

## A Study of Energy, Ecology, Environment and Society Under Fuzzy Logic Spaces

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(Received on: July 8, 2014)

### ABSTRACT

A study of ecosystem is absolutely essential in these days because ecology is very seriously disturbed. The problems of ecology, Environment, Atmosphere, Hydrosphere, Lithosphere and Ecosphere are very random and uncertain. The pollution in the earth, air and water is increasing day by day due to human activities. This problem is brought under this study in Fuzzy spaces. The natural balance is made by interconnecting large number of ecosystems and their dynamics of energy flow. If the energy from one ecosystem to other is restricted, the system has a failure rate. The failure rates may be mild, medium, harsh and severe that may be solved by Fuzzy set theory and Fuzzy Logic. Fuzzy Logic is effective in the problems of uncertainty random, base less without origin, without reference and no contest. The problems of Ecology failures have large number of elements that can be solved using Mean of Moments [MOM] method or Center

of Area Method [COAM]. Fuzzy cardinality method Mean Max and average method are used. The ecosystems are represented by sets spaces, vector spaces, probabilistic occurrence and Fuzzy distribution functions.

**Keywords:** Ecosystem, Pollution Hazard.

## INTRODUCTION

The society directly or indirectly affected by the pollution. The biotic systems interact with abiotic systems and energy is consumed. The input energy is taken from ecosystem in the form of materials and output is a pollution of all kinds. Many researches make a study of ecological balance caused by energy consumption. The food chain is distributed in the ecosystems, the intake of energy is too much and the resulting pollution is well known. In this issue an off directional study is made to find the failure rates of the ecosystems. Since no work is done of this category in the literature, therefore a few inferences are given to study the ecosystems. Moreover the ecosystems are non-linear due to unbalance

of the components input and output. The better indicator of ecosystems are the electrical parameters like resistance, inductance, capacitance, quality factor and relative density and their failures.

### 1. Ecosystems and their failure rates

The population of organisms interact with each other in biological community and no biotic community can live in isolation. It lives in an environment which supplies its materials and energy requirements and provides other living conditions. A biological community interacting with non living environment is called an ecosystem. One can find a Fuzzy, grade of truth of an ecosystem as follows, incorporating their failure rates, in table-1.

**Table - 1**

Fuzzy Systems	$\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
An ecosystem can be	0.886	0.12103	0.10723	0.89276	8.262	0.876
Natural	0.916	0.08773	0.080306	0.9196	11.398	0.906
Artificial	0.892	0.11428	0.10194	0.898	8.75	0.868
Temporary	0.669	0.40196	0.2689	0.73108	2.487	0.632
Permanent	0.796	0.22815	0.1816	0.8184	4.383	0.759
A pond	0.616	0.4845	0.2984	0.7015	2.064	0.598
A lake	0.866	0.14386	0.1246	0.8754	6.9512	0.857
A tract of Forest	0.796	0.2281	0.1816	0.8184	4.384	0.766
A corel reef	0.893	0.11316	0.10105	0.8989	8.837	0.886
A large grassland	0.936	0.06614	0.06206	0.938	15.1194	0.912
A village	0.942	0.0597	0.05628	0.9437	16.75	0.926
An Aquarium	0.957	0.0439	0.04206	0.958	22.78	0.938
A filed of surgarcane	0.876	0.13238	0.11596	0.884	7.554	0.856
A manned space ship	0.869	0.14041	0.122016	0.8788	7.122	0.839
A laboratory culture	0.879	0.12896	0.11336	0.8866	7.754	0.839

The table-1 can be defuzzified using MOM, COA and cardinality methods to obtain an average.

$$|A| = \sum \mu_{\hat{A}}(\lambda) = 12.789,$$

$$\|A\| = \frac{\int \mu_{\hat{A}}(\lambda) d\lambda}{\int d\lambda} = 0.8526 \quad (1)$$

$$\text{MOM} = \frac{\int \mu_{\hat{A}}(\lambda) \lambda d\lambda}{\int \mu_{\hat{A}}(\lambda) d\lambda} = 0.836$$

The Fuzzy grade of truth of interaction will be 0.866 at

$$\lambda = 0.143865 \text{ and } T = 6.95 \text{ years} \quad (2)$$

The Fuzzy grade of truth of the properties of ecosystem may be derived by a given narrative model in table-2. Thus an ecosystem may be defined as dynamic system which includes both organisms as biotic elements and abiotic environment influencing the properties of each other and both necessary for the maintenance of life.

Table – 2

Fuzzy systems	$\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
The living parts calling it a biotic system	0.912	0.0921	0.084	0.89276	8.262	0.876
And non living parts	0.889	0.1176	0.1046	0.8954	8.5034	0.867
The abiotic system of ecosystem are very closely interconnected	0.906	0.0987	0.0894	0.91056	10.1317	0.898
Energy flows in the form of food from one organism to another organism within a community	0.936	0.06613	0.0619	0.938	15.1217	0.918
This is being done through feeding relationship such as grazing, predation and parasitism	0.896	0.10981	0.0984	0.9016	9.1066	0.866
The biotic community is only one part of the ecosystem	0.932	0.07042	0.0656	0.9343	14.2	0.916
Another important part of ecosystem is the biotic system includes oxygen, carbon and nitrogen as being chemical elements as well as physical elements	0.796	0.2281	0.1816	0.8184	4.38	0.778
The wind, fire and climate are also physical elements of abiotic system	0.889	0.1176	0.1046	0.8954	48.5	0.866
Together the biotic and abiotic systems determine the characteristics of the ecosystem	0.798	0.2256	0.180	0.8199	4.432	0.776
The functional aspect of a ecosystem consists of the volume and the rate at which various materials circulate and the rate at which energy flows through it.	0.866	0.12036	0.1072	0.892	8.262	0.867
Energy moves through the food chain in one direction only	0.668	0.40346	0.2695	0.730	2.479	0.632
The movement of matter is cyclic or circular	0.883	0.1244	0.1098	0.890	8.038	0.866
Energy flows through the ecosystem and is finally lost to space in the form of heat	0.662	0.4124	0.27306	0.7269	2.424	0.654
Matter may be changed from one form to another but it always remains in the ecosystem.	0.916	0.08773	0.08036	0.9196	11.39	0.899
The functional aspect of an ecosystem also includes the process by which living organisms change the non living or abiotic environment	0.929	0.0736	0.0684	0.9315	13.58	0.906
The process by which abiotic environment affects living organisms and the events by which population levels or organisms are regulated	0.897	0.1086	0.0975	0.9025	9.208	0.886

The table-2 is a Fuzzy set and can be saved using Fuzzy methods. The cardinality is 13.795 and relative Fuzzy cardinality 0.8621875 at the failure rate  $\lambda = 0.1482806$  and MTBF = 6.7439692 The failures of ecosystem is a problem due to energy flow and pollution. This may be solved using the Fuzzy systems and Fuzzy logic techniques.

Table- 3

Fuzzy systems	$\mu\hat{A}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
The energy from the sun enters the living world through photo synthetic organisms and passes open from one organism to another in the form of food	0.896	0.10981	0.0984	0.9016	9.1066	0.889
	0.886	0.121036	0.1072	0.8927	8.262	0.849
	0.916	0.0877	0.08036	0.9196	11.4025	0.898
	0.834	0.1815	0.15138	0.8486	5.5096	0.812
	0.856	0.1554	0.133	0.8669	6.435	0.845
	0.776	0.2536	0.1968	0.8032	3.9432	0.768
	0.896	0.10981	0.0984	0.9016	9.107	0.887
All organisms require energy for their life processes and this energy enters the world of living things through the process of photo synthetics carried on the green plant	0.886	0.121036	0.1072	0.892	8.262	0.867
	0.936	0.0661	0.062	0.938	15.128	0.918
	0.941	0.0608	0.0572	0.942	16.447	0.924
	0.896	0.1098	0.0984	0.9016	9.1074	0.886
	0.912	0.0921	0.804	0.9156	10.857	0.896
Green plants produce carbohydrates by photo synthesis and also synthesis proteins and fats are called primary procedures.	0.816	0.1142	0.1659	0.898	8.756	0.876
	0.892	0.1142	0.10194	0.898	8.756	0.876
	0.866	0.1438	0.1246	0.8754	6.954	0.832
All the populations in a community are dependent upon green plant and are referred to consumers	0.779	0.249	0.1945	0.8054	4.016	0.752
	0.972	0.0283	0.0276	0.972	35.3	0.952
The non green organisms like the fungi and some bacteria which are incapable of producing their food, live or dead and decaying plants or animal parts and are consumers of a special kind called the decomposers	0.886	0.121036	0.10723	0.89276	8.26	
	0.912	0.09211	0.084	0.916	10.85	
	0.776	0.2536	0.1968	0.8032	3.9432	
	0.866	0.1438	0.1246	0.8734	6.9432	
	0.779	0.2497	0.1945	0.80545	4.004	
	0.912	0.092114	0.084	0.916	10.856	
	0.762	0.2718	0.2071	0.7928	3.679	
These simplify step by step the organic constituents of each dead body. Their activities make chemical substances available for other living beings, therefore they are the energy procedures.	0.798	0.2256	0.18006	0.8199	4.4326	
	0.892	0.1142	0.10186	0.89813	8.756	
	0.936	0.0661	0.061906	0.938	15.128	
	0.779	0.2497	0.1945	0.8054	4.004	
The links of one food chain are a flower, a butterfly a dragon fly, a frog, a snake and a hawk. When a hawk dies its cells and tissues are digested and used a food by bacteria and other organisms of decay	0.866	0.1438	0.1246	0.8754	6.954	
	0.772	0.2587	0.19976	0.8002	3.86	
	0.778	0.25102	0.1953	0.8047	3.983	
	0.792	0.2332	0.184687	0.8153	4.288	
	0.886	0.121036	0.10723	0.89276	8.26	
	0.786	0.2408	0.1892	0.81073	4.152	
	0.936	0.0661	0.06190	0.938	15.128	
In this way the organic materials of food chain are returned to the soil and recycled through another chain	0.892	0.1148	0.10194	0.898	8.7504	
	0.779	0.2497	0.1945	0.8045	4.0048	

The above space in Table -2 is not sufficient to take a decision of 0.8621875 and failure rate 0.1482806 and MTBF 6.7439692 . One can form another Fuzzy space to study the ecosystem using a narrative model in table-3. This is a fuzzy space. Fuzzy system or a Fuzzy set with  $\mu_{\hat{A}}(\lambda)$  the Fuzzy grade of truth.

The Fuzzy humming distance  $= |A| = \mu_{\hat{A}}(\lambda) d\lambda = 33.493$  and Fuzzy grade of truth  $= \mu_{\hat{A}}(\lambda) = 0.8587948$  This may be the reliability  $= R = e^{-\lambda}$

$$\text{Where } A = \frac{\log e \mu_{\hat{A}}}{0.4343} \quad (5)$$

$$= 0.1552 \text{ MTBF} = 6.5692987$$

The space has 39 elements mutually coupled with the energy flow. The 39 points have a fuzzy cardinality 33.493 and Fuzzy grade of truth is 0.8587948. The MTBF is 6.57 years. The ecosystem has a mean time between failures 6.57 years and it must be maintained and care should be taken every 6 years. Failure rates are and care should be taken every 6 years. Failure rates are calculated using Natural Outage Rate [NOR] Forced Outage Rate [FOR] and Pollution Outage Rate [POR], Table-4 is presented for further studies.

Table- 4

Fuzzy systems	$\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
Ecosystem	0.886	0.121036	0.10723	0.89276	8.262	0.866
Ecosphere	0.779	0.2497	0.1945	0.8055	4.004	0.736
Biosphere	0.879	0.12896	0.11336	0.8866	7.7543	0.886
Atmosphere	0.866	0.1438	0.1246	0.8754	6.9541	0.833
Lithosphere	0.912	0.09211	0.084	0.9159	10.856	0.896
Hydrosphere	0.836	0.17912	0.1497	0.8502	5.5828	0.806
Biotech components	0.792	0.2332	0.18468	0.8153	4.288	0.766
Primary producers	0.892	0.11428	0.10194	0.898	8.75	0.866
Primary consumers	0.932	0.07042	0.0656	0.93436	14.2003	0.916
Secondary consumers	0.912	0.09211	0.084	0.916	10.856	0.892

Table- 5

Fuzzy systems	$\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
Abiotic components	0.926	0.07688	0.07119	0.9288	13.0072	0.916
Temperature	0.778	0.25102	0.1953	0.8047	3.9837	0.758
Water	0.798	0.2556	0.18006	0.8199	4.4326	0.788
Humidity	0.886	0.121036	0.10723	0.89276	8.262	0.867
Light	0.812	0.2082	0.16905	0.83094	4.803	0.796
Wind	0.786	0.1691	0.10446	0.89553	5.9136	0.766
Soil PH	0.866	0.14386	0.1246	0.8754	6.9512	0.844
Mineral elements	0.9120	0.092114	0.084	0.9159	10.856	0.899
Topography	0.926	0.07688	0.07119	0.9288	13.0072	0.916
Background	0.938	0.064	0.06	0.9399	15.625	0.926
Habitat's	0.938	0.064	0.06	0.9399	15.625	0.927
Niche	0.896	0.10981	0.0984	0.9016	9.1066	0.886
Biomass	0.839	0.1755	0.14728	0.8527	5.698	0.826

The fuzzy space of table-4 stands for the elements, for the given Fuzzy failure rates. Fuzzy grades of truth or element hood of ten The humming distance would be

$|A| = 8.686$  and relative

Fuzzy cardinality =  $\mu_A(\lambda) = 86.86\%$

The  $R = e^{-\mu} = 0.8686$

$$\lambda = \frac{\log e^{-\mu} A^{-\lambda}}{0.4343} \quad (6)$$

$$= 0.14087, \text{MTBF} = 7.0987$$

The space is a Fuzzy set of baseless without reference and contest of the points. MOM and COA methods are powerful tool of defuzzification. The results are in agreement with other spaces.

On the similar ground the Fuzzy set is represented in table-5. The failure rates are the Fuzzy elements and the Fuzzy grades of truth are obtained by inference and decisions, and marked by exponential distribution function.

$\mu_{\hat{A}}(\lambda) = e^{-\mu}$  and

$$\frac{\log e^{-\mu} A}{0.4343} \mu_{\hat{A}}(\lambda) = 0.8693 = R =$$

The space is solved by using MOM and COA method (7)

Reliability  $|A| = 11.301 =$  Humming distance = Fuzzy Cardinality.

The failure rate  $\lambda = 0.1400652$  and  $\text{MTBF} = 7.1395317$  years. The failure rate is a Fuzzy set which can be fuzzified using probability distribution functions, exponential distribution function, weibull distribution function and hyperbolic functions may be used. Failure rate may be found using 100 years back history and results of ecosystems. The measurement of density, resistivity, dielectric constant and magnetic permeability are measure along with the quality factor of the ecosystems. The relative density of all the ecosystems is changing.

**Table- 6**

Fuzzy systems	Fuzzy grade of $\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
Energy	0.912	0.092114	0.084	0.916	10.856	0.896
Primary production	0.896	0.1098	0.0984	0.9016	9.107	0.866
Secondary production	0.886	0.121036	0.10723	0.8927	8.262	0.877
Food chain	0.796	0.2281	0.1816	0.8184	40304	0.771
Food web	0.812	0.8082	0.1691	0.8308	4-803	0.796
Trophic level	0.779	0.2497	0.1945	0.8054	4.0048	0.766
Energy flow	0.899	0.10647	0.0957	0.90428	9.392	0.881
Ecologic pyramids	0.697	0.36096	0.2516	0.90428	9.932	0.881
Biogeochemical cycles	0.926	0.07688	0.07119	0.9288	13.00	0.912
Producers	0.812	0.2082	0.1691	0.8308	4.8	0.796
Vegetarian	0.936	0.06613	0.0619	0.938	15.12	0.916
First order consumer	0.762	0.2718	0.20711	0.7928	3.68	0.716
Grasshopper	0.629	0.4636	0.2916	0.7083	2.157	0.612
Rabbit	0.796	0.22815	0.1816	0.8183	4038	0.776
Mouse	0.866	0.14386	-1.246	0.8757	6.951	0.822
Second order consumer	0.776	0.2536	0.1968	0.8032	3.94	0.752
Lizard	0.669	0.40196	0.2689	0.7310	2.48	0.640
Snake	0.779	0.2497	0.1945	0.8054	4.00	0.762
Third order consumer	0.642	0.36816	0.2547	0.7452	2.70	1.669
Hawk	0.662	0.4124	0.27306	0.727	2.42	0.636

## 2. Dynamics of Ecosystems and Failure Rates

The various components of the ecosystems constitute an interacting system. They are connected by energy, nutrients, and minerals. The flow of energy on the other hand is in one way. Once used by the ecosystem it is lost. The continuous survival of the ecosystem depends on the flow of energy and the circulation of nutrients and minerals in the ecosystem. Thus the dynamic functions of the ecosystem include the following, marked by their failure rates and fuzzy grades of truth in table-6.

The hawk and vulture are disappearing in the ecosystem. The elements are represented by their failure rates, table -6 can yield a Fuzzy cardinality of

$$|A| = 15.982 \text{ and } ||A|| = 0.7991 \text{ at } \lambda = 0.2242663 \text{ and MTBF} = 4.458984 \quad (8)$$

The Security, availability, and risk may be found under the pollution hazards. All the elements in this Fuzzy system are mutually coupled and carry elementhood or Fuzzy grade of truth.

The explanation of the results in the above six spaces may be very difficult, but a life of failure cycle may be obtained due to pollution. The energy is consumed from the ecosystem and another energy is released to make a pollution. Thus failure rate is due to the pollutants.

## 3. Study of survival of organisms and limiting factors

In nature the growth of organisms is controlled by several factors. Some factors

inhibit the growth while others accelerate it. The biotic and abiotic factors which restrict the growth, reproduction, abundance, and survival of the organisms constitute limiting factors. The growth of plants is affected by various factors. The yield of crops is limited by some raw materials such as Boron, present in very small quantities besides other materials usually present in the large quantities. The growth and reproduction of an organism are dependent on the other factors that are present in minimum quantity in the environment. Light, temperature, and nutrients also required in limitation of minimum value. Carbon dioxide, phosphorus, and oxygen are chemical materials that must have a minimum limit of survival of organisms. In it, limiting substance is the mineral which is a nutrient relative to the requirement and not that which occurs in the smallest absolute amount. The factor interaction is also in the law of minimum conditions. According to this law, high concentration of some substances and action of factors may modify the rate of utilization of minimum nutrients and other factors. Organisms can tolerate same conditions to the highest degree, while in other cases slight change in condition affects, while in other cases slight change in condition affects the organisms. There is a range between the ecological minimum and maximum which is known as limits of tolerance. This is called tolerance ecology. For the successful development of an organism all the physical requirements must be present within the toleration limits'.

These problems can be solved by a Fuzzy logic using a Fuzzy system marked by a Fuzzy set of failures, assumptions, approximations in the theories and laws

made by several researchers. The organisms grow and reproduce well at a particular range of intensity of environmental factors, which is called as optimum condition. When the tolerance is in the field of intensities exceeding the upper limits maximum or minimum limit the organism is excluded from the environment.

The above narrative model can be fuzzified and then defuzzified according to their failures. One may explain it briefly using Fuzzy grades of truth.

$$|A| = \int \mu_{\hat{A}}(\lambda) d\lambda = 24.8 \quad (9)$$

$$\text{and } \frac{1}{n} \int \mu_{\hat{A}}(\lambda) d\lambda = 0.8266$$

$$\text{and } \lambda = \frac{\log_e \mu_{\hat{A}}}{A} = 0.1903513$$

$$\text{and MTBF} = 5.2534443 \text{ years.}$$

Every five years, the ecosystem is to repair maintenance will be required. The reliability of the ecosystem may be 82.66%

Table- 7

Fuzzy systems	$\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
Tolerance ecology	0.896	0.1098	0.9016	0.9016	9.107	0.887
Zone of tolerance	0.886	0.12.103	0.1072	0.892	8.262	0.866
Zone of intolerance	0.912	0.0921	0.084	0.9159	10.869	0.896
Organisms survival	0.776	0.2536	0.1968	0.8032	3.943	0.726
Optimum zone	0.908	0.0695	0.0876	0.912	10.362	0.892
The rate of growth production and survival of the organism are high and organisms						
Increase in number	0.896	0.1098	0.0984	0.9016	9.1074	0.886
The critical maximum	0.912	0.0921	0.084	0.916	10.857	0.906
It is the highest intensity of a factor at which the activity of the organism is retarded and the organisms come to a state of dormancy due to the physiological stress	0.889	0.1176	0.1048	0.8954	8.503	0.876
The critical minimum	0.866	0.14386	0.1246	0.8754	6.9512	0.836
It is the lowest intensity of a factor at which the activity of the organism slows down	0.926	0.0768	0.0712	0.9288	13.02	0.916
Below this intensity the organism may undergo a state of coma	0.892	0.11428	0.10194	0.898	8.75	0.889
The zone of tolerance	0.836	0.17912	0.0268	0.9731	15.582	0.812
When the intensity of an environmental factor is below critical minimum or critical maximum the organisms cannot survive	0.927	0.0758	0.07026	0.9297	13.1926	0.918
This high or low intensity of an environmental factor is called the zone of intolerance	0.892	0.11428	0.1024	0.898	8.75	0.889

There are fourteen elements and each is represented by the Fuzzy element hood depending on the failure rate as Fuzzy

set. The Fuzzy cardinality will be 12.414 and reliability 0.08867172 at the failure rate cardinality



$\lambda = 0.1202309$  and  
 MTBF = 8.3173271 years.

(10)

#### 4. Physical factors working as limiting factors

It is difficult to interpret these results. under the pollution hazards. After every eight years there may be a failure to get it repair or maintain it artificially or naturally.

Following physical factors show limiting actions for the survival or organisms in the modern ecosystem they have a sharp failure rate.

Table- 8

Fuzzy set	$\mu_{\tilde{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
Temperature	0.776	0.2536	0.1968	0.8032	3.9432	0.769
Water	0.969	0.0315	0.0305	0.9694	31.746	0.926
Radiations	0.886	0.121036	0.10723	0.8927	8.262	0.866
Atmospheric gases	0.892	0.1142	0.10194	0.898	8.756	0.886
Biogenic salts	0.912	0.0921	0.084	0.916	10.857	0.898
Currents	0.898	0.10758	0.0966	0.90338	9.2354	0.877
Fires	0.936	0.06613	0.06206	0.938	15.1217	0.926
Soils	0.947	0.0544	0.05156	0.948	18.382	0.918

Table- 9

Fuzzy set	$\mu_{\tilde{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
The sun	0.999	0.001	0.00099	0.999	9.999	0.9999
Energy radiation	0.896	0.1098	0.0984	0.9016	9.107	0.886
Plants growth	0.912	0.09211	0.084	0.916	10.856	0.896
Photosynthesis	0.886	0.121036	0.1072	0.892	8.262	0.867
Foods	0.779	0.2497	0.1945	0.8054	4.0048	0.762
Herbivores	0.736	0.3065	0.2256	0.774	3.262	0.716
Carnivores	0.569	0.5638	0.3208	0.6791	1.7736	0.549
Omnivores	0.892	0.11428	0.10194	0.898	8.7504	0.889
Death [Life]	0.912	0.09211	0.084	0.916	10.856	0.898
Microorganisms	0.956	0.045	0.043	0.957	22.222	0.936
Degradation of animals	0.796	0.2281	0.1816	0.8184	4.38	0.756
Degradation of all organisms	0.882	0.1256	0.1107	0.8892	7.961	0.863
Bacteria	0.936	0.06613	0.0619	0.938	15.121	0.906
Fungi	0.779	0.2497	0.1945	0.8054	4.0048	0.768
Algae	0.892	0.11428	0.10194	0.898	8.75043	0.869
Protozoa	0.768	0.26396	0.2027	0.7972	3.788	0.748
Viruses	0.892	0.11428	0.10194	0.898	8.75	0.879
Soil	0.932	0.07042	0.0656	0.9343	14.2	0.918

Table -8 is an example of survival of organisms. This is a baseless, fuzzification of such a essential set for without reference and contest of the points  $\mu$

$\hat{A}(\lambda)$   $\lambda$   $\lambda$  R, Sec, T and A. Fuzzy cardinality and MOM or COA method may help to decide a Fuzzy grade of truth.

$$\mu_{\hat{A}}(\lambda) = \int \mu_{\hat{A}}(\lambda) d\lambda = 0.668 = \|\hat{A}\| \quad (11)$$

$|\hat{A}|$  = Fuzzy humidity distance = 5.344. This will find an origin to measure the points in a vague space.

### 5. Dynamics of Ecosystem

One more dynamic of ecosystem space may be fuzzified in the uncertainty plane. The sun radiates the energy and received by the plants to make a photo synthesis which makes the sugar, proteins, carbohydrates, fats and several other foods. These foods are consumed by the deer, goat,

cow, elephants etc. These are called herbivores and consumed by tiger, lion, wolf etc. and called carnivores. The plants, animals and carnivores are eaten by human beings. One can fuzzify a set to find its life and failure rate of ecosystem.

Table- 9 has 18 elements that can contribute a fuzzy humming distance 145.414 and reliability 0.8563333 at the Fuzzy rate 0.1550936 and MTBF = 6.4477193 years. The sun can not be the element in this fuzzy set as being infinitely high compared to other elements. The sun as being infinitely high compared to other elements. The sun has a failure rate extremely small as compared to bio systems. The ecosystem has a dynamic reliability of 85%.

Table- 10

Fuzzy set	$\mu_{\hat{A}}(\lambda)$	$\lambda$	$\lambda R$	Sec	T	A
Carbon cycle	0.789	0.23698	0.18698	0.8130	4.227	0.766
Oxygen cycle	0.916	0.08773	0.08036	0.9196	11.3986	0.908
Nitrogen cycle	0.892	0.11428	0.10194	0.898	8.75	0.866
Water cycle	0.936	0.06613	0.061906	0.93809	15.121	0.916
Global water cycle	0.886	0.121036	0.10723	0.89276	8.262	0.866
Phosphorus cycle	0.866	0.1438	0.1246	0.8754	6.954	0.836
Sulphur cycle	0.779	0.2497	0.1945	0.8054	4.0048	0.766
Mineral cycle	0.896	0.10981	0.0984	0.9016	9.1066	0.886
Flow of energy	0.918	0.092114	0.08455	0.9154	10.856	0.898
Environment	0.896	0.10981	0.0984	0.9016	9.1066	0.876
Lithosphere [earth]	0.892	0.11428	0.10194	0.898	8.7504	0.879
Hydrosphere [water]	0.962	0.03874	0.03726	0.96273	25.83	0.957
Atmosphere [Air]	0.936	0.06613	0.061906	0.938	15.121	0.918
Biosphere [All]	0.926	0.07688	0.07119	0.9288	13.0072	0.908

Table - 10 above may represent a Fuzzy set with 14. Fuzzy elements of failure rate,  $\lambda$ , and their Fuzzy grades of truth  $\mu_{\hat{A}}(\lambda)$ . The Fuzzy cardinality of  $\mu_{\hat{A}}(\lambda)$ ,  $(\lambda)$ ,  $\lambda$  R, Sec, T and A may be found These may be solved using MOM and COA methods.

$$\mu_{\hat{A}}(\lambda) = \int \mu_{\hat{A}}(\lambda) d\lambda = 0.8921428$$

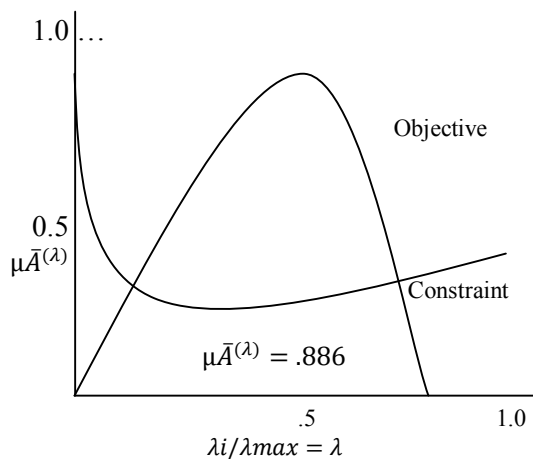
and  $|\hat{A}| = 12.49 =$  Fuzzy cardinality

$$|\hat{A}|(\lambda) = \frac{\int \mu_{\hat{A}}(\lambda) d\lambda}{\lambda d\lambda}$$

$$\mu_{\hat{A}}(\lambda) = \frac{\sum \mu_{\hat{A}}(\lambda) \lambda}{\sum \lambda}$$

$$\mu_{\hat{A}}(\lambda) = \frac{\sum \mu_{\hat{A}}(\lambda) \lambda}{\sum \mu(\lambda)} = \lambda$$

One may find the objective of  $\mu_{\hat{A}}(\lambda)$  and their constraint as the complementary function for a fuzzy plot. The intersection of the two curves will provide a fuzzy decision in Fig. 1.



**Fig. 1** Decision of failure of Ecosystem in Fuzzy space.

## DISCUSSION

One can measure the failure rate of water, air, earth, plants in the form of electrical parameters or the relative density. Melting point, thermal conductivity and viscosity of fluids or another space of the specific study of failure rates. The failure rates are calculated using large number of parameters such as Density, Melting point, Boiling Point, Specific heat capacity, thermal conductivity, electrical, resistivity, permittivity, permeability, quality factor [Q]} Critical temperature [CT] Critical pressure [CP] Critical volume [CV] Surface tension, viscosity etc. may be major parameters of ecosystem.

The density of water, air and soil is not the same today as compared to 100 years old ecosystems. The electrical resistivity of air, water and earth is the same as 100 Q.m. The dielectric constant of water is 81. The permittivity of earth is 15. The dielectric constant of air is 1.0056. The rate of failure of dielectric constant will be good parameter. The failure rates are estimated using density, resistivity, dielectric constant, inductivity and Q factor of the materials of air, earth and water.

One can use the physical, electrical, structural, mechanical, electro thermal electro physical, electronic and thermal parameters. One may find physical and effective parameters, and their difference in the ecological system. The pollution can be found when standards are compared with the results obtained in physical space and effective parameters spaces.

Failure rates may be natural due to energy flow forced outage rate due to forces of the society and pollution outage rate. The biosystems consume energy from the ecosystems and throw wastes in it causing a pollution. One may study the failure rates of ecosystems and biosystems. The society has also a failure rate and deterioration with the failure rate of the ecosystem. There is a great compatibility between ecosystem and the society. There may be the compatibility failures between the society and the ecosystems.

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