IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 21, Issue 5, Ser. I (Sep - Oct 2019), PP 17-24
www.iosrjournals.org

Simulation Model to Determine the Severity of Corruption Level in Adamawa State Civil Service using Fuzzy Logic and Matlab Codes

Manga, I.[1], Salaat, A.B[2]
[1](Department of Computer Science, Adamawa State University, Mubi, Nigeria)
[2](Department of Computer Science, Federal Polytechnic, Mubi, Nigeria)
Corresponding Author: Manga, I.

Abstract:-*This paper titled simulation model to determine the severity of corruption in Adamawa State civil service identifies various forms of staff corruption. despite numerous anti-corruption strategies that have been put in place to curb corruption, such as Economic and Financial Crime Commission (EFCC), Independent Corrupt Practices Commission (ICPC), Police Code of Conduct Bureau (PCCB), Police Service Commission (PSC), the X-Squad Unit and Public Complaint Bureau (PCB), it remains difficult to reduce corruption within the sector. This paper analysed the inadequacies of the anti-corruption strategies and attempted to develop a simulation model based on fuzzy logic for the control of corruption in Nigeria power sector. The researcher employed fuzzy rule-base inference system methodology using four inputs variables: funding, logistics and operational equipment (FLOE) condition of service, remuneration and motivation (CSRM); recruitment, training and promotion (RTP); confidence and support by the community (CSC); were used to determine the corruption severity level. An output variable: corruption severity level (CSL) was adopted for the model development. The simulation was carried out using MATLAB Windows. The results revealed that it is very obvious for Nigeria as a country to have power sector whose corruption severity level is low. Thus (i) condition of service, remunerations and motivation has to be excellent; (ii) funding, logistics and operational equipment has to be adequate; (iii) recruitment, training and promotion has to be excellent, and finally (iv) confidence and support by the community has to be very high.*

Keywords: - *Corruption, Fuzzy logic Model, Simulation, MATLAB*

Date of Submission: 29-08-2019 Date of Acceptance: 14-09-2019

I. Introduction

One of the major setbacks to economic and political development of any nation is corruption. Nigeria, corruption has become the order of the day happening among the young populace. The growing concern that corruption within the civil service remains difficult to manage, despite numerous anti-corruption strategies that have been put in place to fight corruption, it remains difficult to reduce corruption within the civil service. The present system, which involves the anti-grafts agencies such as Economic and Financial Crime Commission (EFCC), Independent Corrupt Practices Commission (ICPC) and other institutional bodies. Different scholars from social sciences, psychology, political sciences, and religious studies have attempted a working definition for corruption from their various disciplines. However, all of the working definitions are interwoven [13]. In everyday use, corruption is a term which conveys an element of moral disapproval. Salisu [4] simply defined corruption as the misapplication of public resources to private ends. This among others include the public officials collecting bribes for issuing permits licenses for authorizing passage of goods at sea/airport, passports or visa, for awarding contracts or for enacting regulations designed to create artificial scarcity, awarding undeserved score or grades to students after exam, availing question papers to students before examination, and at times it may come in the form of sexual or other forms of gratifications. The World Bank has defined corruption as "the abuse of public office for private gain" (World Bank, 1997). Additionally, Transparency International (TI) defined corruption as "the misuse of entrusted power for private benefit" (Pope, 2000). In a more legal form, [6] defined corruption as "an abuse of position or inducement of an abuse of position for an undeserved benefit, advantage or relief".

[3] In their report advocate that corruption is a destructive and complex practice is openly acknowledged in Nigeria, yet it remains ubiquitous in the functioning of society and economic life. The consequences of corruption for the country and its people are, moreover, indisputable. Acts of diversion of federal and state revenue, business and investment capital, and foreign aid, as well as the personal incomes of

Nigerian citizens, contribute to a hollowing out of the country's public institutions and the degradation of basic services. All the same, corruption is perhaps the least well understood of the country's challenges.

It has been estimated that close to $400 billion was stolen from Nigeria's public accounts from 1960 to 1999, (UNODC, 2017) and that between 2005 and 2014 some $182 billion was lost through illicit financial flows from the country (Global Financial Integrity, 2017). This stolen common wealth in effect represents the investment gap in building and equipping modern hospitals to reduce Nigeria's exceptionally high maternal mortality rates – estimated at two out of every 10 global maternal deaths in 2015; (WHO, 2015) expanding and upgrading an education system that is currently failing millions of children; (UNICEF, 2017) and procuring vaccinations to prevent regular outbreaks of preventable diseases.

President Muhammadu Buhari has shown sincerity in his commitment to lead anticorruption efforts in Nigeria, including through strengthening whistleblowing incentives and protections, high-profile investigations of prominent individuals for large-scale theft of public funds, and the recovery of billions of naira by Nigeria's anti-corruption agencies. These efforts are essential, but cannot by themselves foster a sustainable, comprehensive reversal of long-established assumptions and practices in the absence of a decisive shift in public apathy and a collective will to achieve collective behavioural change. Nigeria's ongoing anti-corruption efforts must now be reinforced by a systematic understanding of why people engage in or refrain from corrupt activity, and full consideration of the societal factors that may contribute to normalizing corrupt behaviour and desensitizing citizens to its impacts. This holistic approach would better position public institutions to engage Nigerian society in anti-corruption efforts.

[8], Analysed corruption in Africa using Nigeria as a case study. They identified that corruption is alien to Africa and that a sizable number of African pre-colonial nations – states were founded on strong ethical values ensuring social justice and compliance. They also argue that colonialism imported corruption to Africa and by extension Nigeria. Their paper explains corruption from different perspectives and concluded that corruption is innate and deep seated in Nigeria particularly in the public sector. The paper then identified non – conformity religious tenets, values, culture, ethnicity, favouritisms, nepotism and weak legal systems among others as the causes of corruption in Nigeria. Thus the paper finds four factors as the costs of corruption in the country – political, economic, social and environmental. Finally, the paper put forward nine points as possible options and frame-work for curbing corruption in Nigeria, thus restoration of indigenous values and institutions, re-educating the citizens through formal, informal and non-formal education, adopting religion as a national building institution, promotion of the Africa "nation" state, strengthening anti-graft institutions, establishing anti-corruption court, autonomy of ant-graft agencies with supporting legislations, improve standard of living through provision of health care, education, food security and infrastructure.

II. Related Work

[10] in their paper they have studied the topic for measuring and removing corruption from the society by using mathematical modelling. They observed and concluded that the real world problem is "corruption" from the society they convert this problem in to mathematics problem then they get some models such as "Mathematical Corruption Model, Mathematical Corruption Control Model, Mathematical Corruption-Development Model, Mathematical Development Model and Mathematical E-virus Constant Model". They are used for measuring as well as removing the corruption from the society of any country of the world. Schleifer (1993) shows that the effect of corruption on the economy is nonlinear and bounded by a corrupt-free output and a subsistence level of output. Since every government agent in an economy will not leave the productive sector to become corrupt, some level of output will be produced.

[5] Studied Administrative corruption by Providing a fuzzy inference system of good governance to combat corruption. The study aims to propose a comprehensive model to measure the administrative corruption through a widespread study in the review of literature of previous studies. In the study the definition of fuzzy systems of effective factors on administrative corruption including predictive variables of a good governorship of a world bank like: comment right and responding, political stability, lack of violence, the effectiveness of government, the quality of regulations, the authority of law and the control of corruption have been used. All various dimensions of a good governorship to fight against the corruption were used as an input of the fuzzy inference system and of corruption as an output of a system. Afterwards, the membership dependencies and fuzzy rules, the fuzzy inference system for measuring the administrative corruption was designed by using good governorship indicators. Finally, the output of the model was compared with the experts' opinion. Also rule formation was extracted by applying the opinion of five university professors. The results of the study showed that the results of experts' opinion and those of the fuzzy inference system were close together and this represents a high validity of a system. The study concludes that the validity lies in the identification of appropriate units of measurement for predicting. the study units of measurement were extracted from the World Bank

[11] used epidemic diffusion model by [13] and studied corruption as an epidemic phenomenon. The framework of the model has allowed the study of corruption dynamics and the statement of a threshold epidemiological theorem of corruption. The study revealed that an epidemic corruption occurs when the number of corruptible surpasses the threshold.

[9] developed a mathematical model of corruption and study the stability analysis of the transmission dynamics of corruption in a population with a constant recruitment rate, standard incidence rate and effort rate against corruption. The study revealed that the corruption free equilibrium is globally asymptotically stable if the reproduction number (R_0) $R \leq 1$, and globally asymptotically stable endemic if $R_0 \geq 1$. The numerical simulations were also carried which further uphold the analytical results and further revealed that corruption can only be reduced to a bearable level but not totally eradicated.

[12] employed the use of Fuzzy Logic Control (FLC) methodology to design a system for the determination of severity level of Osteomyelitis in adults and children. He stated that Fuzzy models have the capability of recognizing, representing, manipulating, interpreting, and utilizing data and information that are vague and lack certainty in which medical field is not an exemption. In his model, he used four input (pain, swelling, fever and age) and one output (severity level). Multiple Input Single Output (MISO) rules fuzzy controller was designed and implemented, and will provide a valid fuzzy inference system that will determine the severity level of Osteomyelitis based on identified factors (input variables). The system developed will allow users to input symptoms in natural language term and not precise values and will make computer interaction easier by using linguistic variables which facilitates human description using natural language. The results show that work tries to eliminate the error-prone conclusion in decision making by modelling and developing several input cases, rules and the implementation.

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III. Methodology

The data for this study was obtained from both primary and secondary sources. The primary sources were obtained from experts' opinions which include Police officers and legal practitioners. The secondary sources include Journals, Reports, Newspapers, Textbooks, Conference papers.

Mamdani type fuzzy inference technique was used in this paper. The technique is performed in steps:

i) fuzzification of the input variables: done by the fuzzification module, which translates crisp inputs into fuzzy ones; that is, classical measurements are converted to fuzzy values through the use of linguistic variables;
ii) application of the Fuzzy operator and formation of rules for evaluation: done by a set of if-then fuzzy rule bases or knowledge bases, consisting of a set of conditioned fuzzy propositions;
iii) aggregation of the rule outputs: done by the fuzzy inference engine which has a specific inference method—here the Mamdani type. It applies fuzzy reasoning mechanisms to obtain outputs and carries out the computation using fuzzy rules;
iv) defuzzification: done by a defuzzification module which transforms fuzzy outputs back to crisp values.

An expert system is a computer program that helps in solving problems demanding substantial human expertness by using explicitly exhibited domain knowledge and computational decision procedures. These are designed to make available some of the skills of an expert to non-experts, as they attempt to imitate the thinking patterns and logical decisions of an expert. The FES makes use of the theory of fuzzy reasoning [14]. Fuzzy inference is the process of developing the mapping from a given input to an output using fuzzy logic which then offers a base from which decisions can be made or patterns perceived. The classical logic has only two truth values, true or false, and so the process of inference is simplified as compared to fuzzy logic, where we have to be concerned not only with propositions but also with their truth values. Every FES has a fuzzy inference system that reasons using fuzzy logic membership functions, which refers to the degree to which the value of a particular attribute belongs to a set. The FES designed and employed in this research can be generalized by means of a simple structure as shown in Fig.3.1 below

The FES developed in this research employs the Mamdani type fuzzy inference technique. This technique is performed in four steps:

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Defuzzification: done by a defuzzification module which transforms fuzzy outputs back to crisp values

The fuzzifier converts the crisp inputs which are supplied to the system to fuzzy inputs and also determine the degree to which these inputs belong to each of the appropriate fuzzy sets. These fuzzy inputs are then used in the inference engine to generate fuzzy outputs. For developing control tool for corruption in NPF, data is required that is capable of representing the menace as well as the severity of the corruption. Basically the data consists of opinion of the experts, corruption reports, journals, and other secondary sources. By consulting the experts and by analysing the data from the other sources mentioned four attributes were considered and used as the inputs variables for determining the corruption severity levels. Fuzzy values were assigned for each of these input variables to get different fuzzy sets based on the expertise of the specialists and knowledge from the standard textbooks and journals. Triangular membership function was adopted for both inputs and output variables to simplify computation. The membership function parameters for the input variables and the membership function plots for the input variables and the output variable is given below:

i) Condition of Service, Remunerations and Motivation (CSRM) having linguistic variables and parameters as follows: Poor [0 2 4], Moderate [2 4 6], Good [4 6 8] and Excellent [6 8 10].

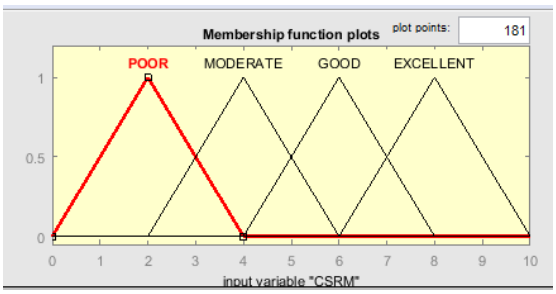

Fig. 3.1: Membership function for Condition of Service, Remunerations and Motivation (CSRM)

ii)Funding, Logistics and Operational Equipment (FLOE), having linguistic variables and parameters as follows: Inadequate [0 2.5 5], Relatively adequate [2.5 5 7.5], and Adequate [5 7.5 10]

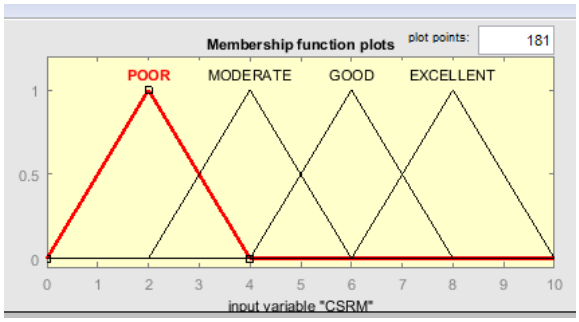

Fig. 3.2 Membership function for Funding, Logistics and Operational Equipment (FLOE)

ii) Recruitment, Training and Promotion (RTP), having linguistic variables and parameters as follows: Poor [0 2 4], Fair [2 4 6], Good [4 6 8] and Excellent [6 8 10].

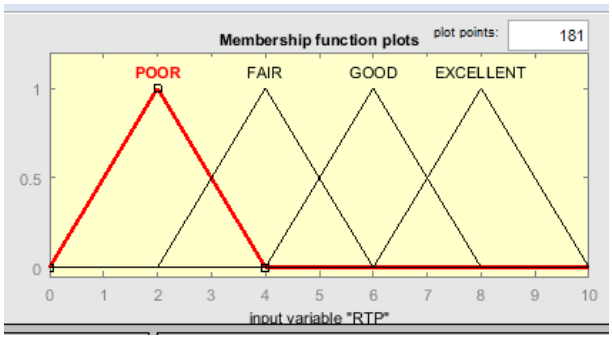

Fig. 3.3: Membership function for Recruitment and Training Promotion (RTP)

iii)Confidence and Support from Community (CSC), having linguistic variables and parameters as follows: Low [0 2 4], Moderate [2 4 6], High [4 6 8] and Very High [6 8 10].

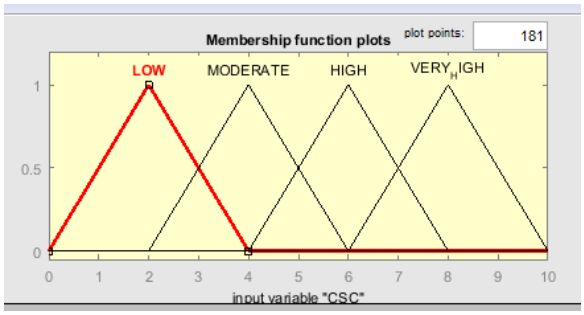

Fig. 3.4: Membership function for Confidence and Support by the Community (CSC)

iv) The output variable Corruption Severity Level (CSL) parameters are defined based on the linguistic variables which are High [15 22.5 30] corruption level, Low (7.5 15 22.5) corruption level and Very low (0 7.5 15) corruption level.

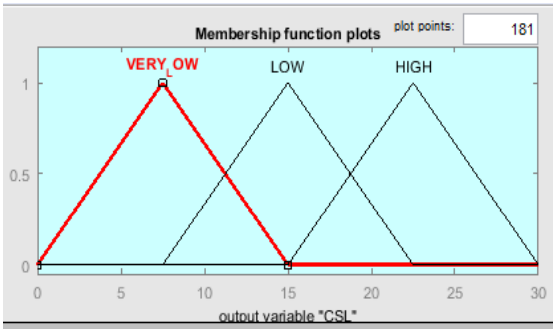

Fig. 3.5 Output membership function showing severity levels of corruption

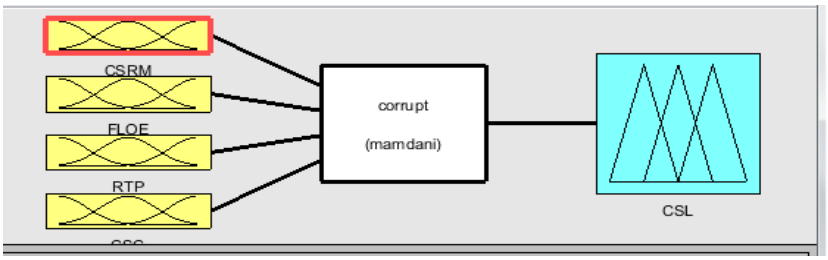

Fig. 3.6: Multi-input Single Output Corruption Control Model.

IV. Result And Discussions

Recall the output parameter Corruption Severity Level (CSL) is defined on the basis of the linguistic variables Very high (15 – 30) level corruption, High level corruption (7.5 – 22.5) and Low-level corruption (0 – 15). On the other hand, we have four input parameters defined as follows:

i. CSRM with linguistic variables Poor (0 - 4), Moderate (2 – 6), Good (4 – 8) and Excellent (6 – 10).
ii. FLOE with linguistic variables Inadequate (0 – 5), Relatively adequate (2.5 - 7.5), and Adequate 5 – 10)
iii. RTP with linguistic variables Poor (0 – 4), Fair (2 – 6), Good (4 – 8) and Excellent (6 – 10)
iv. CSC with linguistic variables Low (0 – 4), Moderate (2 – 6), High (4 – 8) and Very high (6 – 10)

It is clear from figure 4.2 a, that when the condition of service, remuneration and motivation (CSRM) is poor (0-4) and funding, logistics and operational equipment (FLOE) is inadequate (0-5), then the corruption severity level (CSL) becomes very high (15-30). Also, if CSRM is good (4-8) and FLOE is relatively adequate (2.5-7.5), then obviously the corruption severity level will be low (0-15). In the situation where the CSRM is excellent (6-10) and FLOE is adequate (5-10), then the corruption severity level will also be low.

In figure 4.2 b, if the recruitment, training and promotion (RTP) is poor (0-4) and funding, logistics and operational equipment (FLOE) is inadequate (0-5), then the corruption severity level (CSL) will be very high (15-30). If the RTP is fair (2-6) and FLOE is relatively adequate (2.5-7.5), then the corruption severity level will be low (0-15). The CSL will also be low if the RTP is excellent (6-10) and FLOE is adequate (5-10).

In figure 4.2 c, If the confidence and support by the community (CSC) is low (0-4) and funding, logistics and operational equipment (FLOE) is inadequate (0-5), then the corruption severity level (CSL) will be very high (15-30). If the CSC is high (4-8), but FLOE is relatively adequate (2.5 – 7.5), the CSL will be low. The CSL will also be low if CSC is very high (6-10) and FLOE is adequate (5-10).

In figure 4.2 d, if recruitment, training and promotion (RTP) is poor (0-4) and condition of service, remuneration and motivation (CSRM) is also poor (0-4), then the corruption severity level (CSL) will be very high (15-30). If RTP is fair (2-6) and CSRM is good (4-8), the CSL will be low. CSL will also be low if both RTP and CSRM are excellent.

In figure 4.2 , if confidence and support by the community (CSC) is low and condition of service, remuneration and motivation (CSRM) is also poor (0-4), then the corruption severity level (CSL) will be very high (15-30). If CSC is high (4-8) and CSRM is good (4-8), then the CSL will be low. Also if CSC is very high (6-10) and CSRM is excellent (6-10), then CSL will also be low.

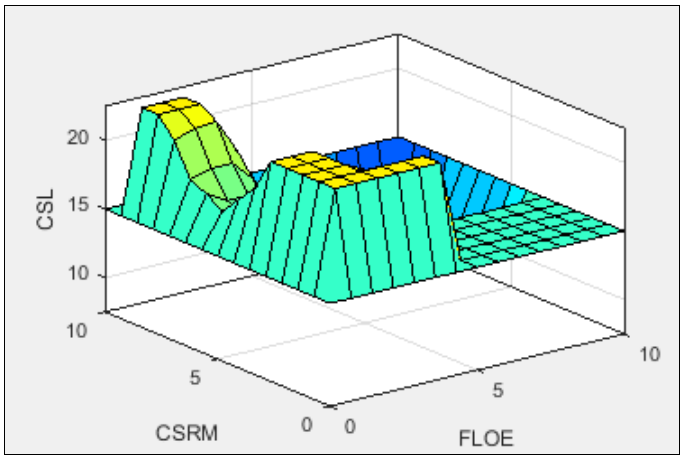

Fig: 4.2 a. Surface viewer plot for FLOE versus CSRM

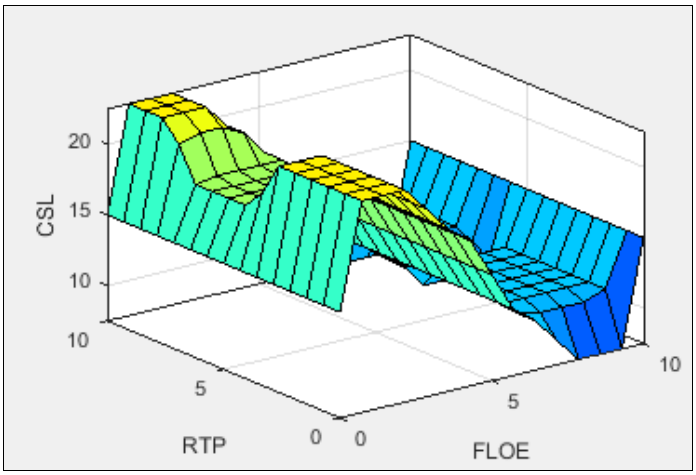

Fig: 4.2 b. Surface viewer plot for FLOE versus RTP

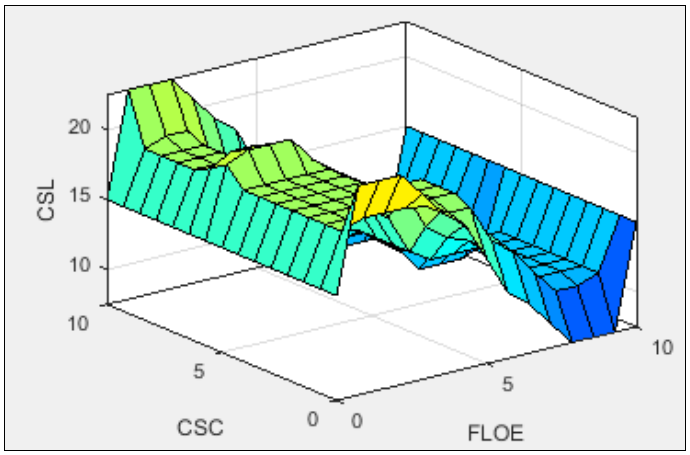

Fig: 4.2 c. Surface viewer plot for FLOE versus CSC

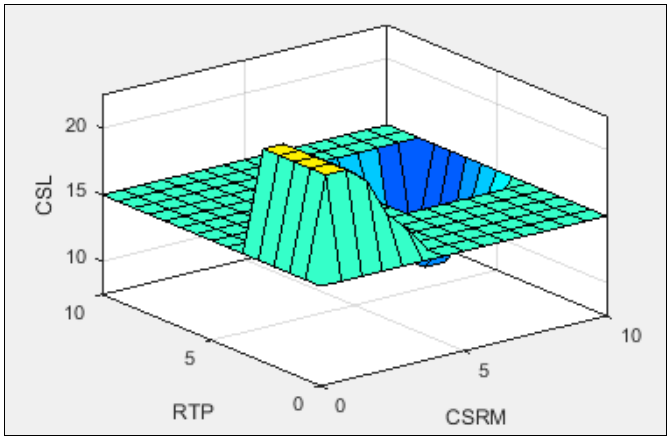

Fig: 4.2 d. Surface viewer plot for CSRM versus RTP

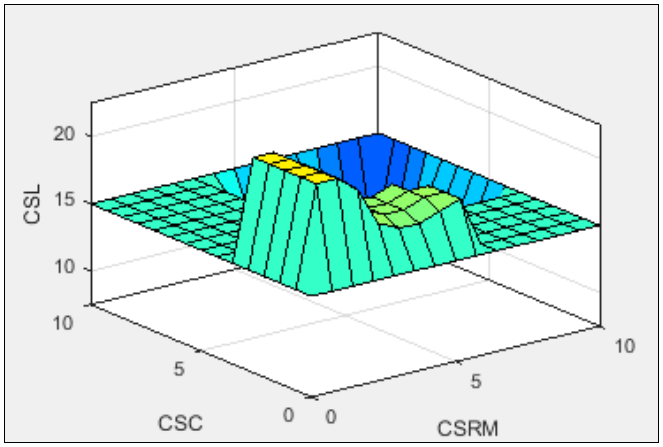

Fig: 4.2 e. Surface viewer plot for CSRM versus CSC

V. Conclusion

This research work aimed to develop system architecture for the determining severity of corruption inAdawawa state. The researcher employed fuzzy rule-base inference system methodology. Four inputs variables; funding, logistics and operational equipment (FLOE) condition of service, remuneration and motivation (CSRM), recruitment, training and promotion (RTP), confidence and support by the community (CSC) were used to determine the corruption severity level. An output variable; corruption severity level (CSL) was adopted for the model development. The simulation was carried out with MATLAB 2015 for windows. The Variables SCRM, RTP and CSC were compared against FLOE as depicted in figures 4.2 (a, b, c, d and e) and discussed in section 3 .The results revealed that it is very obvious for Adamawa state to have a civil service whose corruption severity level is low then:

i) Condition of service, remunerations and motivation has to be excellent or at least good;
ii) Funding, logistics and operational equipment has to be adequate or at least relatively adequate;
iii) Recruitment, training and promotion has to be excellent or at least good, and finally,
iv) Confidence and support by the community has to very high or at least high.

References

[1]. A.Schleifer & R.W. Vishny. (1993). "Corruption." The Quarterly Journal of Economics: 599-617.
[2]. J. Pope. (2000). *Transparency International Source Book 2000: Confronting Corruption: The Element of a National Integrity System 13*. Online available from http://www.transparency.org/content/download/2439/14493/file/sourcebook.pdf.zip
[3]. L. K. Hoffman & R. N. Patel (2017). Collective Action on Corruption in Nigeria A Social Norms Approach to Connecting Society and Institutions Great Britain: The Royal Institute of International Affairs, http://www.chathamhouse.org
[4]. M. Salihu. (2000).Corruption in Nigeria. Lancaster University Management School Working Paper 2000/006. The LUMS Working Papers series
[5]. M. Morteza,M. T. Gholamreza & R. Hamed. (2013) Administrative corruption: Providing fuzzy inference system of good governance to combat corruption. *13th Iranian Conference on Fuzzy Systems (ICFS)*. Qazvin, Iran: IEEE Online available [Accessed November 12, 2017]
[6]. O. N. Ogbu. (2008) "Combating Corruption in Nigeria: A Critical Appraisal of the Laws, Institutions, and the Political Will," *Annual Survey of International & Comparative Law*: Vol. 14(6) Available at: http://digitalcommons.law.ggu.edu/annlsurvey/vol14/iss1/6
[7]. O.Olagungu. (2012), Corruption Control in Nigeria: Holistic Approach". *Advances in Arts, Social Sciences and Education Research*. 2(1):76-84.
[8]. P. O. Okolo & A. O. Raymond. (2014) Corruption in Nigeria: The Possible Way Out Global *Journal of Human-Social Science* 14 (7) USA: Global Journals Inc
[9]. S.Hathroubi and H. Trabelsi (2014) Epidemic Corruption: A Bio-economic Homology. *European Scientific Journal* 10(10) Online available [Accessed September 2 2017]
[10]. S.R. Waykar. (2013) Mathematical Modelling: A comparatively Mathematical Study Model Base Between Corruption and Development. *IOSR Journal of Mathematics.;6(2),54-62*.
[11]. S. Abdurahman. (2014). "Stability Analysis of the Transmission Dynamics and Control of Corruption". *Pacific Journal of Science and Technology*. 15(1):99-113
[12]. U. T. Maigari. (2016) Fuzzy based system for determining the severity level of osteomyelitis in adults and children. Unpublished MSc Thesis, Adamawa State University Mubi.
[13]. W. O. Kermack & A. G. McKendrick (1927). Contributions to the mathematical theory of epidemics. *Proceedings of the Royal Society of Edinburgh. Section A. Mathematics.*11,.700-721.
[14]. L. A. Zadeh, (1983). Making computers think like people. IEEE Journal - Spectrum. 1984;8(1), 26-32.

IOSR Journal of Computer Engineering (IOSR-JCE) is UGC approved Journal with Sl. No. 5019, Journal no. 49102.

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