



CENTRAL ASIAN JOURNAL OF LITERATURE, PHILOSOPHY AND CULTURE

Volume: 02 Issue: 07 | July 2021

Ecological Theory and Its Application, Ecology Relationships and Other Science, and Approaches to Human Ecology

Arman A

*Department of Civil Engineering, Institute of Padang Technology (ITP) & Doctoral Program
of Environmental Science, Postgraduate - Universitas Negeri Padang, Indonesia*

Eri Barlian

*Department of Coaching, Faculty of Sports Science,
Universitas Negeri Padang, Indonesia*

Siti Fatimah

*Department of History Education, Faculty of Social Sciences,
Universitas Negeri Padang, Indonesia*

Heldi

*Department of Fine Arts, Faculty of Language and Art,
Universitas Negeri Padang, Indonesia*

Iswandi Umar

*Department of Geography, Faculty of Social Sciences,
Universitas Negeri Padang, Indonesia*

Received 20th May 2022, Accepted 13th June 2021, Online 7th July 2021

Abstract: Ecology is a scientific discipline that studies the ins and outs of natural economics, a study of inorganic relationships and the organic environment around them, which is then expanded to become a study of the reciprocal relationship between living things and their environment. Ecology is often referred to as the basic science of the environment. Based on the above understanding, Haeckel specifically defines ecology as the science of the reciprocal relationship between living things and their biotic and abiotic environments. Around 1900, ecology was recognized as a science and developed rapidly, especially when the world was very sensitive to environmental problems in establishing and maintaining the quality of world civilization. More specifically, Haeckel defined

ecology as the science of the interrelationship between living things and their biotic and abiotic environments. Around 1900, ecology was recognized as a science and developed rapidly, especially when the world was very sensitive to environmental problems in establishing and maintaining the quality of world civilization.

Keywords: ecology, abiotic, biotic environment

Introduction

Ecology is defined as the study of ecosystems. The word ecology comes from the word Oikos which means home or place to live and Logos means knowledge. The first time the word ecology was introduced by [1] with the meaning: Ecology is a discipline that studies the ins and outs of the natural

economy, a study of inorganic relationships and the surrounding organic environment which later this definition was expanded to become a study of the reciprocal relationship between living things with the environment. In 1866, Ernst Haeckel - a biologist from Germany - for the first time introduced the term ecology which became known as ecology. This term comes from Greek, Oikos means house, and logo or logos means science. So that ecology can be interpreted as the science of living things in their homes or it can be interpreted as the science of the household of living things. From this generic understanding, various disciplines have developed which study the dynamics and character of the life of various household species and populations. communities to natural ecosystems including man-made ecosystems.

[2] explain ecology is often referred to as the basic science of the environment. Based on the above definition, ecology includes the study of plant and animal populations, plant and animal communities, and ecosystems. An ecosystem describes a network of relationships between organisms at different scales of organization. The fulfillment of human needs can be fulfilled because of the use of the environment in the form of environmental management. Through environmental management, there is a reciprocal relationship between the biophysical environment and the social environment. This means that it is related to the concept of ecology, especially regarding the concept of a reciprocal relationship between the biophysical environment and the social environment [3]. Thus, when talking about the environment, the concept of ecology will always be related, so that environmental problems are ecological problems.

FINDINGS

Definition of ecology and the scope of ecology

The term ecology was first introduced by Ernest Haeckel, a German biologist, in 1869. Ecology comes from the Greek word Oikos which means house or residence and logos which means science/study. Therefore, ecology means the science of the home (residence) of living things [5].

Ecological studies can also be carried out at the level of individual humans, families, households, communities. villagers. district, provincial communities. country, continent. to the global level. Each of these principles has a similarity: studying how a human "household" is built and developed in the midst of its environment. Some focus on the individual, family pathways. community and consumers maintain survival (survival and sustainability of life through studies of nutritional and food adequacy, family health, and welfare. and protection of consumer communities. However, there are also those who focus on the pathways of how local communities, rural and urban communities can gain equitable access to economic resources to ensure the survival and sustainability of the living community or communities concerned So it is not surprising that within the organization the Faculty of Human Ecology (Fema) 1 PB is under the auspices of the Department of Community Nutrition, the Department of Family and Consumer Science and the Department of Communication and Community Development. Each department occupies different ecological niches as a result of a long process of specialization in human ecology.

More specifically [1] defines ecology as the science of the interrelationships between living things and their biotic and abiotic environments. a. Around 1900, ecology was recognized as a science and developed rapidly, especially when the world was very sensitive to environmental problems in establishing and maintaining the quality of world civilization. Ecology is a branch of science that underlies and is always related to everyday life. This is because ecological principles can explain and provide inspiration in finding ways to achieve a more decent life.

Over the last two decades, Fritjof Capra - the world's foremost physicist has devoted his attention to the phenomenon of the paradigm of science. The paradigm referred to here is a worldview where theory, practice. knowledge, science. conceptualized mindset. The paradigm contains a series of assumptions. idea. understanding. values (generally unwritten) and rules about what is relevant and what is not. what questions should be asked and whatnot,

what knowledge is considered legitimate, and what are the practices that are considered correct? The classic ecological definition is presented by [5]. [5] states that ecology is the study of the structure and function of nature. Meanwhile, a view that sees the world as a whole is called holistic, organic, or ecological [6]. This shift in perspective from the part to the whole dates back to the 1920s in Germany, in the Weimar Republic. At that time quantum physics, organismal biology, and gestalt (organic form) psychology grew as part of the protest movement against the fragmentation and alienation of human nature that had been firmly entrenched since the 16th and 17th centuries. This anti-mechanistic movement (at that time was an intellectual trend) can be said to emerge as a reflection of the 'thirst of intellectuals for a holistic view'. However, this holistic view has only developed rapidly in the last four decades since the discovery of the concept of the food chain and food web, a deeper understanding of quantum physics, and new concepts of general systems theory.

This new discovery or understanding has paved the way for the growth of the view that all life is basically interwoven and interdependence forms a web of life [6, 7]. As a whole whose components are interrelated and interdependent and not as a collection of separate parts, this is a system thinking.

Scope of ecology

The scope of ecology includes several units in the biological spectrum. The units of the ecological scope are, respectively, individual ecology, population ecology, ecology k community, ecosystem ecology, landscape ecology, and global ecology. In summary, the scope of ecology can be described through a spectrum of biology, which describes the organizational levels of life as follows:

- Protoplasm is the living substance in cells and consists of complex organic compounds, such as fats, proteins, and carbohydrates.
- Cell is the basic unit of an organism which consists of protoplasm and nucleus contained in the membrane. The membrane is a component that separates it from other basic units.

- Tissue is a collection of cells that have the same shape and function, for example, muscle tissue.
- Organs or organs are part of an organism that has a specific function, for example, legs or ears in animals, and leaves or roots in plants.
- Organ systems are cooperation between harmonious structures and functions, such as cooperation between eyes and ears, between eyes and hands, and between nose and hands.
- Organism is a living thing, living body, or living thing.
- Population is a group of similar organisms that live and reproduce in a certain area. For example, the deer population in Java, the banteng population in Ujung Kulon, the rhino population in Ujung Kulon, and the native chicken population in West Java.
- Communities are all populations of various types of organisms that occupy a certain area. In this area, each population interacts with one another. For example, the deer population interacts with the tiger population on the island of Sumatra or the goldfish population interacts with the tilapia fish population.
- Ecosystem is an order of unity as a whole between all elements of the environment which influence each other. The ecosystem is a complex reciprocal relationship between living things and their environment, both living and nonliving (land, water, air, or physical chemistry) which together form an ecological system.
- The biosphere is the layer of the earth where ecosystems operate. The biosphere layer is approximately 9000 m above the earth's surface, several meters below the land surface, and several thousand meters below sea level.

Population

Dynamics disrupted by environmental conditions that change periodically all populations will and have shown fluctuations in size. Many populations undergo cycles of fluctuation drastically influenced by the complex interactions between biotic and abiotic factors. A metapopulation is a population

group linked by immigration and emigration, for example, immigration and emigration linking the Belding ground squirrel population with other populations of the species which all form the metapopulation. Like an individual, a population also has biological characteristics, including Having a certain structure and organization, which are constant and some that fluctuate over time. Ontogenetic has a history of life (birth, growth, differentiation, aging, and death). Can be recognized for environmental impact and respond to environmental changes. Have heredity. Integrated by heredity factors by hereditary (genetic) and ecological factors.

Interactions between population ecologies

Some of the relationships in the life of an organism are interactions with individuals from various other species in the community. Interactions between species include competition, predation, herbivory, and symbiosis (including parasitism, mutualism, and commensalism).

- Competition: When the population occupies the same habitat. If in the competition there is one of the losers, the loser will die or leave the area where he lives.
- Predation: Interactions between species where one species predators, killers, and prey on other species.
- Herbivory: Ecologists use the term herbivory to refer to interactions in which organisms feed on plant parts or algae.
- Symbiosis: When individuals of two or more species live in direct and close contact with one another, their relationship is called symbiosis. Some biologists define symbiosis narrowly, as a synonym for mutualism, namely interactions that benefit both species.

Kinds of ecosystems

The following are examples of types of ecosystems, namely:

Water

The ecosystem is divided into two: Freshwater is soft, the freshwater ecosystem is an ecosystem in water that does not flow, for example in lake

ecosystems, reservoirs. And lotic freshwater, namely the lotic freshwater ecosystem is an ecosystem in flowing water, for example in rivers.

Sea Water

- Littoral zone. Characteristics: Located on the edge of the sea or beach, Provides a place for most fish and shrimp, crabs to raise their young, and is usually surrounded by land that forms mangroves.
- Shallow Sea Zone. Characteristics: Formed by colonies of coelenterate animal skeletons, acting as fish breeding areas and ecosystems that are easily damaged by pollution, contamination, etc.
- Pelagic zone. Characteristics: It is an open sea area, consisting of 2 different depth areas, namely the photic zone and the aphotic zone, and the Pelagic Zone at a depth of 76,000 m above sea level, so there is no sunlight.

Land

- Tropical rainforest. General Characteristics: Generally located on the equator, high ecosystem diversity, high rainfall (200-450 cm per year), and sunshine throughout the year.
- Savanna. General Features: Kerinci, located in tropical and subtropical areas, is dominated by large grasslands, scattered shrubs, and trees, dominated by insects, herbivores, and carnivores. And the African Savanna is a grassland biome known for its wildlife. There are lots of trees, some areas are even denser than forests. Savannah Africa is filled with a variety of animals.
- Desert. General Characteristics: Desert is a very dry biome, rainfall is very low (± 25 cm per year), dominated by plants such as shrubs, succulents, and grasses.
- Tundra. General characteristics: Dominated by coniferous plants, located in sub-tropical or mountainous areas, long winters, short summers, animals that live include deer, wolves, etc.
- Taiga. General characteristics: Has a very long winter, dominated by moss, grasses, and shrubs. And the weather in summer can reach over 100

degrees Fahrenheit. While in winter the temperature can drop to around negative 80 degrees. Since the annual average temperature is below freezing, there is a kind of permanent permafrost.

Food chains, flows, and energy transfer

The communities of an ecosystem interact with each other and also interact with their abiotic environment. This interaction occurs in an attempt to survive the organism. This activity requires energy. Energy for various activities is obtained from organic materials, so it is referred to as chemical energy. The organic material in the biotic components is originally formed with the help of sunlight energy and organic elements, such as carbon and nitrogen. This organic material is transferred from one organism to another. The transfer of chemical and elemental energy takes place through the interaction of eating and eating.

The events of eating and eating between organisms in an ecosystem form a trophic structure, which consists of several trophic levels. Example 1st terrestrial food chain is Plants will absorb and use sunlight to manufacture or produce food in the form of sugar and will be stored in the seeds, stems, fruit, and other storage. Rats (consumer level I), namely herbivores or plant eaters, will eat these plants. Then the mouse body converts many foods into energy for its activities and reproduction. Snakes (consumer-level II), namely carnivores or meat-eaters, will eat mice. Rats are food or energy sources for snakes, so they can survive. Eagles (level III consumers or peak consumers) will eat snakes. The eagle eats the snake to use the energy available from the snake to survive. When the eagle dies, it decomposes.

In the process of decay, it will be broken down by microorganisms such as bacteria, then it will be absorbed again by the soil where plants such as grass grow. An example of a food chain in water or sea is Phytoplankton (Producer), in the aquatic ecosystem, Phytoplankton acts as a producer because of their ability to photosynthesize, form food reserves (starch). Fish (consumer level I), namely animals that eat phytoplankton, then the fish's body will convert

food into energy for its survival. Seals (consumer-level II), seals eat fish, because fish is a source of food. Killer whales (level III consumers or peak consumers), will eat seals. Killer whales eat seals to use the available energy from the snake to survive.

Food webs have a trophic level and a trophic position. Plant species make up the first-order basal species. Basal species are also known as producers; it is the resource of the species that the main consumers or main predators feed on these webs. The main predators eat no other living things other than the main producers in the food web. Basal species can either be composed of autotrophs or detritivores which also include decomposing organic matter and related microorganisms and plant material. Autotrophs capture the form of sunlight and produce energy through photosynthesis

Ecological pyramid

An ecological pyramid is a pyramid that describes the amount of weight and energy from producers to peak consumers. This pyramid is made with the assumption that at the time of the eating and eating events there has been a transfer of energy from living things that are entered into the living things that eat it. This ecological pyramid serves to show an overview of the comparison between trophics in an ecosystem. The first level is occupied by producers as the basis of the ecological pyramid, then primary consumers, secondary, tertiary to peak consumers. There are 3 types of ecological pyramids:

- Biomass: pyramids Number of pyramids in different ecosystems cannot be compared with one another. This is because, in each ecosystem, the individuals involved in it are not the same. Therefore, the-emerged so-called biomass pyramids. Pyramid serves to describe the combined mass of all organisms in a particular habitat which is measured in grams.
- Energy: Pyramid Biomass pyramid sometimes does not provide sufficient energy flow information in certain ecosystems. Therefore, the energy pyramid is based on research depth on the flow of energy and can provide an accurate picture of the flow of energy. In the pyramid of there is a reduction in energy in each trophic

level that occurs because some foods are not completely digested into energy. Only a certain part of the food is edible and only a portion of the food is stored in the body because the rest is used as energy.

- Pyramid of number: In the food chain, organisms at low trophic levels have a greater number of individuals. The higher the level of trophic, the fewer the number of individuals in the ecosystem. If the number of individuals per unit area for each trophic level is depicted in the histogram, will form a kind of pyramid called a pyramid of numbers.

Biogeochemical cycle

The biogeochemical cycle is the movement of chemical elements through living things and the abiotic environment (soil and water). This biogeochemical cycle functions to regulate the balance of the ecosystem. That is, the balance of the ecosystem depends on the repetition that occurs circularly in certain chemical elements. Chemical elements that can undergo a biogeochemical cycle include carbon, nitrogen, hydrogen, and oxygen, as well as phosphorus.

- The carbon cycle: The cycle starts with the CO contained in the air and dissolves in water to form a stock of inorganic carbon (C) and the origin of organic C elements. Plants will absorb the element carbon in the form of CO in the air as a basic material in the photosynthesis process. In this process, the carbon contained in the abiotic environment enters the biotic environment and the carbon from the biotic environment will return to the abiotic environment in the process of respiration. Elemental carbon from respiration in the form of CO or other forms as metabolic waste. plant remains. Dead and other organic material will be decomposed by decomposers and the elemental carbon is released into the air and water as CO. Carbon is always moving from inorganic reserves to living systems and back again. Half of the CO compounds from the combustion of fossil fuels remain in the atmosphere and the rest dissolves in seawater. Its levels in the air are also increased through the

oxidation of organic matter. Human activity increases CO levels by up to 15%. This will have an impact on the regulation of the earth's temperature (greenhouse effect).

- Nitrogen Cycle: Inorganic nitrogen reserves are in the form of N gas, which makes up about 78% of air. However, N gas has little biological activity. This gas enters the body of the organism, then comes out again without playing an important role in the process of life. Some bacteria, blue-green algae, and fungi can break down N to synthesize small amounts of materials other organisms can use. Nitrogen fixation by microorganisms can provide nitrogen for a large number of inhabitants of the earth's ecosystem. There is always a release of N from soil or water back into the air. This can happen because there are bacteria that carry out a denitrification process that converts ammonia into N and releases it. In the five-stage nitrogen cycle involving living things. In the figure, it can be seen that nitrogen in the air (N) will turn into ammonia (NH₃) 1) this stage is called nitrogen fixation by the Rhizobium bacteria found in nodules roots of legume plants. Ammonia will turn into nitrate (NO₃⁻) by nitrifying bacteria in the soil. The change of ammonia to nitrate is called the nitrification stage; 2) In fact, ammonia doesn't suddenly turn into nitrate. However, initially, ammonia will be converted into nitrite (NO₂⁻) by Nitrosomonas and Nitrosococcus bacteria. Furthermore, Nitrobacter bacteria will convert nitrite to nitrate (NO₃⁻). The third stage in the nitrogen cycle is the assimilation stage; 3) At this stage nitrogen will be absorbed by plants, then it will be assimilated into proteins and amino acids. When the plant dies, the nitrogen bonds will break and the ammonia bacteria will be converted back into ammonia, this stage is called ammonification; and 4) Nitrogen in the form of nitrate (NO₃⁻) can be directly reduced to nitrogen gas (N). The stage of changing the form of nitrogen that occurs due to the presence of denitrification bacteria is called the denitrification stage.

- **Water Cycle (Hydrogen and Oxygen):** Rainwater that falls on the ground will immediately evaporate back into the air. Water that flows and does not immediately evaporate is absorbed by plants or drunk by animals. The rest flows on the ground into rivers, lakes, and some that penetrate the soil layer into springs. Surface water will flow into the sea. Evaporation comes from streams, rivers, lakes and seas, animals, and plants. The process of evaporation of water (evaporation) is released back into the air from vegetation or plants in the form of water trapped in the canopy, such as rainwater or dew water. In addition, it also comes from metabolic wastewater which is achieved through the process of transpiration. In animals, metabolic waste (residual respiration from sweat) will evaporate through the process of transpiration into the air. Meanwhile, plants carry out evapotranspiration, namely evaporation from the rest of the respiration. Partially evaporated energy comes from solar radiation. The water cycle never stops going to the earth as rain and returns to the atmosphere through evaporation, then returns to the earth through the rain to supply water for the earth's life. This cycle is the main factor that changes the earth's temperature and transports various chemical elements in the ecosystem.
- **Phosphorus cycle:** The phosphorus cycle is a simpler cycle than the carbon cycle or the nitrogen cycle. The movement of phosphorus in the phosphorus cycle does not exist in the atmosphere. The phosphorus cycle occurs starting from land to sediment in the oceans. Water will carry phosphorus found in rocks in the form of phosphate (PO_4^{3-}). Phosphate will be absorbed by plants and used for the synthesis of organic substances, for example, nucleic acids. Animals will get phosphorus from the plants they eat. Furthermore, when the plant or animal dies, the phosphate will be broken down by the decomposer becomes phosphate again. Phosphorus is the only major element in commercial fertilizers. Phosphorus is widely available in corals. In nature, the amount of

available phosphorus is lower than nitrogen with a P: N ratio of 1: 23. Humans carry out excavations to accelerate the transfer of phosphorus minerals from corals to aquatic organisms.

Ecological success

Succession is the change or development of a community through certain stages. There are two types of succession, namely primary succession, and secondary succession. Ecosystem development towards maturity and balance is known as ecological succession or succession. Succession occurs as a result of modification of the physical environment in a community or ecosystem. The succession process ends with a community or ecosystem climax or a state of balance has been reached (homeostasis). In this realm, there are two kinds of succession, namely primary succession, and secondary succession.

- **Primary Succession Primary:** Succession is the emergence of a new community in an area where previously there was no community. Primary succession occurs when the original community is disturbed resulting in a total loss of the original community so that new habitat is formed in the original community. An example of primary succession in Indonesia is the formation of succession on Mount Krakatau, which erupted in 1883. In the area where the eruption of Mount Krakatoa first appeared pioneers in the form of lichen and moss plants that were resistant to sunlight and drought. The pioneer plants began to weather the surface area of the land, so that simple soil was formed. If the pioneer plant dies, it will invite decomposers to come.
- **Secondary succession secondary:** Succession is the formation of an ecosystem that has been damaged to its initial state before being disturbed. This succession can occur due to fire, human destruction, and earthquakes. The secondary succession process is faster than primary succession. This is because in secondary succession there no succession is need for stages of pioneer community formation. Secondary Occurs when a community experiences disruption, both naturally and artificially. The

description of the secondary succession image above is a small pool formed near the coast and has a barrier in the form of beach sand. After two years, a vegetation formation grows. After 50 years, the plants that grow are large trees. The resulting sediment is so large that the pond is shallow. After 150-250 years, the pond becomes a new community, namely grasslands. ecological paradigms, perspectives, and ethics. Through a systems approach, we will see every living entity more complex, dynamic, and attractive than ever before. So that instead of a mechanistic world view, an organic, complex, and dynamically interwoven world view now emerges as new consciousness. Instead of a linear causal relationship, we now see the presence of complex webs of life that are cyclically interwoven across space and time [8].

CONCLUSION

Ecology comes from the Greek Oikos which means house or place to live and logos which means science/study. So, ecology means the science of the home (residence) of living things. In brief, the scope of ecology can be described through the biological spectrum, which describes the levels of the organization of life, namely macromolecules, protoplasm, cells, tissues, organs, organ systems, organisms, populations, communities, ecosystems, and the biosphere. Many populations undergo cycles of fluctuation drastically influenced by the complex interactions between biotic and abiotic factors. Some of the relationships in the life of an organism are its interactions with individuals from various other species in the community. Interactions between species include competition, predation, herbivory, and symbiosis (including parasitism, mutualism, and

commensalism). The transfer of chemical and elemental energy takes place through the interaction of eating and eating. The events of eating and eating between organisms in an ecosystem form an atrophic structure. Biomass pyramids sometimes do not provide sufficient energy flow information in certain ecosystems. Therefore, the energy pyramid is based on in-depth research on the flow of energy and can provide an accurate picture of the flow of energy.

ACKNOWLEDGMENT

This paper is the study of human ecological changes to the surrounding environment, resulting from theoretical lectures on the capita selecta and human ecology course in the Doctoral Program (S3) in Environmental Sciences, Postgraduate – Universitas Negeri Padang (UNP).

REFERENCES

1. Haeckel E. 1866. *Generelle Morphologie der Organismen. Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von C. Darwin reformirte Descendenz-Theorie, etc.*
2. Odum H T. 1963. Limits of remote ecosystems containing man. *The American Biology Teacher*, 25(6), 429-443.
3. Chapra U. 2001. *The Future of Economics (An Overview of Islam)*, Jakarta: echo Insani Press.
4. Sterling J., Stanley M., Gatward G., and Minson T. 1990. Production of human papillomavirus type 16 virions in a keratinocyte cell line. *Journal of Virology*, 64(12), 6305-6307.
5. Stephen A. 1990. *A reunion of trees* (Vol. 80). Cambridge, MA: Harvard University Press.