

# Triple Sustainability: Unraveling the Path to Sustainable Food, Water, and Energy Supply

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## **Abstract:**

As the global population continues to grow, the challenges of supplying food, water, and energy have become increasingly prominent. The world is facing a situation where the demand for these essential resources is surging, while the availability is under threat. According to various reports, nearly 30% of the global population lives in areas with unstable or scarce water resources, which poses a serious threat to drinking water and irrigation. The food security situation is also grim. Approximately one-seventh of the world's population still lacks sufficient protein and calories, and more people are deficient in important micronutrients. Moreover, the energy supply is facing pressure due to the increasing demand and the need to transition to sustainable energy sources.

**Keywords:** Food, Water, Energy Supply, Sustainability

## **1 Introduction**

### **1.1 Background**

As the global population continues to grow, the challenges of supplying food, water, and energy have become increasingly prominent. The world is facing a situation where the demand for these essential resources is surging, while the availability is under threat. According to various reports, nearly 30% of the global population lives in areas with unstable or scarce water resources, which poses a serious threat to drinking water and irrigation. The food security situation is also grim. Approximately one-seventh of the world's population still lacks sufficient protein and calories, and more people are deficient in important micronutrients. Moreover, the energy supply is facing pressure due to the increasing demand and the

need to transition to sustainable energy sources.

Sustainable development of food, water, and energy is of utmost importance. It not only ensures the survival and well-being of current generations but also safeguards the interests of future generations. Sustainable development aims to achieve a balance between economic, social, and environmental aspects, ensuring the long-term stability and prosperity of human society.

### **1.2 Purpose**

The purpose of this research is to explore innovative methods and strategies for the sustainable supply of food, water, and energy. As the global population continues to expand, the demand for these essential resources is on the rise. To meet this demand while ensuring the long-term viability of our planet, it is crucial to find sustainable solutions.

In the area of food supply, we need to focus on sustainable agricultural practices. According to research, sustainable development in agriculture can increase food production while reducing the use of pesticides and fertilizers. For example, adopting ecological farming techniques can promote soil protection and increase biodiversity. Additionally, promoting precision farming can improve crop yields and quality while minimizing environmental impacts.

Regarding water supply, innovative approaches are needed to address the growing water scarcity. One possible solution is to develop advanced water treatment technologies that can convert seawater or wastewater into clean drinking water. Another approach is to implement more efficient water management systems that reduce waste and ensure the proper allocation of water resources.

For sustainable energy supply, the development and utilization of renewable energy sources such as solar, wind, and hydro power are essential. These sources not only reduce our dependence on fossil fuels but also have a lower environmental impact. Moreover, technological innovation in energy storage and distribution can help ensure a stable and reliable energy supply.

In conclusion, exploring innovative methods and strategies for the sustainable supply of food, water, and energy is crucial for the future of our planet. By combining scientific research, technological innovation, and policy support, we can achieve a more sustainable and prosperous future for all.

## 2 Theoretical Basis

### 2.1 Concept of sustainable development

Sustainable development refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In the context of resource supply, sustainable development plays a crucial role in ensuring the long-term availability of food, water, and energy.

#### 2.1.1 Core principle of sustainable development

The core principles of sustainable development include economic, environmental, and social sustainability. Economic sustainability focuses on ensuring the long-term viability of economic activities without depleting natural resources. Environmental sustainability emphasizes the protection and conservation of the natural environment to maintain ecological balance. Social sustainability aims to ensure that the benefits of development are equitably distributed and that the basic needs of all people are met.

These three aspects are closely interrelated. For example, economic development often depends on the availability

of natural resources, which in turn is influenced by environmental protection measures. At the same time, social stability and well-being are essential for sustainable economic and environmental development.

#### 2.1.2 The embodiment of sustainable development in resource field

The development of renewable energy is a prime example of the application of sustainable development principles in the resource field. Renewable energy sources such as solar, wind, and hydro power are sustainable because they are replenished naturally and do not deplete finite resources. According to data, the global installed capacity of renewable energy has been growing rapidly in recent years. For instance, as of 2023, the installed capacity of solar power has exceeded [X] gigawatts, and wind power has reached [Y] gigawatts.

The development of renewable energy not only reduces our dependence on fossil fuels but also has a lower environmental impact. It helps to reduce greenhouse gas emissions and mitigate climate change. Moreover, it can create new job opportunities and promote economic development. For example, the renewable energy industry has created millions of jobs worldwide, and countries that invest in renewable energy are seeing significant economic benefits.

### 2.2 The interrelationship of resource supply

The supply of food, water, and energy is closely interconnected and interdependent. Understanding these relationships is crucial for developing sustainable solutions.

#### 2.2.1 The connection between food and water

In agriculture, water is essential for food production. For instance, crops need water for growth and development. According to research, approximately [X] liters of water are required to produce one kilogram of wheat. Irrigation is a common practice in many agricultural regions, and the availability of water directly affects the quantity and quality of food produced.

Moreover, water quality also plays a significant role in food supply. Poor water quality can lead to contamination of crops and livestock, reducing food safety and quality. For example, water contaminated with heavy metals or pesticides can pose a serious threat to human health.

On the other hand, food production also impacts water resources. Agricultural activities can lead to water pollution through the use of fertilizers and pesticides. Runoff from farms can carry these chemicals into water bodies, causing eutrophication and other environmental problems.

#### 2.2.2 Relationship between energy and water

Energy production consumes a significant amount of wa-

ter. For example, in thermal power plants, water is used for cooling purposes. According to data, a typical coal-fired power plant may consume several hundred thousand gallons of water per day.

The production of biofuels also requires water. For instance, the cultivation of crops for biofuel production needs irrigation water. Additionally, the processing of biofuels also consumes water.

At the same time, energy can also be used to manage water resources. For example, energy is needed for pumping water for irrigation and for treating wastewater. Hydroelectric power is an energy source that is closely related to water. The operation of hydroelectric power plants depends on the flow of water, and they can generate clean electricity while also providing flood control and water storage services.

In conclusion, the relationship between food, water, and energy is complex and intertwined. Recognizing these connections is essential for developing integrated and sustainable solutions to meet the growing demand for these essential resources.

## 3 Sustainable Supply of Water Resources

### 3.1 Coping with water scarcity

#### 3.1.1 Global water scarcity

The global water shortage situation is extremely serious. As reported in the article “Global water resources are in short supply and the situation is becoming increasingly severe”, there are currently more than 1 billion people living in water-scarce areas. For example, in South Africa, as mentioned in “South Africa: Severe lightning strikes cause some areas of Johannesburg to face a ‘water shortage’”, due to severe lightning strikes, some pumping stations in Johannesburg malfunctioned and had to stop operating, resulting in water shortages in some southern areas of the city. In Bolivia, according to “Bolivia’s drought is severe and two provinces enter a state of disaster”, Oruro and Potosí provinces have officially declared a state of disaster due to drought and water shortages. In Mexico, as reported in “(Foreign frontline) Many places in Mexico are facing water shortages”, including the capital Mexico City, many places in Mexico have been experiencing continuous water shortages since January this year due to high temperatures.

#### 3.1.2 Analysis of shortage causes

There are several main reasons for the global water shortage. Firstly, population growth is a significant factor. As

the global population continues to increase, the demand for water for daily life, agriculture, and industry is also surging. Secondly, industrial development consumes a large amount of water. Many industrial processes require water for cooling, cleaning, and production. For example, a typical coal-fired power plant may consume several hundred thousand gallons of water per day as mentioned in the relationship between energy and water. Thirdly, climate change also exacerbates water shortages. Changes in precipitation patterns and increased evaporation due to rising temperatures lead to uneven distribution of water resources and more frequent droughts and floods. Additionally, agricultural activities can also contribute to water shortages. The extensive use of fertilizers and pesticides can pollute water sources, and irrigation methods that are not efficient enough can waste a large amount of water.

### 3.2 Innovative water supply

Water scarcity is a global challenge, and innovative water supply methods and technologies are crucial for sustainable development.

#### 3.2.1 seawater desalination technology

Seawater desalination technology offers a potential solution to address water shortages. The advantages of seawater desalination are significant. Firstly, as mentioned in “Seawater desalination technology 能否有效解决全球水资源短缺问题?-手机版”, the ocean covers 71% of the earth’s surface, providing an almost inexhaustible source of water. With advanced desalination methods such as distillation, reverse osmosis, and electrodialysis, we can convert seawater into fresh water. Reverse osmosis technology, in particular, has a desalination rate of up to 99%, effectively removing salts and other impurities from seawater.

However, seawater desalination also faces challenges. One major challenge is high energy consumption. The desalination process requires a significant amount of energy, especially with distillation methods. This leads to high costs. According to the article, although some countries and regions have achieved commercial operation of seawater desalination, the high cost and energy consumption remain major constraints. Another challenge is the environmental impact. The waste water and salt generated during the desalination process need to be properly disposed of to avoid negative impacts on the environment.

#### 3.2.2 Rainwater collection and utilization

Rainwater harvesting and utilization is another innovative approach to water supply. Rainwater collection systems have a wide range of applications. In buildings and houses, rainwater can be collected from roofs and drainage

systems for non-potable uses such as flushing toilets, watering gardens, and washing cars. In agriculture, rainwater can be used for irrigation, reducing farmers' dependence on groundwater and reservoirs. In industrial and commercial areas, collected rainwater can be used for cooling equipment, cleaning, and flushing.

For urban planning and water resource management, rainwater collection systems can help manage and protect water resources. By collecting rainwater, cities can reduce flood risks and provide sustainable water supplies. Rainwater harvesting also has environmental benefits. It can help protect the ecosystem by reducing overexploitation of natural water resources. For example, rainwater can replenish groundwater, raise underground water levels, and alleviate the downward trend of underground water levels. It can also increase air humidity, purify the air, and curb the heat island effect, improving the urban environment.

In conclusion, innovative water supply methods such as seawater desalination and rainwater collection and utilization offer promising solutions to address global water shortages. However, we need to address the challenges associated with these technologies to ensure their sustainable implementation.

## 4 Sustainable Energy Supply

### 4.1 Types of sustainable energy

#### 4.1.1 Solar energy

Solar energy, as a sustainable source of power, holds immense potential in the energy supply chain. It is one of the most prevalent renewable energies, converting sunlight into electrical power through photovoltaic technology. Statistics indicate that, as of 2023, the global cumulative installed capacity of solar power has reached [specific data to be supplemented] gigawatts. The applications of solar energy are extensive, encompassing distributed generation systems such as residential rooftop solar panels and commercial building solar power stations, as well as large-scale centralized solar power plants.

The advantages of solar energy lie in its cleanliness, environmental friendliness, renewability, and low maintenance costs. Compared to traditional fossil fuels, solar power generation does not produce greenhouse gases and pollutants, making it eco-friendly. Moreover, solar energy resources are abundant and can be harnessed almost anywhere globally. With continuous technological advancements, the conversion efficiency of solar cells is also improving, and costs are gradually decreasing. For instance, new types of multi-junction solar cells and flexible solar cells offer higher conversion efficiencies and broader

application prospects.

However, solar energy also faces some challenges. Firstly, the supply of solar energy is intermittent and significantly affected by weather and diurnal variations. This necessitates the use of energy storage devices to ensure a stable energy supply. Secondly, large-scale solar power stations require substantial land use, and how to plan and utilize land resources rationally is also an issue. Despite these challenges, solar energy remains a vital component of future sustainable energy supply.

#### 4.1.2 Wind Energy

Wind energy is another significant form of sustainable energy. Wind power generation refers to the engineering technology that converts the kinetic energy of wind into electrical energy, utilizing devices such as wind turbine systems to transform wind energy into mechanical energy, which is then converted into electrical energy.

Currently, the global wind power industry is developing rapidly. According to relevant reports, the global cumulative installed capacity of wind power reached [specific data to be supplemented] gigawatts in 2023. In China, the national cumulative installed capacity of wind power was 44.134 million kilowatts in 2023, a year-on-year increase of 20.7%. From January to February 2024, the national cumulative installed capacity of wind power was 45.035 million kilowatts, a year-on-year increase of 21.3%.

The advantages of wind power generation include cleanliness, environmental friendliness, strong renewability, short infrastructure cycles, and flexible installation scales. Similar to solar energy, wind energy is a widely distributed energy resource with development potential in many regions. Moreover, with continuous innovation in wind power technology, including advancements in turbine design, material science, and intelligent control, the efficiency and reliability of wind turbine systems are continuously improving.

However, wind energy also faces some challenges. On one hand, the supply of wind energy is also intermittent, and unstable wind speeds can affect the stability of power generation. On the other hand, the construction and maintenance costs of wind turbine systems are relatively high, and they require a certain amount of land area. Additionally, wind power generation may have certain impacts on wildlife, such as birds. Despite these challenges, with continuous technological progress and cost reduction, the role of wind energy in sustainable energy supply will become increasingly important.

### 4.2 Sustainable Energy Supply Strategies

#### 4.2.1 The Role of Smart Grids

Smart grids play a pivotal role in optimizing energy

distribution. A smart grid is an electricity system based on advanced communication and information technology, achieving intelligent management and interconnectivity of energy. It realizes real-time monitoring, regulation, and optimization of energy through automated control and intelligent algorithms. Various components and devices within a smart grid can connect and exchange data, achieving comprehensive information sharing and collaborative operations. They are flexible and sustainable, capable of adapting to diverse energy supplies and demands while promoting the integration and utilization of renewable energy.

In terms of distributed energy management, smart grids optimize the scheduling and distribution of energy by monitoring and managing distributed energy resources such as solar photovoltaics and wind power. For instance, when there is an excess of solar or wind power generation, smart grids can store the surplus electricity or allocate it to other areas in need, improving energy utilization efficiency. In terms of energy storage and dispatch, smart grids utilize energy storage technologies, such as battery storage systems, to achieve flexible dispatch and storage of energy to meet peak energy demands. In terms of smart home and electricity management, smart grids integrate with smart home systems to monitor, control, and manage household energy, enhancing energy utilization efficiency. In terms of electric vehicle charging and the energy internet, smart grids provide management and dispatch of electric vehicle charging facilities while promoting the development of the energy internet, achieving interconnectivity of energy.

#### 4.2.2 Energy Storage Technologies

Energy storage technologies, such as battery storage, play a crucial role in sustainable energy supply. With the development of renewable energy, the demand for energy storage technologies is growing. Currently, various energy storage technologies are being developed and perfected.

Lithium-ion batteries are one of the widely applied energy storage technologies. By the end of 2022, the total installed capacity of grid-scale battery energy storage was close to 28GW, with an estimated 90% being lithium-ion battery storage, approximately 25.2GW. Lithium-ion batteries offer advantages such as high energy density and long cycle life but also have issues with high costs and safety concerns. Additionally, new technologies in long-duration energy storage are also being developed. For example, the iron flow battery startup ESS received 30 million in Series C funding from SoftBank Energy, a subsidiary of SoftBank, and Breakthrough Energy Ventures, backed by Bill Gates. The chemical energy storage company Form Energy also received 40 million in funding from investors including Italian oil giant Eni, which was expected to take

10 years to commercialize but is now expected to be commercially available within 3-5 years with the funding.

Apart from flow batteries, compressed air energy storage is also developing. The global compressed air energy storage market was valued at 4 billion in 2021 and is projected to reach 31.8 billion by 2031, with a compound annual growth rate (CAGR) of 23.6% from 2022 to 2031. For instance, Hydrostor signed a binding agreement with mining project developer Perilya to utilize Perilya's existing mining assets at the Potosi mine in Broken Hill, Australia, to support the construction of the Silver City Energy Storage (SCES) project.

Thermal energy storage is also a promising energy storage technology. The global thermal energy storage market was worth 20.8 billion in 2020 and is expected to reach 51.3 billion by 2030, with a CAGR of 8.5% from 2021 to 2030. Australian-based MGA Thermal received 8.25 million in funding to expand its long-duration energy storage system, which includes thermal blocks.

In summary, the continuous development of energy storage technologies will provide strong support for sustainable energy supply.

## 5. Sustainable supply of food

### 5.1 Agricultural sustainable development

Organic farming practices play a crucial role in promoting sustainable agriculture. Organic agriculture is a farming method that emphasizes natural processes and avoids the use of synthetic pesticides and fertilizers. This approach has several positive impacts on the environment and food supply.

#### 5.1.1 Organic farming practice

For example, organic farming helps protect soil health. According to research, traditional agriculture often uses chemical fertilizers and pesticides, which can lead to soil degradation and loss of fertility over time. In contrast, organic farming uses natural fertilizers such as compost and manure, which can improve soil structure and increase soil organic matter content. This not only helps maintain soil fertility but also reduces soil erosion and water pollution.

Organic farming also promotes biodiversity. By avoiding the use of synthetic pesticides, organic farms provide a habitat for beneficial insects, birds, and other wildlife. This helps maintain a balanced ecosystem and can improve the resilience of agricultural systems to pests and diseases.

In addition, organic farming can reduce greenhouse gas emissions. Organic farms often use practices such as crop

rotation and cover cropping, which can sequester carbon in the soil and reduce the need for synthetic fertilizers and pesticides. This can help mitigate climate change and contribute to a more sustainable food system.

### 5.1.2 precision farming technology

Precision agriculture technology is another important approach to improving agricultural production efficiency and sustainability. Precision agriculture uses advanced technologies such as sensors, drones, and satellite imagery to collect data on soil conditions, crop growth, and weather patterns. This data can then be used to optimize farming practices such as irrigation, fertilization, and pest control. For instance, precision irrigation systems can use sensors to monitor soil moisture levels and adjust irrigation schedules accordingly. This can help reduce water waste and improve crop yields. Similarly, precision fertilization systems can use data on soil nutrient levels to apply fertilizers more accurately, reducing the amount of fertilizer needed and minimizing environmental impacts.

Drones and satellite imagery can also be used to monitor crop growth and detect pests and diseases early. This can help farmers take timely action to prevent crop losses and reduce the use of pesticides.

In conclusion, sustainable agriculture is essential for ensuring a reliable food supply while protecting the environment. Organic farming practices and precision agriculture technology offer promising approaches to achieving this goal. By adopting these methods, we can promote a more sustainable and resilient food system for the future.

## 5.2 Sustainability of food supply chain

Food supply chains play a crucial role in ensuring the availability of food. To achieve sustainable food supply, it is essential to focus on the sustainability of the entire food supply chain.

### 5.2.1 reduce waste of food

Food waste is a significant problem globally. According to data from the Food and Agriculture Organization (FAO), approximately one-third of the food produced globally is wasted each year, worth around \$1 trillion. In developed countries, a large portion of food waste occurs at the consumer level due to over-purchasing and improper storage. In developing countries, food waste often occurs during production, storage, and transportation due to lack of proper infrastructure and technology.

There are several methods to reduce food waste. Firstly, consumers can practice smart shopping by making a shopping list and only buying what they need. This can help avoid impulse purchases and reduce the amount of food that goes to waste. Secondly, understanding expiration

dates is important. Many foods can still be safely consumed after the expiration date has passed, so consumers should not be overly cautious and throw away food prematurely. Thirdly, learning food preservation techniques such as canning, freezing, and fermentation can extend the shelf life of food and reduce waste. Fourthly, consumers should avoid being perfectionists and choose slightly imperfect fruits and vegetables, which are often just as nutritious but are discarded due to cosmetic reasons. Fifthly, keeping the refrigerator organized can help prevent food from being forgotten and going to waste. Sixthly, saving leftovers in transparent containers can help ensure they are not forgotten and can be eaten later. Seventhly, eating the skins of fruits and vegetables can reduce waste and provide additional nutrients. Eighthly, packing lunch instead of eating out can save money and reduce food waste. Ninthly, avoiding overeating can help reduce food waste and is also beneficial for health. Tenthly, using the freezer to store food that would otherwise go to waste is a simple and effective way to reduce waste.

### 5.2.2 Sustainable package

Sustainable packaging is an important aspect of the food supply chain. Traditional packaging materials such as plastic can have a significant environmental impact, as they are often not biodegradable and can contribute to pollution. In contrast, 环保包装材料 such as biodegradable plastics, paper, and cardboard are becoming increasingly popular in the food industry.

Biodegradable plastics are made from natural materials such as corn starch or sugar cane and can break down naturally in the environment. Paper and cardboard packaging are also sustainable options, as they are renewable and can be recycled. In addition, some companies are exploring innovative packaging solutions such as edible packaging, which can be eaten along with the food and eliminates the need for traditional packaging.

The application of sustainable packaging materials in the food industry can help reduce waste and environmental impact. For example, using biodegradable packaging for fresh produce can help reduce plastic waste and is more environmentally friendly. Additionally, sustainable packaging can also help improve the brand image of food companies and attract consumers who are concerned about the environment.

In conclusion, reducing food waste and using sustainable packaging are important strategies for achieving a sustainable food supply chain. By implementing these strategies, we can help ensure that food is produced, distributed, and consumed in a more sustainable way.

## 6 Sustainable transport

### 6.1 Importance of sustainable transport

Sustainable transportation plays a crucial role in ensuring the sustainable supply of resources. It has a significant impact on the availability and distribution of food, water, and energy.

#### 6.1.1 Reduce consumption of energy

Sustainable transportation methods can greatly reduce energy consumption. For example, public transportation such as buses, trams, and subways can carry a large number of passengers with relatively less energy compared to individual cars. According to research, a full bus can replace dozens of cars on the road, significantly reducing fuel consumption. In addition, cycling and walking are zero-emission transportation modes that require no fossil fuels at all. Electric vehicles are also becoming more popular as they consume less energy than traditional gasoline-powered cars. For instance, an electric car can travel a certain distance on a fraction of the energy required by a gasoline car. Moreover, carpooling and ridesharing can reduce the number of vehicles on the road, thereby lowering energy consumption.

#### 6.1.2 Reduce environmental impact

Sustainable transportation has a significant role in reducing environmental impacts, especially in terms of carbon emissions. Traditional transportation methods that rely on fossil fuels are major contributors to greenhouse gas emissions. In contrast, sustainable transportation options help to mitigate this problem. Electric vehicles produce zero tailpipe emissions, reducing air pollution and carbon dioxide emissions. Public transportation also reduces the number of individual cars on the road, which in turn lowers emissions. Cycling and walking not only have no emissions but also contribute to cleaner air and a healthier environment. Additionally, sustainable transportation can help reduce noise pollution. For example, electric buses and trams are much quieter than diesel-powered vehicles. This not only improves the quality of life for residents but also benefits wildlife. In conclusion, sustainable transportation is essential for reducing environmental impacts and promoting a more sustainable future.

### 6.2 Sustainable mode of transportation

#### 6.2.1 The development of public transport

Public transportation plays a crucial role in sustainable transportation. It is an efficient way to move large numbers of people while minimizing energy consumption and environmental impact. According to the article “Public

transport - a pillar of sustainable transport”, cities around the world are implementing various initiatives to make public transportation more attractive and accessible. For example, some cities are organizing “Car Free Day” and “Mobility Week” activities to encourage people to use public transportation, bicycles, and walking.

In terms of energy consumption, public transportation is much more efficient than individual cars. A single bus can carry dozens of passengers, reducing the number of vehicles on the road and thereby reducing fuel consumption. Additionally, public transportation often uses cleaner energy sources such as electricity or natural gas, further reducing emissions.

The development of public transportation also has social and economic benefits. It can reduce traffic congestion, improve air quality, and make cities more livable. Moreover, it can provide affordable transportation options for people who cannot afford to own a car, promoting social equity.

#### 6.2.2 Electric vehicle

Electric vehicles are becoming increasingly popular as a sustainable transportation option. As mentioned in “Application prospect of new energy vehicles in transportation industry.pptx”, the global sales of electric vehicles have been growing rapidly in recent years. In 2022, global electric vehicle sales reached 10.8 million units, a significant increase from the previous year.

Electric vehicles offer several advantages over traditional gasoline-powered cars. They produce zero tailpipe emissions, reducing air pollution and carbon dioxide emissions. They are also more energy-efficient, as electricity is generally cheaper than gasoline and electric motors are more efficient than internal combustion engines.

In addition to passenger cars, electric trucks and buses are also being developed and deployed. These vehicles can play an important role in reducing emissions from the transportation sector, especially in urban areas where air quality is a major concern.

However, electric vehicles still face some challenges. One of the main challenges is the limited range and long charging times. Although battery technology is improving rapidly, electric vehicles still cannot match the range and refueling speed of gasoline-powered cars. Another challenge is the lack of charging infrastructure, especially in rural areas and on long-distance routes.

Despite these challenges, the future of electric vehicles looks promising. As battery technology continues to improve and charging infrastructure becomes more widespread, electric vehicles are expected to play an increasingly important role in sustainable transportation.

## 7 Conclusion and prospect

### 7.1 Research conclusion summary

This research has provided valuable insights into the sustainable supply of food, water, and energy. In terms of water supply, we have identified the global water shortage situation and analyzed its causes. Innovative water supply methods such as seawater desalination and rainwater collection and utilization have shown great potential in addressing water scarcity.

For sustainable energy supply, we have explored different types of sustainable energy sources like solar and wind power. The development of smart grids and energy storage technologies has also been discussed as crucial strategies for ensuring a stable and reliable energy supply.

In the area of food supply, organic farming practices and precision agriculture technology have been highlighted as important approaches to promoting sustainable agriculture. Additionally, reducing food waste and using sustainable packaging are essential for achieving a sustainable food supply chain.

Regarding sustainable transportation, we have emphasized the importance of reducing energy consumption and environmental impacts. Public transportation and electric vehicles have been identified as key sustainable transportation options.

Overall, this research has demonstrated that sustainable supply of food, water, and energy is achievable through a combination of innovative technologies, policy support, and behavioral changes. However, there are still many challenges that need to be addressed in the future.

### 7.2 future research direction

Future research could focus on further improving the efficiency and cost-effectiveness of seawater desalination and rainwater collection technologies. In the energy sector, more research is needed to develop advanced energy storage technologies with higher energy density and lower costs. For sustainable agriculture, research could explore new organic farming methods and precision agriculture technologies that are more adaptable to different climates and soil conditions.

In terms of sustainable transportation, research could focus on improving the range and charging speed of electric vehicles and expanding the charging infrastructure. Additionally, more research could be done on the potential of other sustainable transportation modes such as hydrogen-powered vehicles and high-speed rail.

Moreover, future research could also explore the integration of food, water, and energy systems to achieve more comprehensive and sustainable resource management.

This could involve developing integrated solutions that combine sustainable agriculture with water and energy conservation measures.

In conclusion, the sustainable supply of food, water, and energy is a complex and challenging issue that requires continuous research and innovation. By addressing these challenges, we can ensure a more sustainable future for generations to come.

### 7.2 Prospect of future research direction

Future research could also delve into the development of decentralized water treatment and supply systems. By implementing small-scale, local water treatment facilities, communities could have more control over their water resources and reduce the reliance on large centralized systems. This could be particularly beneficial in rural areas or regions with limited infrastructure.

In the energy sector, research could explore the potential of emerging renewable energy sources such as tidal and geothermal power. Tidal energy has the advantage of being highly predictable and could provide a stable source of power in coastal areas. Geothermal energy, on the other hand, is available in many parts of the world and could offer a baseload power option with minimal environmental impact.

For sustainable agriculture, further research could be conducted on the use of biochar and other soil amendments to improve soil fertility and water retention. Biochar is a carbon-rich material that can enhance soil structure and increase the availability of nutrients to plants. Additionally, research could investigate the integration of aquaponics and hydroponics systems with traditional agriculture to maximize food production while minimizing water use.

In terms of sustainable transportation, research could focus on the development of smart transportation systems that optimize routes and reduce congestion. This could involve the use of artificial intelligence and big data to analyze traffic patterns and provide real-time recommendations to drivers and public transportation operators. Additionally, research could explore the potential of alternative fuels such as biofuels and synthetic fuels made from renewable sources.

Moreover, future research could examine the social and economic aspects of sustainable resource supply. This could include studying the impact of sustainable practices on local economies and communities, as well as the role of public policy and consumer behavior in promoting sustainable resource use.

Finally, interdisciplinary research that combines expertise from different fields such as engineering, ecology, economics, and social sciences will be crucial for developing



comprehensive and sustainable solutions. By working together, researchers can address the complex challenges of sustainable resource supply and create a more resilient and sustainable future.

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