Fuzzy logical data mining and analysis of bamboo biomass knowledge engineering for energy happenstances

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Abstract

Fuzzy logical analysis engineers knowledge discovery in existing data to resolve bamboo biomass energy happenstances. The problems are large kilo tons of oil equivalents from biomass use needing engendering for production, and applications without adverse impacts on livelihood, biodiversity and economic development. Data gathering approaches are data mining methods of existing data from Food and Agricultural Organization.

Results in diagonal patterns show truth values of 0.54 and 0.46 for full and empty behaviours and other way around. Hypothesis 1 rejects null hypothesis and state a diagonal correlation exists between hectares of bamboo forests and species population.

Hypothesis 2 shows values in diagonal patterns with similar results that tend to break-even around 0.50. Therefore, reject null hypothesis and state a diagonal correlation exists between culms of bamboo forests and tons of yields. Encouraging creative understanding of bamboo biomass database management for economic development, livelihood and ecological sustainability gives conservation benediction.

Keywords: *Bamboo, biomass, data mining, fuzzy logics, energy, knowledge engineering*

1. Introduction

"If we truly want an innovative and creative renewable fuel industry then it needs to be challenged. And if we create a set of protections that allow it not be as creative and innovative as possible, then we aren't doing service to the industry or to the people of this country"—Tom Vilsack, 2006

The Union of Myanmar faces multiple fuzzy logical decision-making to engender economic development especially in the energy sector. There are fuzzy logical analyses that pervade systems, procedures, and strategies for finding solutions to energy challenges. The society does have multiple biomass energy uses with the goal of providing sustainable energy for its growing population, economy and to meeting Myanmar Millennium Development Goal 7, indicator 27 for sustaining natural environment, and improving energy efficiency.

There are large gaps in understanding how to minimize energy use costs, maximize energy use benefits and simultaneously sustaining ecological sanctification for economic prosperity. Green and traditional engineers, knowledge engineers, scientists, spatial managers, technologists, and politicians though have some common needs for energy, have different beliefs and understanding of how to acquire, store, transfer and apply benefits from this variable mix of energy.

Given some serious degrading global ratio of traditional energy uses, individual countries are looking for new and innovative ways of having a suitable mix of energy for sustainable livelihood and economic development. Given these background the Union of Myanmar proposes using more renewable energy resources over the years, but has already started using large volume of biomass resources. [10] Myanmar Millennium Development Goals Report (2006) shows high level uses of biomass (wood and charcoal) in the energy mix. Thus, the nation has proposals for minimizing the use of 9 per cent growth rate of crude oil by 2010 and develops renewable energy resources.

1.1 Research problems

Looking at economic development desires of the Union of Myanmar and needs for meeting Millennium Development Goals, sustainable ecological and economic improvement in energy challenges is manifold and tripartite. There are empowering needs for energy sector towards market economy, renewable energy uses and environmental sustainability. Resolving present trendy challenges would demand fuzzy logical reasoning and analysis which this study proposes would give a roadmap for resolving renewable energy uncertainty.

1.2 Research purpose

The objectives of this study are to:

1. Develop a fuzzy logical hypothesis for computing and testing solutions for stock of bamboo biomass energy problems;
2. Compute diagonal relationships between stock of hectares of bamboo forests and species population to inform decision-making;
3. Explain fuzzy classes of living-dry weight bamboo biomass above and below ground levels.

1.3 Model and hypothesis

The model for this study is a fuzzy rule to help analyze relationships between high bamboo biomass uses and uncertain rapid loss of culms and tons of yields in the long run. The model is:

IF Myanmar uses high biomass from bamboo forests without ecological replenishments
THEN Myanmar risks rapid loss of hectares of bamboo forests and species population as well as culms and tons of farm yields

The null hypothesis (H_0) and alternative Hypothesis (H_1) for each set of hypotheses are:

Hypothesis 1

H_0: *No diagonal correlation exists between stock of hectares of bamboo forests and species population*

H_1: *Diagonal correlation exists between stock of hectares of bamboo forests and species population*

Hypothesis 2

H_0: *No diagonal correlation exists between culms of bamboo forests and tons of yields*

H_1: *Diagonal correlation exists between culms of bamboo forests and tons of yields*

Hypothesis 3

H_0: *What is the degree of truth between above and below classes of biomass energy?*

The hypothesis for this study is to analyze relationships between bamboo biomass energy uses and risks that might cause deforestation and subsequent desertification among other things.

1.4 Study area

According to [10] Myanmar Millennium Development Goals Report (2006), Myanmar is former Burma with capital Yangon (Rangoon). Now new capital is Nay Pyi Taw. Myanmar is the largest nation in South East Asia with a land mass of 667,000 kilometres square of which 653,508 kilometres square is land cover and 23,070 is water inhabiting 55.4 million people (2006). The gender measure shows 49.7 per cent of males while females are accounting for 50.3 per cent. The society has over 100 racial groupings residing in 7 States and 7 Divisions.

The spatial arrangements of Myanmar show 936 kilometres from east to west, and 2051 kilometres from north to south. The nation has a coastline of 2229 kilometres. By means of 6151

kilometres, five countries share frontiers with Myanmar. These nations include China having 2205 kilometres, India 1339 kilometres, Thailand 2108 kilometres, Bangladesh 274 kilometres and Laos 225 kilometres.

The geographical coordinates of Myanmar is 22^0 00' north of the equator, and 98^0 00' east of the prime meridian.

The lowest elevation shows Andaman at 0 metres and the highest point in Myanmar is Hkakabo Razi having 5881 metres, which is the highest point in South East Asia. A principal feature for farming is the landscape of Irrawaddy river contrivances. Myanmar has fertile delta plain covering 47,000 kilometres square. The nation has two climates; the south west monsoon from July to September and north east monsoon from December to April.

About 50 per cent of Myanmar is covered with forests consisting of rubber, bamboo, ironwood, acacia, mangrove, coconut, teak, cinchona, betel palm, oak, pine, and many rhododendrons. The Union of Myanmar is a party to environmental agreements including biodiversity, ozone layer protection, tropical timber, climate change and desertification.

2. Literature review

[10] Myanmar Millennium Development Goals Report (2006) shows strategic desires and plans for developing energy sector to improve industrial development. The principal objectives illustrates Myanmar would implement bio-diesel to supplement traditional energy resources. It shows the nation would embark on conserving green and natural environment. Essentially, there is a need to understand some historical evidences of the development of fuzzy logics and unfolding disciplines that inform this study.

2.1 Learning some history and definitions

Fuzzy logical analysis stems from history as far back as the writings of Aristotle (384BC-322 BC) as he argues about relationships between science and logic. This philosophical apologetics gave rise to a scientific name—*2-value logics.* He propounds discussions on 2-value logics showing TRUE or FALSE responses to questioning. The TRUE or FALSE responses to reasoning and questioning conceive interrelationships between art, science, mathematics, philosophy, politics, economics and fuzzy logics. Modern day fuzzy logical analysis has a lot to honour the works of Aristotle and other ancient scholars.

However, [5] Gottwald (2010) shows fuzzy logics gain momentum when Lofti Zadeh in 1965 proposes fuzzy set theory. Other fuzzy logical theories include *3-value logics* dealing with problems by responding to needs for TRUE, FALSE or UNCERTAIN answers. *Finite value logics* argue scientific answers demand greater than 3 value responses to challenging decision-making. The fourth logical argument is *infinite value logics*, which explains problem-solving using fuzzy logics and probability distributions. Fuzzy logics direct this study by allowing creation of fuzzy hypothesis and rule for analysis in [1] Arabacioglu (2010) and [4] Gerla, 2006).

Fuzzy logics estimate fuzzy variables with true values that may vary between 0 and 1, similar to probability distributions. It relates to patterns of behaviour in logical computations and analysis of common sense knowledge and talents. These common sense and experiences represent uncertain, vague, ambiguous, inexact, and incomplete sets of data in decision-making for solving teething challenges. Though fuzzy logics and probability logics are not the same in interpreting issues, these are common in solving genuine ecosphere problems as [3] Blacino and Gerla (2002) and [9] Montagna (2001) show.

Biomass is a renewable energy (wood and charcoal) coming from plants and ecological resources. Biomass energy is an asset suitable for domestic, economic and industrial undertakings. The services it offers include cooking, heating, baking and so on, despite its use creates some costs to natural bionetworks.

While *data mining explains discovering novel and innovative ideas from existing data for solving problems*, knowledge engineering *is state-of-the-art uses of scientific knowledge with goal of optimizing energy happenstances.*

Learning about solving biomass malediction is similar to human cognition that stimulates behaviour to certain responses in specific environments. Hence, machine responses to

resolving biomass energy encounters are fuzzy psychologically interweaving, interlocking and intertwining. Thus, these interconnections demand solutions with logical paradigms to finding correlations and patterns in energy resources like bamboo biomass use behaviours for economic development Myanmar needs as [7] Masera, Drigo, Trossero (2003) discourse.

2.2 Biomass energy happenstances

Bamboo biomass energy happenstances need fuzzy logical analysis of data to help Myanmar consumes biomass in profitable and sustainable ways. [11] Food and Agricultural Organization (FAO) of the United Nations (2006) reports on Myanmar's notable biomass resources—Bamboo biomass. Although little data exist about bamboo biomass stock of vegetation in Myanmar, large stock of biomass resources exist. Technically, an enabling environment fosters growth of bamboo biomass forests resources serving as biomass energy inputs.

Theoretically, biomass has dual perspective definitions relating to whether these resources are either above or below ground levels. First, above ground level biomass includes living plants. For example, leaves, twigs, ferns, stumps, ropes, branches, mushrooms, rattans, spirogyras, barks, piassava fronts, grains, seeds, sawdust, foliage among other things.

Second, biomass resources below ground level include things such as roots larger than 2 millimetres in size, because below this statistics someone cannot logically distinguish such roots from soil components. [11] FAO (2006) illustrates Myanmar exports 170 metric tons of bamboo shoots at price between US$210 and US$600 per metric ton.

[7] Masera, Drigo, and Trossero (2003) show biomass as energy resources having mixed outcomes, with diverging consequences and ambiguous understanding since there are two main constraints—land uses and biomass farm yields—can cause daunting challenges. Even when land is available, with good watered ecologies, and suitable environment interacting with some limiting factors including crop production, greening ecologies, and ecotourism can be counterproductive from mismanagement.

These resources include bamboo, and some other renewable resources including solar and hydroelectric energy supplies, despite some inherent challenges to contend with in energy uses. Even so, if these resources do not undergo fuzzy logical analysis for suitable answers, population contingent on these energy resources could have livelihood and economic challenges as a consequence.

[12] Trossero (2002) shows rippling effects on climates and biodiversity should be taken seriously, as costs on climate, environment and economy can be life-threatening. For instance, food production and animal husbandry influence one another leading to adverse impact as in [2] Berndes, Hoogwijk, and van den Broek (2003).

[6] Hoogwijk, Faaij, Van den Broek, Berndes, Gielen, Turkenburg (2002) show biomass energy happenstances suggest multiple outcomes needing fuzzy logical decision-making that are important since there are no single dimensions to reducing fossil fuel uses while increasing bioenergy consumptions.

[8] Masera, Ghilardi, Drigo, and Trossero, (2006) argue an innovative and diverse ways on understanding situations of optimizing biomass uses is to help remove side effects of biomass medicine to cure climate change and bionetwork challenges. An understanding of spatial patterns for managing biomass for economic growth, ecological sustainability and curing energy needs demand careful strategic planning and formulating appropriate energy mix variables.

3. Methodology

Discovering knowledge from data mining of bamboo biomass offers varying perceptions of information. There are needs to determination of these problems by looking at correlations and patterns of behaviours from biomass energy resources for realistic harnessing of renewable energy to solve energy problems.

3.1 Data Mining Approaches

Data mining in this study involves collecting data from [11] FAO (2006) among others for calculations and analysis. The energy statistics of

Myanmar in these documents offer energy consumptions from 1981 up to 2005 for each period. There is a set of energy consumption using fuzzy logical values helping analyze and calculate data. This undergoes normalization of data using a new fuzzy value.

$$\textit{New fuzzy value} = \textit{One-} \frac{\textit{Initial and or later value}}{\textit{Total value}}$$

The normal new fuzzy value should be between 0 and 1. These are essential because they help cancel effects of bias data as well as hidden values that influence results adversely. This research model utilizes hypotheses for accurate analysis and testing of results.

3.2 Fuzzy systems knowledge engineering

The fuzzy systems of knowledge engineering works by setting particular rule for helping data mine and discuss findings. These analyses are on certain basis relating to issues for examination. The rule variables include fuzzy input and output for analysis and discussions of findings, fuzzy sets of rules to engender model building and hypothesis, and fuzzy inference systems help extrapolate and interpret results. The fuzzy rules help develop fuzzy concepts to use in hypothesis testing in this form:

IF *feature* IS *asset* THEN *accomplishment*

Hence, bamboo biomass relationships analysis might look like these:

IF relationship IS diagonal THEN improve hectares of bamboos forests and species population

IF relationship IS diagonal THEN increase culms of bamboo forests and tons of bamboo yields

IF degree of truth value IS 0.8 for above ground level definitions THEN maintain level

IF degree of truth value IS 0.2 for below ground level definitions THEN maintain level

IF relationship IS unlike THEN replace biomass with other renewables.

4. Results and Analysis

The model and hypotheses in section 1.3 and new fuzzy value formula in section 3.1 are features to consider in creating fuzzy rule and calculations. The existing data and calculations of fuzzy values for analysis are in tables below.

4.1 Tabulation and calculations

There are *three periodic tables* for tabulating and calculating data. Testing hypothesis 1 helps ascertain diagonal relationships between hectares of bamboo forests and species population. The fuzzy logical calculations are in Table 1.

Table 1. Biomass stock of bamboo forests

Periodic details	Area (hectares)	Species population
1981-1990	9,553,731	42
1994-2004	8,050,940	49
Total	17,604,671	91
Full	0.54	0.46
Empty	0.46	0.54

Source: [11] FAO (2006) **Note:** Microsoft Excel 2010

Testing hypothesis 2 is to reveal diagonal relationships between net yields of culms and tons of stock of bamboo biomass in Table 2.

Table 2. Net yields of stock of bamboo forests

Periodic details	Culms	Tons
1981-1990	15,301,217,520	164,001,035
1994-2004	14,741,723,120	166,532,269
Total	30,042,940,640	330,533,304
Full	0.51	0.50
Empty	0.49	0.50

Source: [11] FAO (2006) **Note:** Microsoft Excel 2010

Answering hypothesis 3 demands fuzzy logical analysis of findings as in Table 3.

Table 3. Classes of living dry-weight bamboo

Ground level definition	Metric tons (million)			Total	Degree
	1990	2000	2005		
Above	159.54	169.86	175.03	504.43	0.8
Below	43.08	45.86	47.26	136.20	0.2
Total	202.62	215.72	222.29	640.63	1.0

Source: [11] FAO (2006)

4.2 Analysis of findings

Table 1 shows a falling trend from 1981 through 1994 to 2004 in hectares of bamboo forests, a rising trend of species population for biomass. Similarly, in Table 2, a falling trend happens for net culms, and a rising trend of tons of biomass stock of bamboo forests in Myanmar.

In *testing hypothesis 1* stating no diagonal correlation exists between hectares of bamboo forests and species population, the study would use last two rows in Table 1. These show areas in hectares and species population for analysis. In 9 years some mean hectares of stock of bamboo biomass forests is about 9.5 million and in 10 years is around 8 million.

There is a falling change from 1991 to 2004 in 14 years. The fuzzy logical analysis shows 0.54 for full feature for hectares of stock of forests during 1981-1990 and 0.46 shows reduction for empty feature over other activities including harvesting biomass forests, and or desertification in next 14 years.

The bamboo species population shows a similar fuzzy logical rising trend. Looking at the four variables in fourth and fifth rows in diagonal patterns, 0.54 behaviours unify the two variables in certain ways to show how input variables correlate. Also, 0.46 shows similar answers for same two input variables indicating tangential relationship between hectares of stock of bamboo forests and species population. Thus, this study reject null hypothesis, and state there is a *diagonal correlation between hectares of bamboo forests and species population.*

The *testing of hypothesis 2* uses fourth and fifth rows in Table 2, which states how null hypothesis has no diagonal correlation between culms of bamboo forests and tons of yields. That is, net culms and tons of bamboo biomass show similar fuzzy logical results. Fuzzy logical analysis shows a fall from 0.51 to 0.49 for culms, and equal value of 0.50 per tons of yields.

Looking at these four values in diagonal patterns someone could infer similarity in results even though variables tend to break-even around 0.50 suggesting strong options for alternative hypothesis. Therefore, this study reject null hypothesis and state there are positive *diagonal correlation between culms of bamboo forests and tons of yields.*

Fuzzy logical analysis in Table 3 shows classes and definition of biomass with rising trends in biomass above and below ground levels. Biomass potentials in Myanmar undergo this analysis to show patterns of degrees of truth to explain mathematical vagueness of results in fuzzy logics for solving problems.

Hypothesis 3 tests question about degrees of truth between above and below classes of bamboo biomass energy resources in Myanmar. The answer to this analysis is in Table 3 that shows if aggregate classes of biomass resources is equivalent to 100 million metric tons per annum, then above ground level definitions of biomass disaggregate to 80 million metric tons a year and disaggregation for below ground level definition is 20 million metric tons per annum.

4.3 Scientific and practical applications

Studies involving fuzzy logics, data mining and energy arouse scientific interests, practical applications to validate international response and utility for real world problems-solving. The model suggests if the Union of Myanmar uses high biomass energy mix from bamboo forests, then Myanmar risks rapid loss of culms and tons of yields and subsequent deforestation.

Chemical elements with energy components has diagonal relationships, which suggest strings of energy flows diagonally from elements with lower atomic energy to higher in *Periodic Table* with opposing properties. For example, as one analyses diagonal relationship between boron and silicon, the revelations are these elements share similar size, electronegativity and opposing impact in the periodic table in crosswise patterns.

The components, structures, properties and reactions show water hydrolyses these resources. These elements could form semi-conductors, halides and acidic oxides. By analysis, horizontal opposing effects increase electronegativity, covalence and acidity. Vertical downward flows of resources decrease electronegativity, increase basicity and iconicity across the periodic table.

First, Table 1 shows strong bonding between hectares of bamboo stock of biomass and species population in testing hypothesis 1. The nation

stands risks of losing vital energy resources—bamboo forests if strategic polices and control mechanisms are not set to check and balance energy mix.

Fuzzy logically, as hectares of bamboo forests decreases over the years in horizontal patterns species population rises to have similar size of 0.54. The corresponding effects happen when species population horizontally increases, allowing hectares of bamboo forests adjust to have similar value of 0.46 for stock of bamboo in the periodic table. Analytically, results suggest understanding diagonal relationships between hectares of bamboo forests and stock of species population according to *hypothesis 1*.

Second, Table 2 shows similar bonding with respect to *hypothesis 2*, suggesting total yields of stock of bamboo biomass over same period. As culms of bamboo falls in horizontal manner, tons of bamboo yields adjust to have similar size of 0.50 and another way around for increases in tons of stock of bamboo over the years. *Hypothesis 2* therefore tests and verifies diagonal relationships between yields of culms and tons of bamboo biomass.

Finally, Table 3 analyses degrees of truth by scientifically applying *hypothesis 3*. Thus, fuzzy logical analysis shows diagonal relationships are in correspondence with Paretto principle, where 80 per cent of million metric tons of above ground level definitions get supports from 20 per cent of below ground level definitions of bamboo biomass in the Union of Myanmar.

5. Conclusion

Fuzzy logical analysis helps nations learn about challenges of energy uses especially involving mix of renewable energies. Renewable energy contributions across the world are gaining attention considering continuous occurrences of climate changes partly because of overuses of traditional energy resources. The degrading impact would be high for fauna and flora if careful management of bamboo forests and other biomass resources are not comprehensive.

The results of this study clearly rejects the null hypotheses and state that there are tangential relationships between hectares of bamboo forests and species population on one hand, and between culms of bamboo forests and tons of yields on the other hand. The answers to analysis show if aggregate classes of biomass resources is equivalent to 100 million metric tons per annum, then above ground level definitions of biomass disaggregate to 80 million metric tons a year and disaggregation for below ground level definitions are 20 million metric tons per annum. It is therefore essential to educate and encourage people for biomass production and uses in sustainable ways.

5.1 Recommendations

This study promotes essential use of fuzzy logics in data mining for analysis of bamboo biomass energy for better energy services for sustaining national economy and environment in Myanmar. Some recommendations include:

1. Promoting development of systems and mechanisms to foster appropriate renewable energy mix for national development;
2. Greening and conserving bionetworks where energy uses maximize without adversely damaging natural resources including plants and animals;
3. Reforestation of bamboo and other forests materials for energy production;
4. Engendering database management systems for variable areas of biomass resources to make and use energy in an accountable manner and enable people to use these resources in user-friendly manners;
5. Formulate and apply strategic policies for enhancing development and sustainability of energy production and efficiency in conserving natural resources;
6. Making efficient uses of renewable energy including hydroelectric, solar, waves, wind, geothermal, and other renewable resources;
7. Providing understanding of biodiversity, climate change, and application of energy;
8. Research and develop sustainable baskets of innovative ideas to improve bioenergy resources development across the country;
9. Develop further strategies, policies and plans for harnessing above listings of energy resources in Myanmar, and;

10. Provision and transfers of skills for energy development and training for sustainability and creativity in energy sector in general and biomass in particular.

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Biography

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Rising behind mountains: Spicy poems and juicy African stories at www.trafford.com/06-1829
Business unusual: Deleting corporate baggage and excess fat at www.trafford.com/06-2304
My shadow at www.voicesnet.org/displayonepoem.aspx?poemid=82749
Dear tripartite at www.voicesnet.org/displayonepoem.aspx?poemid=98027

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