warms, the polar ice caps melt, the ocean level rises, and the seasons intensify. In this manner, winters may be less warm than ever, and summers may be hotter and drier. These changes have a destructive impact on agriculture, which is one of the key efficient sectors on Earth. Climate change is increasing the global temperature of the Earth, hence prolonging the growing season. In regions in which summertime season warmth is excessive beneath normal conditions and dangerous to crop growth, growing temperatures make the scenario even more difficult. As the temperature rises, the chance of drought will increase, and the rate of evaporation of soil moisture will increase.

According to the office of the national climate change plan, the projected growth in temperature will lessen the fertility of rice seedlings, shorten the shelf life of corn, ripen wheat, and decrease the germination of potatoes. On the other hand, global warming modifies the quantity of rainfall in specific areas. Changes in the quantity and timing of precipitation have an effect on soil erosion and moisture, factors that are each very crucial in agriculture. It is anticipated that if the heating fashion increases in an equal manner, the quantity of precipitation will grow in the northern regions and decrease in the regions close to the equator.

Increasing atmospheric Carbon Dioxide (CO₂) can also make vegetation, together with wheat and rice, extra fertile. On the other hand, water constraints and growing temperatures no longer permit CO₂ to increase yields. Also, the growth of different pollutants together with Ozone (O₃) inside the atmospheric layers close to the Earth's surface, which is due to global warming, impairs the growth of agricultural products.

The speedy emergence of greenhouse gases during the early Jurassic period (approximately one hundred eighty million years ago) additionally precipitated the common Earth temperature to an upward push between 5 and 9 degrees Celsius.

2 | Methodology

It is usually recommended to apply the System Dynamics (SD) version for holistic evaluation of plans and selections. The ensuing qualitative and quantitative evaluation may be an outstanding exercise manual for coming across and reading the headaches of a device.

SD is a technique of device modeling and coverage evaluation primarily based on the comment structures theory. In the late 1950s, Jay Forester, a pioneer in laptop engineering and layout, coined the idea. Since then, SD has evolved as a separate discipline from disciplines together with operations studies and control science. The laptop without problems simulates those fashions because of their numerical nature. SD combines the

behavioral and social sciences. It calls for cautious layout and production of revolutionary fashions with many interactive variables [5]. However, the outcomes and arguments of an excellent version will no longer be too indistinct and complicated for decision makers.

On the other hand, despite the fact that the dynamic version of the device is a complicated version, it's nonetheless compressible enough to run on a laptop. This characteristic permits all hypotheses and eventualities to be examined quickly and punctiliously in interactive approach improvement sessions.

SD is utilized in structures that face complicated and crucial decisions that are seeking to combine insights into essential troubles that could have an effect on the outcomes of years or decades to come [6]. SD assists those structures in verifying the pros and cons of guidelines they have taken into consideration, or can also remember later. An inclusive and strategic imaginative and prescient is wanted, whilst specific guidelines have a couple of short-term and long-term results (together with the response of all affected elements and the response to these reactions). In such instances, habitual planning techniques (together with the usage of spreadsheets, statistical, or maybe regression models) will no longer work because they cannot expect feasible embedded comment loops to be conducted.

In a dynamic version, one coverage can also additionally appear like an excellent coverage at first glance; however, inside the actual global, it faces limitations or resistances that counteract its outcomes. It can also make matters worse, as opposed to assisting in resolving the hassle. Also, the coverage that appears vulnerable or costly at the beginning may fit nicely inside the stop, and its boundaries and drawbacks may be lessened due to its advantages.

SD fashions consciousness is no longer limited to primary outcomes but additionally on secondary outcomes and comment outcomes, thereby enhancing our capacity to select smart guidelines (which stay solid through the years).

SD fashions are custom-constructed to resolve a particular hassle. The hassle to be modeled should be exactly defined. The version fashion dressmaker should work with the patron at all levels to decide the primary movements and final results variables [7]. Determining the extent of elements of movements and variables is likewise very crucial. A version is beneficial whilst it considers all of the crucial variables and excludes useless sub-variables. Such a model will consider all to be had and feasible choice-making guidelines (even the ones that are uncommon but really well worth considering) and eliminate useless guidelines as a result.

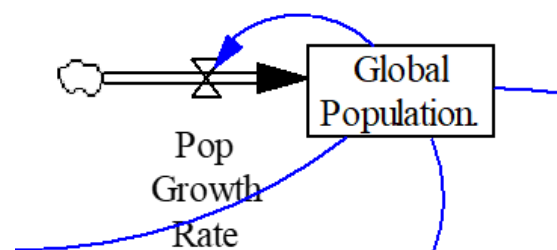


Fig. 1. System dynamics loop sample.

The idea of comments is one of the most crucial elements of the SD approach. As shown in *Fig. 1*, feedback loop diagrams and causal loops are tools for conceptualizing the shape of a complicated device and linking version- based total findings. A comments loop takes place whilst data from a motion or motion circulates throughout a device and in the end returns to the point of origin. If the loop has a tendency to expand the preliminary motion, it's also known as a tremendous comments loop or reinforcing loop.

In this case, if a variable increases (decreases), it'll grow (decrease) once more after a delay. If the loop has a tendency to oppose the preliminary motion, the loop is known as a bad or balancing comments loop. In this case, if the variable decreases, it'll grow, and if it increases, it'll decrease. The signal of the hoop is known as the "polarization of the hoop". No version can be as it should be, and absolutely expect the destiny. However, a few fashions are more dependable than others. Dynamic modeling of the device calls for knowledge,

artwork, and effort, and the slightest mistake or slip in it can result in intricate outcomes. In designing an excellent version, on the one hand, historical information for the final result variables ought to be as complete as possible. On the other hand, suitable numerical assessment ought to be executed for the version of enter hypotheses. A top version ought to be complete and complete with convincing evidence.

In the SD version, after choosing the variables, we need to not forget a few hypotheses and continue to the modeling technique primarily based on them. Not all hypotheses want to be whole and conclusive. This uncertainty of the hypotheses suggests how crucial it is to check the sensitivity and validity of the hypotheses [8]. The motive of those experiments is to see if an extrude inside the version hypotheses will affect the outcomes of the relative outcomes of strategic selections. In reality, the character of the SD is such that the inaccuracy of the hypotheses no longer depends on a good deal, due to the fact that those hypotheses may be changed at some stage in the technique. Here are a few matters to search for whilst choosing yours.

- I. Search for extra information and data that may help resolve the uncertainty of the hypotheses.
- II. Design the version with extra information on the parameters associated with the hassle or issue.
- III. Identify which parameters of the hassle want to be similarly investigated to get a more definitive solution to the hassle.

The SD simulation consists of the subsequent steps:

- I. Define the hassle dynamically, primarily based on graphs whose horizontal axis is the time axis.
- II. Trying to acquire an endogenous behavioral perception of the dynamics of a device and focusing on the traits of the device.
- III. Thinking approximately all of the ideas inside the actual device as non-stop values which are associated with every difference inside the comment's loops and the causality loop.
- IV. Identify the tiers of shares inside the device and the charge in their input and output flows.
- V. Develop a behavioral version that has the potential to reproduce. This version is a laptop simulation. The model is typically expressed as nonlinear equations; however, it is sometimes expressed as a diagram primarily based on the buildup comments shape and the waft/causal comments shape of the device, as opposed to being quantified.
- VI. Understanding the ideas and government guidelines of the ensuing version.
- VII. Implement the modifications derived from the findings and version understanding.

2.1 | Global Warming

The quantity of CO₂ in the air is a measure of greenhouse gases. For instance, earlier than the industrialization of the sector, the quantity of CO₂ inside the air became 260-280 Parts Per Million (PPM); however, after industrialization, this quantity accelerated, and now it has reached 360 PPM. 2005 is stated to be the warmest 12 months in the ultimate century; in these 12 months, the quantity of CO₂ inside the air reached 381 PPM. An organization of French specialists considers that the fight against rising temperatures ought no longer to be restricted to lowering CO₂ because methane, another gas whose greenhouse impact could be very crucial in the short term, has been ignored. The specialists additionally referred to that lowering CO₂ by myself couldn't lessen worldwide temperatures with the aid of using stages with the aid of using 2050.

NASA scientists have observed a big mixture of world air pollutants, together with thick fog from smoke and summertime season chemical vapors that play a major role in global warming.

In a worldwide assessment, they calculated the impact of O₃ on global warming and how O₃ has modified temperatures in the lowest part of the ecosystem over the last hundred years. Using the quality estimates obtained from the worldwide emissions of O₃-generating gases, Goddard Institute for Space Studies (GISS)

laptop pattern studies show how a good deal of these air and greenhouse gas pollutants have contributed to heating positive regions of the sector.

The new outcomes spotlight the surprising effect of the world's air pollutants on outcomes. According to researchers, we now recognize that lowering O₃ pollutants can't handily enhance air health, but also facilitate global warming, particularly in the Arctic. Global warming impacts all dwelling and non-dwelling matters on Earth: Global warming will increase the depth of evaporation and, consequently, the demand for water for agricultural products. On the other hand, the quantity of water for agricultural use is decreased, and due to drought, food safety is endangered. Drought leads villagers to emigrate to towns, to be marginalized, to show fake jobs, and to grow social anomalies.

Rising worldwide temperatures are also affecting access to clean water and the amount of water consumed. On the other hand, because of growing sea levels, saline water infiltrates coastal freshwater assets and modifies them. Another hassle is that floor evaporation because of global warming causes rivers to dry up and water to decline. This phenomenon is particularly glaring in much less watery regions, together with deserts and semi-deserts. In addition, the growth in freshwater salts, because of evaporation, reduces their quantity. Rising worldwide temperatures are also causing the rapid melting of polar ice caps and floating icebergs, resulting in growing sea levels.

According to the forecasts of worldwide corporations within the next 100 years, the water level of the high seas will grow between 30 cm and 1.5 meters, which in turn will cause the disappearance or depopulation of a few islands, the development of water in coastal regions, and affect centers and human lives in ports. Another devastating result of global warming is the growth in the range and power of hurricanes and tornadoes that we're presently facing. The melting of the polar ice caps creates a circulation of natural bloodless water that, because of being bloodless, slides beneath the nice and cozy waters of the oceans, developing large-scale ocean currents that create more storms, hurricanes, and more intense hurricanes.

As global warming increases, so does the probability of volcanoes erupting. Rising temperatures at the Earth's surface in recent years have led to much more profound modifications than the melting of the polar ice caps, ultimately leading to the melting of the Earth's internal layers, which emerge from volcanic mountains. With the disappearance of icebergs, the strain exerted on the rocks below the ice sheets may be substantially decreased, resulting in the melting of the Earth's internal rocks and the formation of magma. As the ice melts, extra magma will shape the Earth, which can set the stage for volcanic eruptions that would have an effect on the entire globe.

As the strain on the Earth's crust changes, so does the strain on the geological layers inside the Earth's crust. As a result, an explosion is probable to occur because the weight of the ice sheets acts as a barrier to the melting of the Earth's internal crust and has blanketed the Earth from volcanic eruptions for years. Another devastating result of growing temperatures is the unfolding of tropical illnesses, a few fevers, and viral illnesses. The slow warming of the Earth additionally will increase the start charge of rodents together with mice and, consequently, the unfold of illnesses transmitted with the aid of using them.

According to worldwide corporations, the floor of the oceans will rise by 30 to hundred fifty centimeters in the next one hundred years because of the phenomenon of "global warming". Surface evaporation because of the "global warming" phenomenon causes rivers to dry up and water to decline. O₃ is the Earth's protective layer in opposition to the sun's dangerous rays. Around 1970, cavities together with Chlorofluorocarbons (CFCs) had been used inside the compressors of fridges and a few different refrigerants to create cavities on this shield. Most of those substances are used in the manufacturing of foaming agents, solvents, cooling structures, and insulation.

Due to the giant impact of those materials on O₃ depletion, a worldwide settlement (the Montreal Protocol) has been reached to limit the usage of those materials. Hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs) have now changed those substances, which aren't O₃-depleting but have greenhouse outcomes.

Therefore, studies are presently underway to update substances that don't increase the greenhouse effect and are well suited to the O3 layer.

Human emissions of CO₂ come from fundamental reasserts: Burning fossil fuels and converting land use, together with deforestation. Scientists' studies suggest that sufficient solar electricity reaches the Earth's surface. The electricity acquired every forty minutes can offer one hundred percent of the entire electricity needed with the aid of using the sector for 12 months. Trapping only a small part of this solar electricity can meet the complete energy needs of the United States (US). On the other hand, we can also point out wind electricity and geothermal electricity. In the US, we've got lots of wind electricity in the east and west, which can meet the needs of the towns in this region.

In the subsequent *Figs. 2-4* global warming causes and outcomes tree and loops supplied:

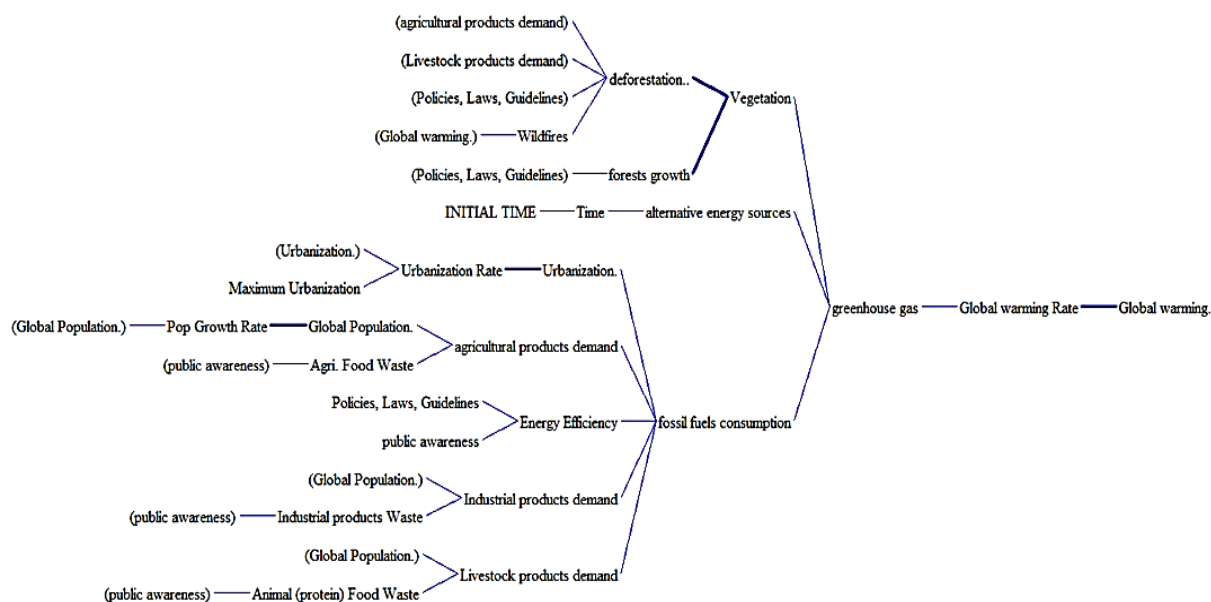


Fig. 2. Global warming causes tree.

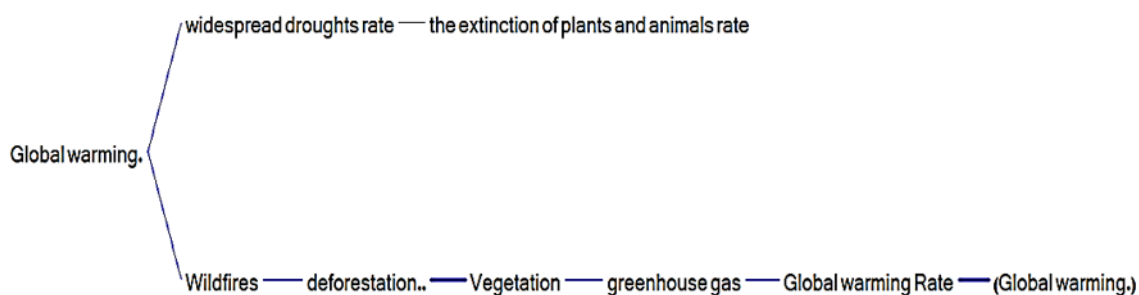


Fig. 3. Global warming effects tree.

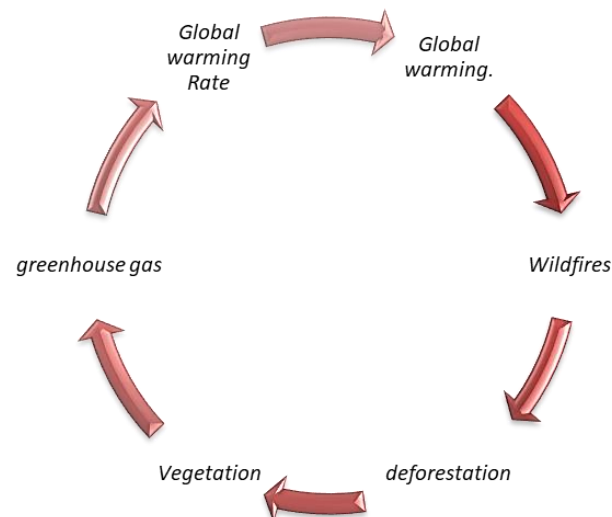


Fig. 4. Global warming loop.

As you can see, global warming will reproduce and expand itself in growing conduct because of the above tremendous comments loop.

2.2 | Biodiversity

Decreased biodiversity and destructive outcomes on plant and animal species are two different results of global warming. Animal migration and flowers are affected because of drought and water shortage, resulting in modifications in the food chain and destructive outcomes in the atmosphere of the region. This hassle additionally results in modifications within the biodiversity of the aquatic environment in the seas. A clean and tangible instance of that is the whitening of corals at the beaches of the Persian Gulf. According to scientists, corals die in advance and turn white because of the common growth in water temperature.

Due to the significance of climate change, diverse research on fowl existence was carried out, and exciting outcomes were obtained. In general, climate change has direct and indirect outcomes in the lives of birds, which can significantly disrupt their life cycles. For instance, because the climate warms, birds migrate to extra northern beaches. In this manner, the birds journey longer distances than inside the beyond at some stage in their migration, which can result in the extinction of weaker species. An exciting study posted with the aid of the University of Michigan in the US suggests that because the awareness of CO₂ inside the ecosystem doubled due to extra global warming, the range of birds in positive regions reduced substantially and became no longer observed in any respect in a few regions. Different birds now and again lay eggs approximately per week or in advance, which makes the birds approximately per week or older whilst migrating. In such instances, whilst returning or at some stage in the journey, the opportunity of extinction of birds will increase, and their population will decrease daily.

On the other hand, because of global warming, the time of flowering and blooming of plant species has been modified compared to the past. Many animal and plant species are actually extinct because of climatic outcomes, and plenty of animal species are compelled to emigrate. As a result, the entire planet's atmosphere is falling apart. More than 1/2 of all dwelling matters were extinct in numerous instances in Earth's history; however, it has taken millions of years to recover. The causes of extinction of plants and animals due to climate change are illustrated in Fig. 5.

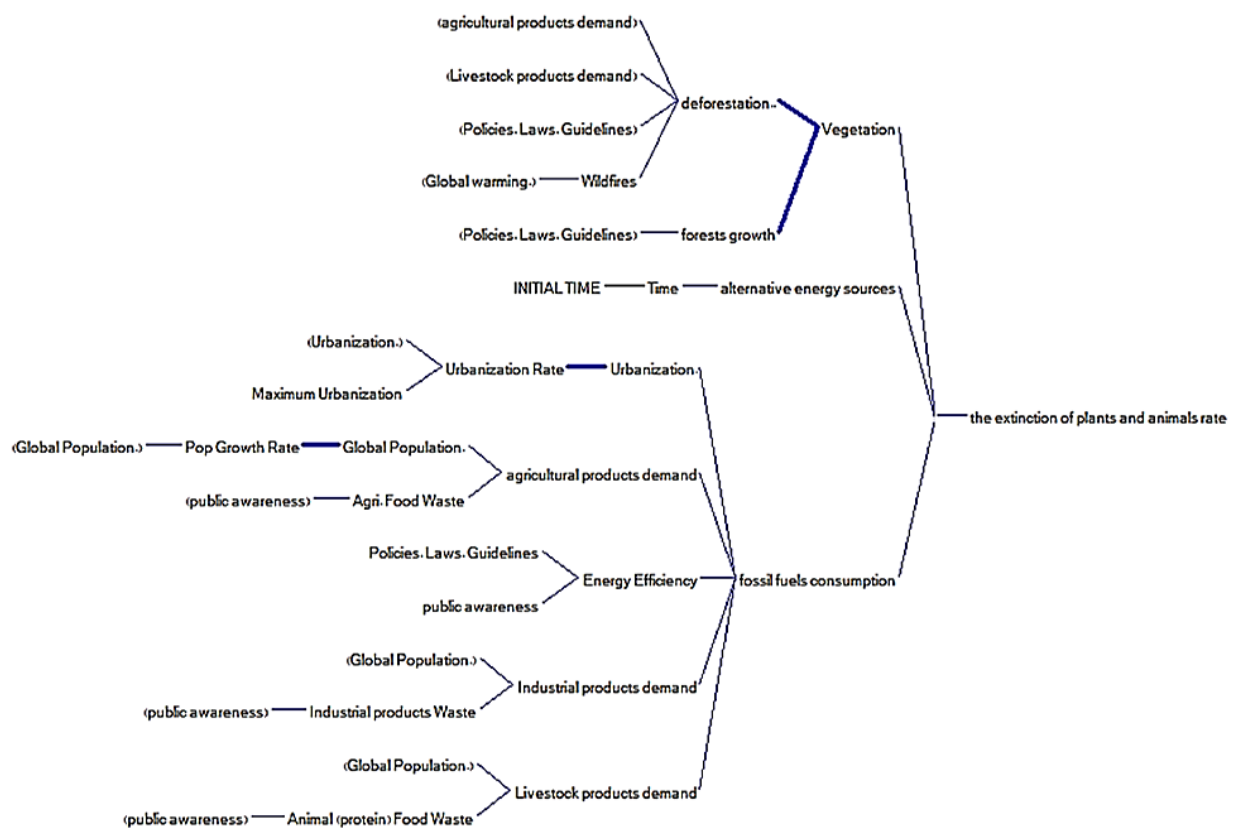


Fig. 5. Extinction of plants and animals causes tree.

2.3 | Fossil Fuel Consumption

As defined earlier, many variables contribute to global warming and climate change; however, the fundamental variables are as follows:

2.3.1 | Urbanization

From historic instances to the present day, villagers have migrated to towns for diverse purposes, and this trend has increased in recent years and has brought about the phenomenon of sizable urbanization. It is plain that the growth in the city population will result in an increase in electricity intake, which can result in the decline of herbal assets.

Urbanization will grow the call for commercial goods (in particular plastic). On the other hand, on average, consistent with per capita meal intake is better in city communities. These outcomes will increase electricity consumption, greenhouse gas emissions, and global warming.

An increasing city population can also result in demanding situations, together with growing air pollutants, widening the income gap, and the deterioration of city infrastructure. The maximum crucial motion that managers and residents can take to save their assets from walking out is to take strategies to stabilize as many towns as possible. What we're searching for right here is to take note of the impact of urbanization on global warming. It ought to be noted that the modern fashion of growing urbanization is 0.3% consistent over 12 months.

2.3.2 | Agricultural and livestock merchandise

An organization of scientists, and particularly some environmental Non-Governmental Organizations (NGOs), has pointed the finger at the rural and farm animal industries as one of the fundamental reasons for global warming. According to the Food and Agriculture Organization of the United Nations (FAO), farm animals and animal husbandry enterprises rank first in environmental threats.

The file, entitled livestock's long shadow, states that the farm animal enterprise has degraded land, polluted water assets, destroyed species variety, and affected the greenhouse impact.

Livestock sports result in the manufacturing of greenhouse gases directly and indirectly. Consumption of fossil fuels and the manufacturing of CO₂ gas, on the other hand, and gases produced at some stage in the manufacturing of animal feed or inside the technique in their digestion, which are released from the gut and especially through feces, on the other hand, it has challenged environmental activists and advocates.

The maximum crucial greenhouse gas produced at some stage in animal feed is nitrogen dioxide. Wheat and soybean manufacturing produce large quantities of nitrogen dioxide, with a few scientists claiming that approximately 65% of atmospheric nitrogen dioxide comes from such sources.

The subsequent pollutant is methane. The adverse outcomes of methane in the global warming technique are 23 times more than those of CO₂. 37% of the methane inside the ecosystem is produced with the aid of animal husbandry. India's farm animal industries by themselves produce 11.75 million tons of methane in a 12 months.

The United Kingdom (UK) Department for Environment, Food and Rural Affairs (Defra) has taken the lead and partnered with Cranfield University on the environmental impact of resources, gadgets, and techniques utilized in diverse branches of agriculture and animal husbandry, and the effect of each on heating. The research targeted 10 principal sports together with red meat manufacturing, beef manufacturing, mutton, chicken, eggs, and milk manufacturing. According to a hallmark known as Global Warming Potential in One Hundred Years (GWP100), rooster and egg manufacturing have the least effect, and red meat manufacturing has the maximum effect on global warming. However, rooster-breeding ammonia makes up a big part of the ammonia in acid rain (64%).

2.3.3 | Industrial merchandise

All sectors, from transportation and agriculture to enterprise, make a contribution to greenhouse gas emissions; however, it should be stated that enterprise has an outstanding proportion of air pollutants and greenhouse gas emissions.

To show this claim, we are able to seek advice from everyday humans dealing with diverse varieties of commercial merchandise. Industry, with its considerable variety of merchandise, emits greenhouse gases in direct and indirect ways. Meanwhile, the primary component is created because of the lifestyles of manufacturing centers, and the second component is created with the aid of electricity to supply merchandise. In the dialogue of the direct emission of greenhouse gases, we can seek advice from the emission of gases produced with the aid of fossil fuels. Fossil fuels, together with gas and oil, which are by and large utilized in industries including the manufacturing of chemical substances, iron, metal, and cement, generate more greenhouse gases in commercial centers than other fuels. But if we study the problem of oblique greenhouse gas emissions, we come to electricity plant life, which provides the electricity needed to power manufacturing traces and commercial machinery; that is because the electricity that powers electricity plant life is typically supplied by fossil fuels.

In this regard, the US Environmental Protection Agency (EPA) has observed the proportion of diverse industries in the manufacturing of greenhouse gases. According to the file, the entire greenhouse gases produced inside the US are predicted at 6,637 million tons of CO₂, whilst the enterprise with 21% of the entire greenhouse gases in the US, ranks first in gas manufacturing. If we don't forget the manufacturing and use of strength as a powerful factor in producing greenhouse gases, the proportion of enterprise in overall greenhouse gases these 12 months will grow to a figure between 29% and 31%. It turned into the only industrialized US in the world that has now no longer ratified the Kyoto Protocol because US officials consider that lowering greenhouse gas emissions under the Kyoto Protocol will result in a slowdown in the monetary boom.

After the US, China is the biggest manufacturer of greenhouse gases with an annual production of 6018 million tons of greenhouse gases; however, given the quantity of manufacturing and interest of diverse industries in China, the production of this quantity of polluting gases isn't surprising. With a population of over one billion, it's by far the sector's biggest population, with the aid of population and makes use of a large number of fossil fuels in towns, the meals enterprise, and the transportation enterprise.

Various industries are increasingly concerned with the manufacturing of greenhouse gases. Oil and gas manufacturing, which produces gases together with CO₂ and methane, accounts for three. 6% of the sector's greenhouse gas emissions. The cement enterprise additionally emits 4% of the sector's greenhouse gases by emitting CO₂, because the demand for cement is very high due to the increase in production worldwide. Cement manufacturing, which entails extracting limestone after processing it at very high temperatures, calls for lots of electricity. In addition, the aviation enterprise accounts for 3.5% of the sector's greenhouse gas emissions through the manufacturing of CO₂, water vapor, nitrous oxide, and particulate dependents. According to the Intergovernmental Panel on Climate Change (IPCC), the emissions of water vapor, nitrogen oxides, particulate matter, and CO₂ from planes are 2 to 4 times higher than CO₂ emissions. The iron and metallic enterprise additionally emits 2.3% of the sector's greenhouse gases by generating CO₂. The iron and metallic enterprise has one of the most important carbon footprints of any unmarried commercial sector. The sheer length of the enterprise and the approaches of mining, transportation, smelting, and manufacturing that require awesome electricity are key elements in this regard. Waste additionally has a 3% proportion in greenhouse gas emissions by generating CO₂ and methane; Landfills are considered a significant source of methane production because of the decomposition of diverse substances. If waste is incinerated, it additionally releases CO₂. Today, agricultural merchandise waste is set at forty-five to 50%, and animal (Protein) merchandise waste is set at 30%.

The definition of the Kyoto Protocol states that it is a worldwide treaty signed in 1997 to reduce greenhouse gas emissions among countries around the world. The settlement, designed to supplement preceding ones, was meant to permit industrialized international locations to lessen their greenhouse gas emissions by five percentage with the aid of using 10 years and to offer financial support to developing nations to grow the penetration of renewable electricity, reasserts together with solar electricity. The settlement was signed with the purpose of obliging the nations of the sector to reduce the emissions of greenhouse gases and the bad results of global warming. The treaty was drafted in Kyoto, Japan, in December 1997, submitted to diverse nations for signature in March 1998, and finalized on March 15, 1999. The settlement specifies the number of years and with the aid of using how many greenhouse gas emissions may be decreased. The gases blanketed with the aid of this treaty are: CO₂, methane, nitrous oxide, and sulfur hexafluoride. Following the percent, 10,000 delegates from 195 nations assembled in Paris on November 30 to collectively combat climate change and global warming. The fundamental part of the assembly will be the consciousness of the implementation of an opportunity in the Kyoto Protocol to lessen greenhouse gas emissions. The treaty ought to lessen the sector's Fossil Fuel Consumption to such a volume that global warming no longer increases by more than 2 degrees by the end of the 21st century, on the grounds that the start of world industrialization. For the first time, the percentage binds industrialized and growing nations to lessen CO₂ (fossil gasoline) emissions and is predicted to update the Kyoto Protocol by 2020. This time, the leaders of the sector, in particular the industrialized nations, all consider that they should discover an unusual place strategy to fight global warming [9]. For instance, the US, China, Germany, and Russia, the sector's biggest emitters of greenhouse gases, can play a crucial role in worldwide efforts to lessen emissions. Today, 14% of overall electricity is renewable (opportunity) electricity, and it's growing by 1.1% consistent with 12 months.

2.3.4 | Energy efficiency

Energy performance manner the usage of much less electricity for services. For instance, a fluorescent lamp is greener than conventional incandescent bulbs because it consumes much less energy than generating an equal quantity of light. Similarly, a green boiler makes use of much less gasoline to warm a domestic at a positive temperature than a less efficient green boiler.

The time period of electricity performance is mostly a time period used to explain any electricity generation. Technically, though, it ought to be awesome from electricity financial savings - a broader time period that may encompass whether or not a tool modifies the performance of something it produces. Examples of electricity financial savings include decreasing the thermostat in the winter or walking as opposed to riding to a certain place.

Increasing electricity performance frequently comes at a fee; however, in most instances, this fee may be recouped with the aid of lowering electricity expenses within a short time period. This cost-effectiveness makes productivity improvement an appealing starting line for lowering carbon emissions. The scope of the garage and the strategies required rely on the scenario. For houses in bloodless nations, together with the UK, the handiest measures are to grow insulation, install top-quality double-glazed home windows, and use more green equipment and electricity-saving lamps and Light Emitting Diodes (LEDs).

The climate change committee estimates that the development may want to lessen annual CO₂ emissions from British houses with the aid of using approximately 17 million tons with the aid of using 2020. In contrast, growing productiveness in non-residential homes frequently means that it specializes in air flow and air conditioning, similarly to that specializing in light, warmth, and appliances. Many of those homes received approximately 25% of their electricity financial savings after improving their electricity performance. High-electricity industries, together with the iron, metallic, and cement industries, have emerged as extra green through the years because of the use of the latest gadgets and the reuse of heat lost over the years. For instance, a tube that is uncovered to heat and carries chemical substances that need to be cooled may be used to warm different chemical substances. Engines are broadly utilized in enterprises for loads of duties, including pumping, blending, and transferring materials. Installing the proper and green length of vehicles can assist stores in saving as much as 25% of electricity.

Energy performance in vehicles has additionally accelerated in recent years. This growth has been carried out with the aid of editing elements together with engines, headlights, and a higher aerodynamic layout. There is the ability for destiny improvement, and inside the EU the common emission of the latest vehicles is focused to be decreasing from a hundred and fifty to ninety-five grams of CO₂ consistent per kilometer with the aid of using 2020.

This growth in electricity performance in vehicles may help to lessen CO₂ emissions in the UK, with the aid of using 12.3 million tons by 2020, which is set at 10% of overall floor delivery in 2008.

Improving electricity performance no longer always implies modifications to lessen crane emissions. If the electricity comes from fossil fuels, together with fuel in vehicles or strength from coal-fired electricity plants, it'll reduce emission performance improvements. But if electricity from a low-carbon source, together with producing strength from nuclear or renewable electricity plant life, enhancing performance can also have little impact on emissions. When evaluating electric and non-electric appliances, it's crucial not to forget electricity performance: An increase from 90% gas boiler performance to 100% electric-powered heater performance, if strength is provided from a fossil gasoline electricity plant that is closely self-sustaining. They are inefficient and will increase electricity intake and emissions.

Energy performance is continually an excellent idea. Whether or not it ends in electricity financial savings relies on what we do with the cash we store. In a few instances, productivity and financial savings may be offset by an increase in consumer conduct, known as a mirror effect. An instance might be that insulating a residence would possibly make it more affordable for citizens to maintain a better temperature.

Nevertheless, enhancing electricity performance is a key device to lessen CO₂ emissions. Comes with electricity savings, and occasional carbon emissions are reduced, together with renewable electricity. Today, overall Energy Efficiency is set at sixty-five percent.

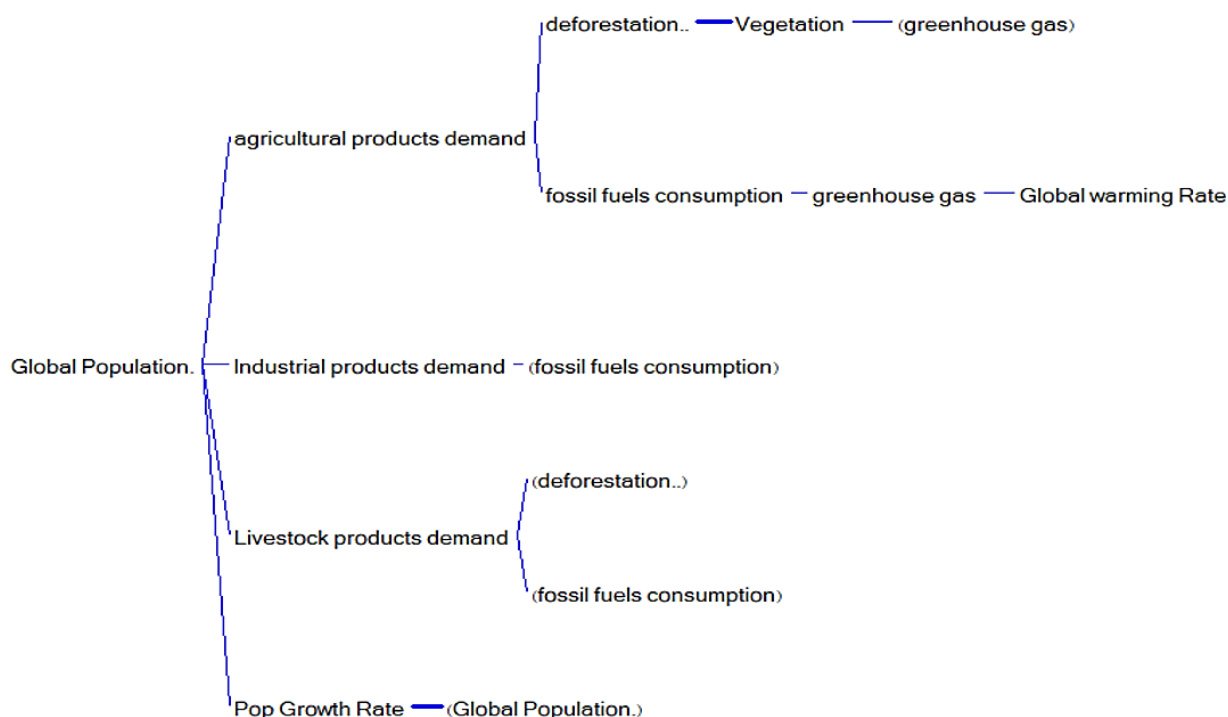


Fig. 6. Goods demand causes tree.

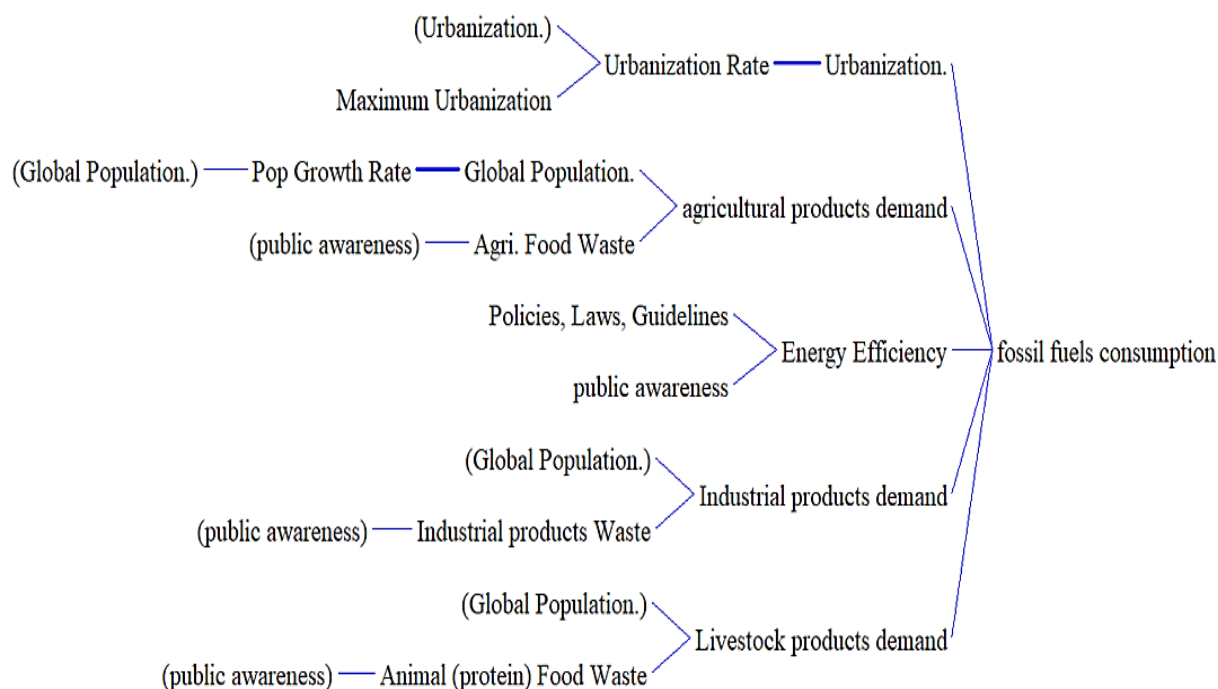


Fig. 7. Goods demand effects tree.

As you can see in *Figs. 6 and 7*, the primary reason for the Goods call for is the growing population and urbanization.

2.3.5 | Deforestation

In addition to elements together with an accelerated call for plant and farm animal merchandise, which had been stated in the element above, sizable fires are one of the reasons for deforestation around the globe.

The outcomes of global warming on air temperature, rainfall, and soil moisture have engulfed most of the planet's forests over a long time. Humidity and rainfall increase as climates heat; in this manner, the moist regions have become wetter daily, and the dry regions have become drier daily. Higher temperatures inside the spring and summer time seasons and the early melting of snow inside the spring result in the soil drying longer, resulting in longer durations of heat threat in pastures and forests, particularly in regions such as the western US, Central Africa, and Australia, which are developing dramatically.

These warm and dry climates make forests very vulnerable to elements, together with lightning and human blunders; in this manner, the slightest spark can cause an outstanding catastrophe.

The first critical woodland hearthplace alarm was sounded in the mid-1980s; since this date onwards, the range of fires, in addition to their period, has accelerated, and as a result, the quantity of burned forests has increased. According to a statistical look at carried out inside the western forests of the US of America, the range of fires and their period lasted from 1986 to 2003, as compared to 1970 and 1986, respectively, 6 and five instances!

Periods of herbal drought, volcanic eruptions, human sports together with land use extrude, and the human effect on climate change are a number of the elements that may increase the probability of fires. Two examples that verify the effect of climate change on the hearthplace are Yosemite National Park and the northern part of the Rocky Mountains, in which land use extent has been averted, and consequently, the primary reason for the growth in fires in those regions is probably climate change. Natural phenomena, together with Hurricane El Niño, can also affect modifications in drought and heatwave ability within the vicinity by affecting air humidity and rainfall. However, because long-term meteorological forecasts display significant modifications in temperature and rainfall at some stage in the twenty-first century, we appear to probably experience more fires at some stage in the twenty-first century.

The duration of the 12 months, whilst there may be an opportunity of pasture and woodland fires, is known as the hearthplace season. This season varies between 6 and 8 months in warm and dry regions. Researchers consider that with growing climate change and global warming, we can possibly see growth within the period of the heartland season to twelve months (the entire 12 months) in many elements of the sector! It ought to be noted that during such circumstances, the opportunity of hearthplace because of elements together with human blunders and lightning will grow more than earlier than.

Also, within the coming long time, the forests of temperate and humid areas will become hotter, and with the lack of moisture, they'll emerge as exceedingly arid areas, which, due to those modifications, will increase the opportunity of fires in such forests, which had been formerly low. Surprisingly, grasslands and pastures in arid regions can be much less prone to hearthplace in the future; due to the loss of water, they'll emerge as semi-wasteland regions, and there may be almost nothing to seize hearthplace in those regions!

Today, Earth's (land) flora is set at 55%, and the deforestation rate is set at 0.25%, consistent with 12 months. Also, the forest boom charge is set at 0.125%, consistent with 12 months. The main drivers and consequences of deforestation are summarized in *Figs. 8 and 9*.

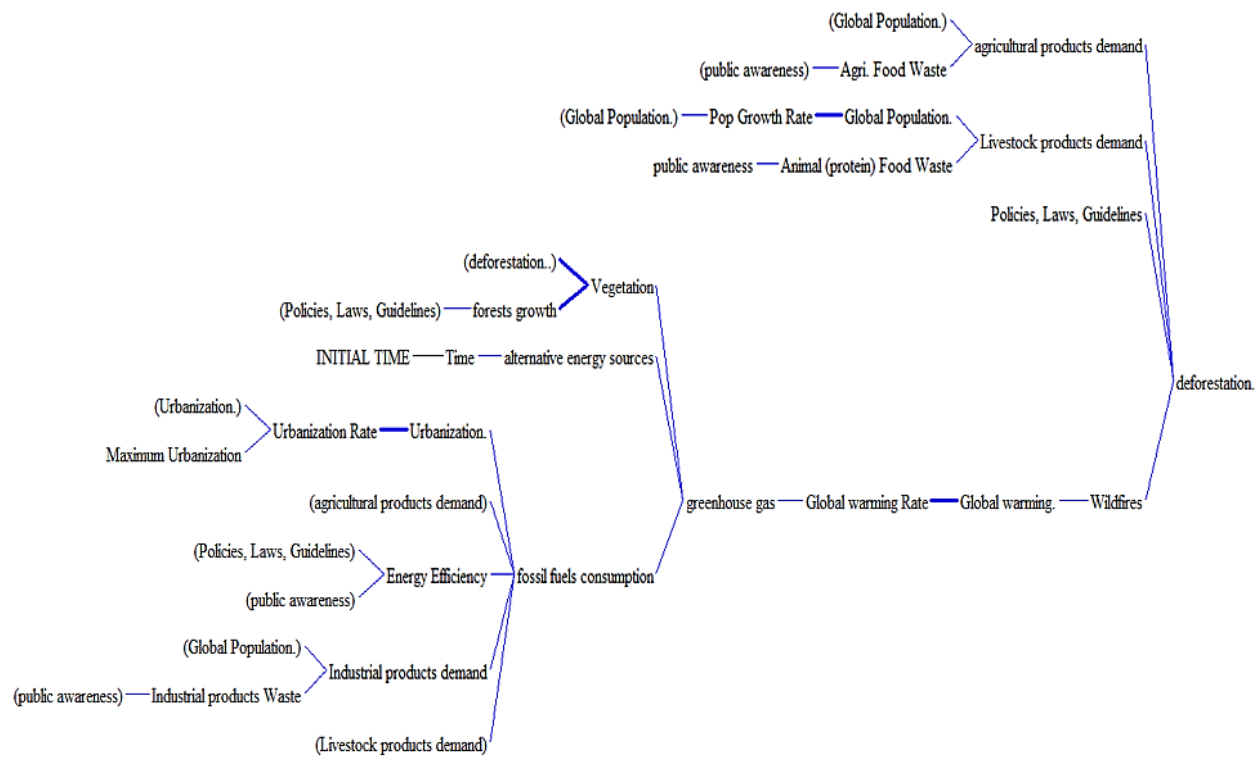


Fig. 1. Deforestation causes tree loss.

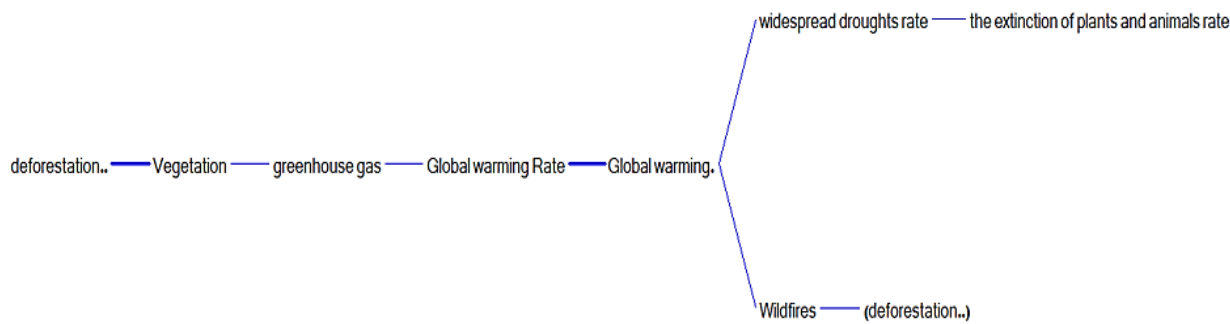


Fig. 2. Deforestation effects tree.

3 | Simulation

The general SD inventory and waft version that incorporate all variables and their courting primarily based on the above descriptions are shown in *Fig. 10*.

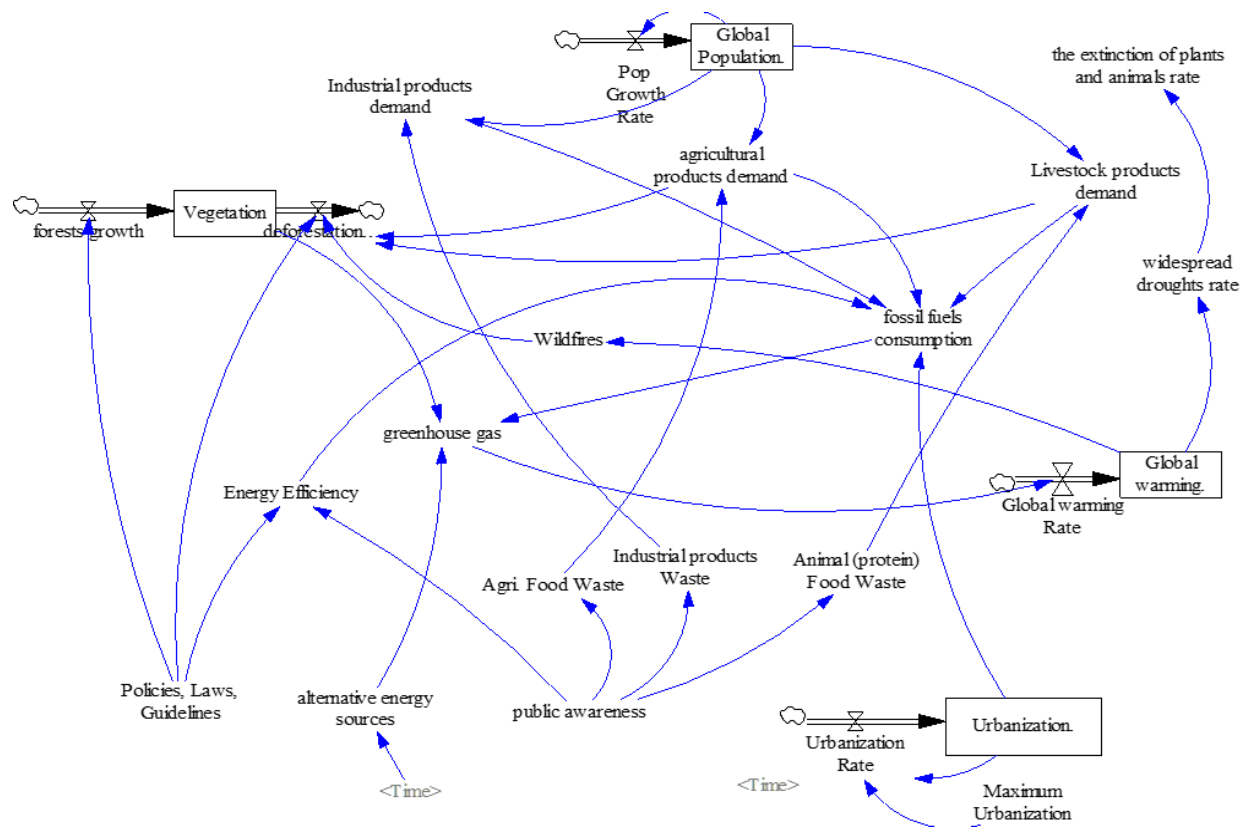


Fig. 10. Overall model.

The simulation (from 2020 to 2100) suggests that if the modern scenario maintains fundamental variables, the fashions will behave as the subsequent Figs. 11-15.

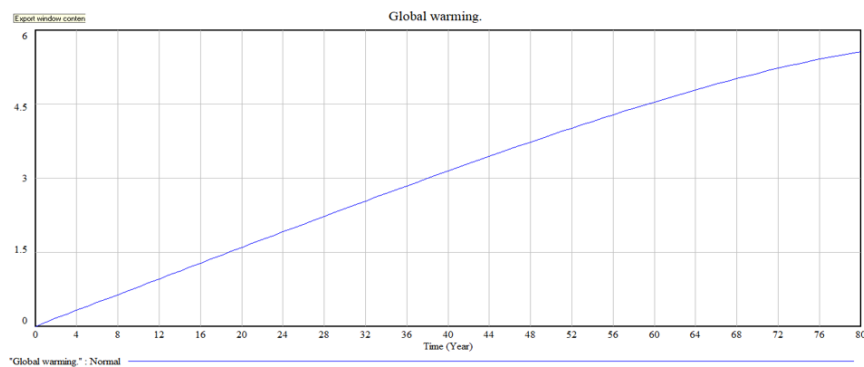


Fig. 11. Global warming normal scenario.

This chart in Fig. 11 says that in 2050 and 2100, Earth may be 2.38 and 5.56 degrees warmer than in 2020. Such an increase in global temperature may be devastating and requires catastrophic climate change tackles.

Climate change fashions designed with the aid of the IPCC display that between 1990 and 2100, the global surface temperature rose to around 6.4 degrees Celsius. Also, this shows that global warming may be approximately 6.26 degrees Celsius (from 1900 to 2100).

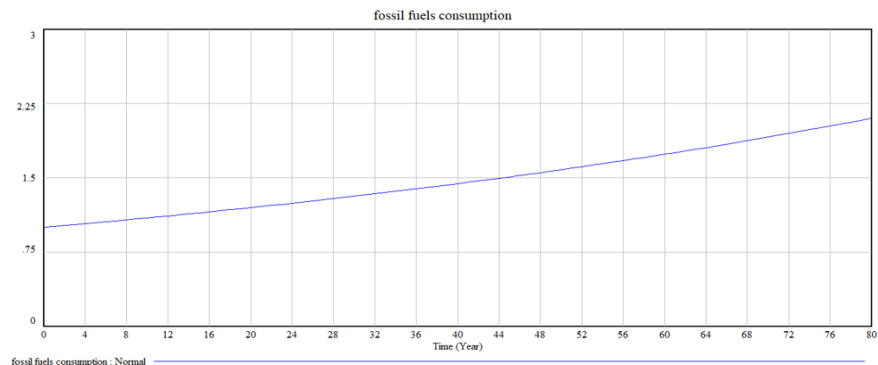


Fig. 32. Fossil fuel consumption normal scenario.

As the simulation in *Fig. 12* shows, Fossil Fuel Consumption may be 1.3 and 2.1 times the 2020 intake. This projected increase in fossil fuel consumption is especially due to population growth. Also, the chart suggests an exponential sample, which makes it increasingly more dangerous.

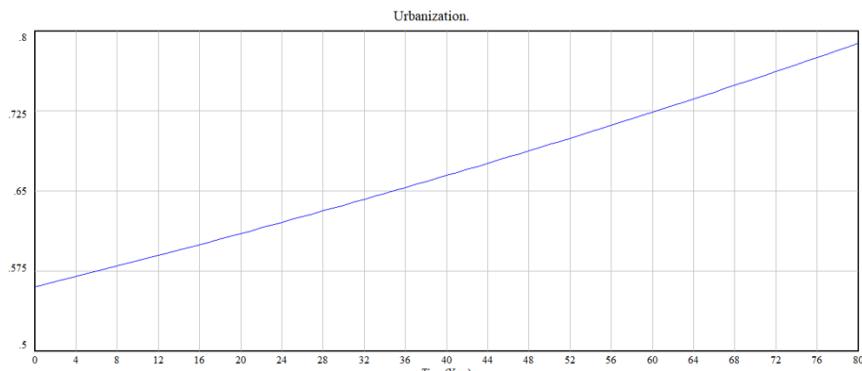


Fig. 13. Urbanization normal scenario.

Many researchers have claimed that if city populations keep growing on the current trend, by 2050, the urbanization rate will increase from the modern 55% to approximately 65%, which the version simulation in *Fig. 13* confirms.

Also, it's far proven that by 2100 Earth city populace is set eighty percent of the overall populace stay on the Earth. This projected level of urbanization may be a new sunrise for the human species' lifestyle.

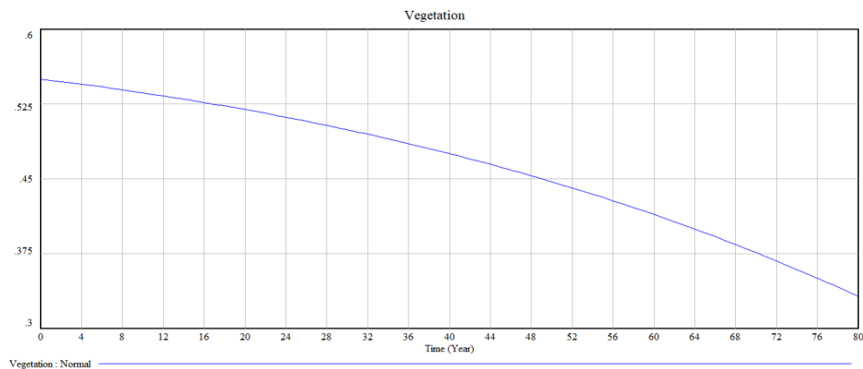


Fig. 14. Vegetation normal scenario.

The chart in *Fig. 14* suggests a traumatic exponential sample in the Earth's (land) flora. In 2050 and 2100, flowers were reduced from 55% to 50% and 33%. This fashion suggests that if humans no longer address global warming, they ought to stay in a world with sparse flowers.

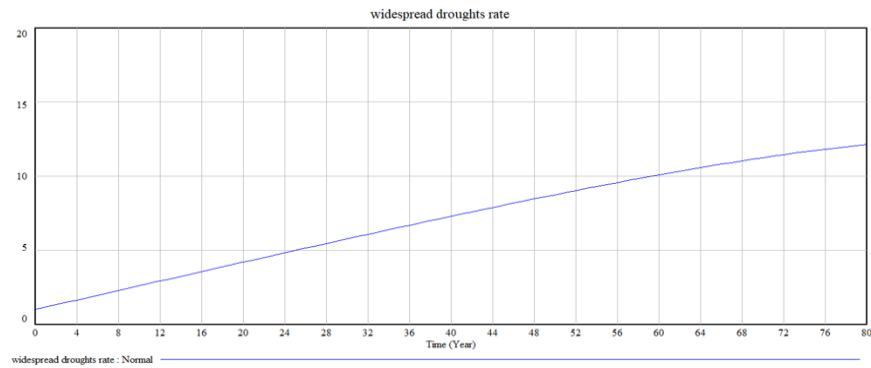


Fig. 15. Droughts' normal scenario.

Simulation in Fig. 15 suggests that droughts may be accelerated by 5.8 and 12.1 instances in 2050 and 2100. Also, animals and plant life will be extinct at an equal rate. It confirms that humans will stay on an arid, dead planet if they don't lessen global warming.

4 | Solutions

4.1 | Public Awareness

In this component, we can take an observation of the impact of fundamental relevant guidelines to lessen global warming. The first coverage is growing “public awareness”. The public awareness reason tree shown in Fig. 16 is as follows:

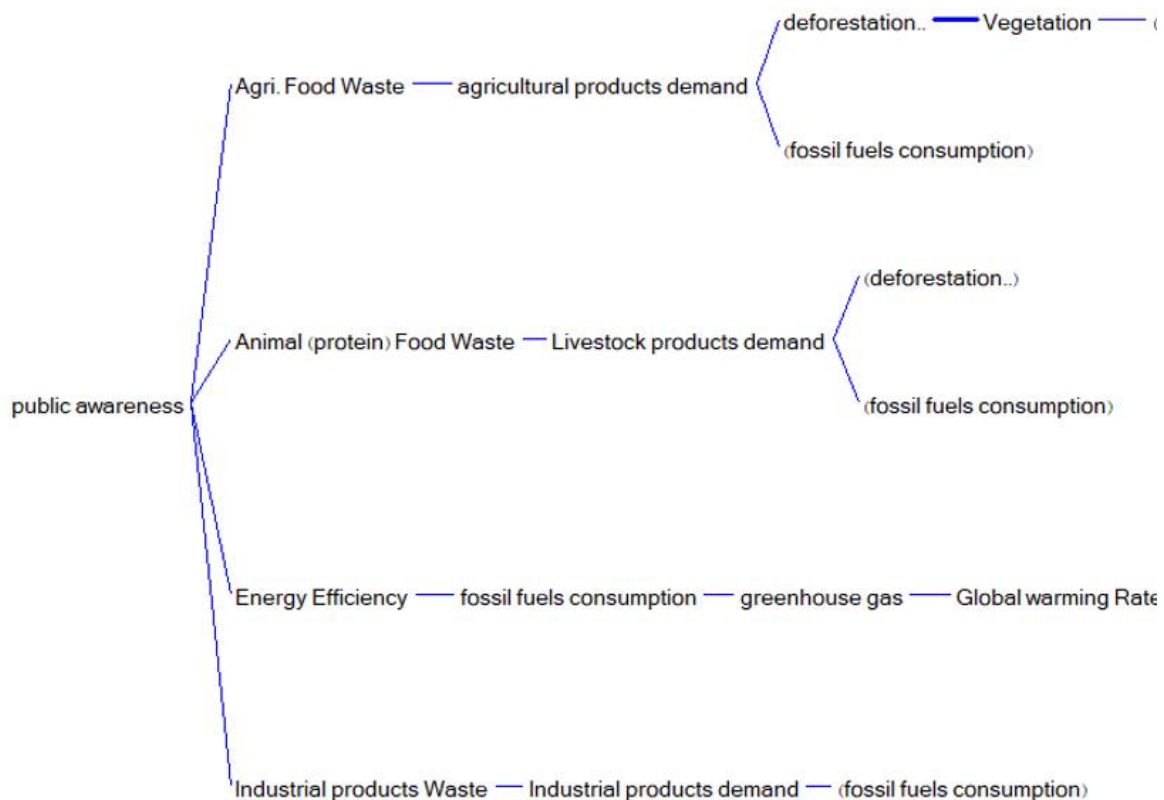


Fig. 16. Public awareness effects tree.

As it's well proven, “public awareness” will lower “agri. Food waste”, “animal (Protein) food waste”, and “industrial merchandise waste”. Also, it'll grow energy efficiency because of training and public trauma regarding the human race's destination.

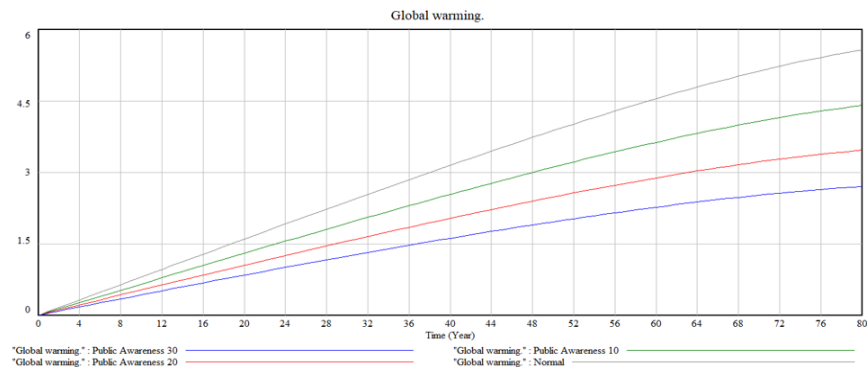


Fig. 17. Public awareness scenario.

As the above chart in Fig. 17 displays, growing 10, 20, and 30% in “public awareness” will lower the temperature by approximately 0.5, 0.9, and 1.2 degrees in 2050. Also in 2100, growing 10, 20, and 30% in “public awareness” will lower the temperature by approximately 1.2, 2.1, and 2.8 degrees. The chart suggests a bad exponential sample, so the ten percent state of affairs has the maximum slope.

4.2 | Policies, Laws, Guidelines

Fig. 18 shows “policies, laws, guidelines” outcomes on deforestation and will lower the reasons for deforestation. Also, it may grow woodland boom with the aid of giving incentives to woodland renovation and Arboriculture programs. Also, “policies, laws, guidelines” will oblige industries to consume much less electricity and grow the ‘energy efficiency’ of their manufacturing [10].

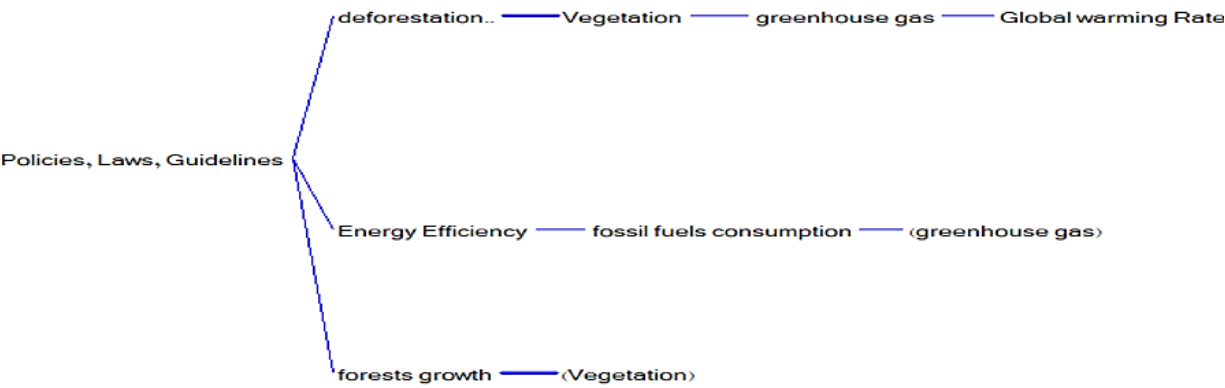


Fig. 18. Policies, laws, and guidelines effects tree.

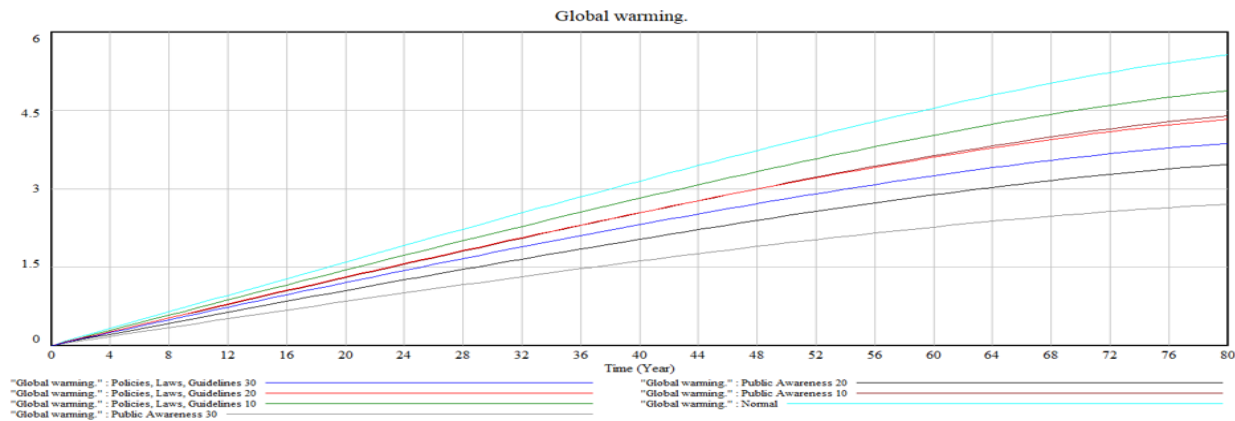


Fig. 19. Policies, laws, guidelines scenario.

As the above chart in Fig. 19 displays, “policies, laws, guidelines” state of affairs is growing its impact with the aid of using 10, 20, and 30%. These eventualities will lower the temperature by approximately 0.24, 0.44,

and 0.60 degrees in 2050. Also in 2100, growing 10, 20, and 30% in “policies, laws, guidelines” effectiveness will lower the temperature by approximately 0.69, 1.24, and 1.7 degrees. The chart suggests a bad exponential sample, so the ten percent state of affairs has the maximum slope.

5 | Conclusion

Do we have the power to devour sufficient strength to heat the sector, cause floods, damage forests, because we need to make chandeliers?

Scientists at a convention in Britain say global warming is rapidly drawing close to a point that can no longer be stopped.

Scientists concerned with the "European project", which is analyzing the quantity of CO₂ using sampling from the depths of the Antarctic ice sheet, defined their findings at a convention in Norwich. They have proven that CO₂ levels are actually a good deal better than at any time within the past 800,000 years, and they finish that if global warming maintains at its current rate, it can easily take a decade for this fashion to attain an irreversible factor.

Eric Wolff, of the British Center for Antarctic Studies, stated the most horrifying component of their findings was the velocity with which climate change was taking place.

According to a brand-new file launched with the aid of the FAO, commercial animal husbandry emits 18% more CO₂ than transportation devices. In addition, it's a crucial element in the destruction of water and land assets. "Industrial animal husbandry is a crucial element in environmental crises today, and options should be urgently taken into consideration," stated Henning Steinfeld, FAO's head of animal husbandry data and writer of the file.

As welfare increases, humans devour extra meat and dairy products every 12 months. Global meat manufacturing is projected to more than double from 229 million tons in 2001-2009 to 465 heaps in 2050, and commercial milk and dairy manufacturing from 580 heaps to 1,043 heaps.

The farm animal enterprise is increasing more than some other departments of agriculture within the global, and this developing charge is accompanied with the aid of using massive environmental losses. Livestock is predicted to supply 9% of the CO₂ emitted by human activities; however, the enterprise additionally produces different greenhouse gases that have more dangerous environmental outcomes: 65% of all nitrous oxide gas produced by human activities belongs to commercial farm animals. 296 heating units of Global Warming Potential (GWP) have more heating ability than CO₂. Most of this gas is launched from animal manure. In addition, it's far predicted that 37% of the entire methane gas produced with the aid of human agriculture is released from commercial farm animals. (Which has 23 instances of the heating ability of CO₂!) This gas is specially produced inside the digestive tract of ruminants, and of path 64% ammonia, which plays a major role in acid rain.

Today, commercial animal husbandry controls 30% of the complete floor of the Earth's total land area. About 20% of the entire stay mass of the Earth is predicted to belong to meat and dairy cattle. The presence of such a large number of farm animals over a wide area of the Earth and their increasing demand for food are likewise a critical and crucial element in the destruction of biodiversity. 15 ecosystems out of 24 crucial ecosystems on the Earth are regarded as endangered, the primary offender being commercial animal husbandry.

As modern simulation suggests, growing “public awareness” and “policies, laws, guidelines” may help lessen global warming. These guidelines have outcomes on deforestation and will lower the reasons for deforestation. Also, they may grow woodland biomass with the aid of giving incentives to woodland renovation and Arboriculture programs. Also, policies, laws, and guidelines will oblige industries to apply much less electricity and grow the “energy efficiency” of their manufacturing. A comparison of temperature increases under different scenarios is provided in *Table 1*.

But if answers are used together, higher outcomes may be supplied. As *Fig. 20* suggests, if a blended state of affairs is used, global warming will be lower between 73% and 41% in 2050 and between 73% and 37% in 2100.

Table 1. Global warming (degree increase).

Time (Year)	2050	2100	2050 Compare to Normal	2100 Compare to Normal
Combine 30	0.9816	2.047	41%	37%
Combine 20	1.307	2.812	55%	55%
Combine 10	1.749	3.905	73%	73%
Policies, laws, guidelines 30	1.773	3.865	74%	74%
Policies, laws, guidelines 20	1.941	4.321	82%	81%
Policies, laws, guidelines 10	2.141	4.876	90%	90%
Public awareness 30	1.239	2.699	52%	52%
Public awareness 20	1.553	3.463	65%	65%
Public awareness 10	1.927	4.399	81%	81%
Normal	2.381	5.564	100%	100%

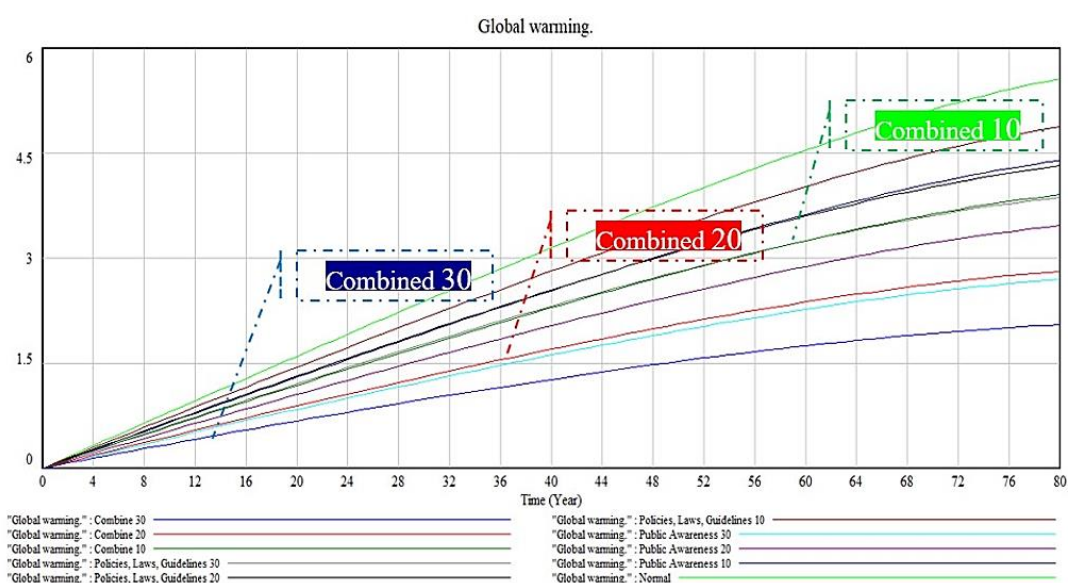


Fig. 20. Combined scenario.

Author Contributaion

A. V.: Writing-creating the initial design, M. H. E.: Writing-reviewing and editing, A. S.: Monitoring. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Data Availability

All data are included in the text.

Conflict of Interest

There are no competing interests to declare.

Consent for Publication

The author confirms consent for the publication of this work

Ethics Approval and Consent to Participate

No studies involving human participants or animals were performed in this research.

References

- [1] Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2), 155–169. <https://doi.org/10.1007/BF01405730%0A%0A>
- [2] Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15(4). <https://doi.org/10.5751/ES-03610-150420>
- [3] Sterling, S., & Orr, D. (2001). *Sustainable education: Re-visioning learning and change*. Green Books for the Schumacher Society Totnes. <https://www.amazon.com/Sustainable-Education-Revisioning-Schumacher-Briefings/dp/1870098994>
- [4] Intergovernmental Panel on Climate Change (IPCC). (2022). *Climate change 2022: Mitigation of climate change: Working group III contribution to the sixth assessment report of the intergovernmental panel on climate change*. Cambridge University Press. <https://doi.org/10.1017/9781009157926>
- [5] Aguirre, M., Agudelo, N., & Romm, J. (2017). Design facilitation as emerging practice: Analyzing how designers support multi-stakeholder co-creation. *She ji: The journal of design, economics, and innovation*, 3(3), 198–209. <https://doi.org/10.1016/j.sheji.2017.11.003>
- [6] Stroh, D. P. (2015). *Systems thinking for social change: A practical guide to solving complex problems, avoiding unintended consequences, and achieving lasting results*. Chelsea Green Publishing. <https://www.amazon.com/Systems-Thinking-Social-Change-Consequences/dp/160358580X>
- [7] Reason, P., & Bradbury, H. (2001). *Handbook of action research: Participative inquiry and practice*. SAGE Publications Ltd. <https://www.amazon.com/Handbook-Action-Research-Participative-Practice/dp/0761966455>
- [8] Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures*, 25(7), 739–755. [https://doi.org/10.1016/0016-3287\(93\)90022-L](https://doi.org/10.1016/0016-3287(93)90022-L)
- [9] Frantzeskaki, N., Loorbach, D., & Meadowcroft, J. (2012). Governing societal transitions to sustainability. *International Journal of Sustainable Development*, 15(1–2), 19–36. <https://doi.org/10.1504/IJSD.2012.044032>
- [10] Pelling, M., O'Brien, K., & Matyas, D. (2015). Adaptation and transformation. *Climatic Change*, 133(1), 113–127. <https://doi.org/10.1007/s10584-014-1303-0>