International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

# Decision Support Based Dry-Land Irrigation using Fuzzy Routing Protocol in WSN (DDI-FRP)

**Jayashree Agarkhed, Vijayalaxmi Kadrolli, Siddarama Patil**

***Abstract:*** ***In Agriculture Sector wireless Sensor Network (WSN) made new trends in the production of crops. One such new trend is Dry-Land Agriculture especially Pigeon Pea irrigation (Normally known to be Red Gram). This article presents Decision Support Based Dry-Land Irrigation By Using Fuzzy Routing Protocol system(DSBDL). It regulates the desired different parameter like soil tempt (ST), PH , water holding capacity(Whc) and Electric conductivity(Ec) values from sensors and transmits the data by using Fuzzy Routing Protocol and Decision Support System for making the decision of fertilization of Pigeon-Pea crop, which resembles the humanlike skill. This leads to the use of a cost-effective system for the awaited yield. The Proposed Fuzzy routing including multipath is employed to enhance the execution of network in terms of energy consumption, lifetime, routing overhead and end to end delay to communicate the information effectively toward the Sink. The proposed approaches simulated results shows better performance than existing protocols and facilitate user to get the application of fertilizer for crop production accurately.***

***Index Terms:*** ***Cluster Head (CH), Fuzzy Routing Protocol (FRS), Pigeon-Pea, Agriculture.***

## I. INTRODUCTION

With the increase in the residents and the corresponding decrease in rainfall, there is a real deficiency of food and rainwater –which are the most common basic needs of life. Hence, the precision agriculture [1] importance has become a vital point to the researchers. In most of the nations, the economy of the family depends on agriculture earning, and so productive agriculture is of primary importance on the producer. Latest agriculture with WSN can be represented with this scene; it reduces agricultural costs and increases productivity. The importance of WSN in the agriculture are especially for the crop of red-gram in significant areas of India, is the Pigeon-Pea (customarily known as Red Gram) pulses. A multi-objective parameter monitoring scheme is devised with the help of wireless communication technology to make the automotive system .WSN consist of a large number of heterogeneous or homogeneous capable sensor nodes scattered over an environment. Processing component processes the collected data that broadcasts it through a fuzzy routing protocol. The implanted devices are the sensor nodes that are proficient of acquiring the signal, handling the messages, transmitting, routing of data, and executing computation tasks. Wireless sensor nodes collected the real data and transferred to the base station through the internet with different sensors which senses soil temperature, soil PH, liquid retaining water holding capacity, and Electric Conductivity Ec. Data is received, saved, decision support System will analyze the parameter and infer what decision is to be taken based on the parameters received and displayed at the remote user [1, 2] For forwarding the data from sensors to sink, it uses the fuzzy routing protocol with clustering concept. Instead of transmitting data by a separate node to sink nod, cluster head (CH) elected by neighboring nodes is used to transmit the data in WSN. The different QoS parameter considered are end to end delay, network overhead, and PDR, etc. The method proposed includes clustering concept and cluster head selection is done by fuzzy logic, and multipath is used to process the data. The purpose of this work is to enhance the performance of energy, delay, and PDR of a network. The simulation outcome confirms that this approach performs much better than the existing protocol. WSN divides the network into several clusters and from this; the network lifetime can be increased. Cluster member transmit data to their respective CH, and then sends collected data to the sink node. Clustering avoids large range transmission of sensor nodes to BS or Nodes. Even with incomplete data, Fuzzy logic is used to make real-time judgment. Fuzzy logic systems, manage the scientific rules. Furthermore, it can be used for identifying different parameters, and suggestion for the cluster head and also for the decision support system. Proposed work for Decision support for Dry Land Agriculture by using optimized fuzzy based routing is shown in section III. The results analysis and simulation are discussed in Part IV, and also in section V, the conclusion is presented.

## II. LITERATURE SURVEY

Management of farming concerns a difference of judgment executing queries with high possibility because multiple parameters can influence crop productivity.

Revised Manuscript Received on 22 May 2019.
* Correspondence Author
**Jayashree Agarkhed*,** professor in the Computer Science and Engineering Department at Poojya Doddappa Appa College of Engineering, Gulbarga, Karnataka, India
**Vijayalaxmi Kadrolli,** currently Research Scholar of Computer Science and Engineering department at Poojya Doddappa Appa (PDA) college of Engineering, Kalaburagi, Karnataka, India
**Siddarama Patil,** Professor and Dean Academics at Poojya Doddapa Appa College of Engineering, Kalaburgi, Karnataka, India

The different influences are, such as usage of applying proper pesticides, usage of irrigation, conceiving the essence of the problem remarkably compelling. Farmers do agriculture without consideration of the earlier parameter like soil properties and if deficiency found, what are all the actions to be taken. Recommendation of fertilizer is not specific to the soil, and are applied everywhere. It causes financial entanglements due to huge cost investment and loss of yield. The inorganic fertilizers and pesticides come from the environment that creates scattered roots of pollution wherever manure are not required[1,2] and supplementary fertilizers are used if they found deficiency. A deficiency of components like Nitrogen (N), Potassium (K) are considered and are most significant effect on soil degradation.

In [2,3] the author stated a smart design for wireless sensor network to collect the data from nodes in an agriculture scene. And then investigate accepted data and results are revealed to its outcome users. In [4,5], the author introduced application by using wireless sensor networks for farming of potato that it observes and explains to the individual crop and provisions. Consequently, farmers can recognize different fertilizers, irrigation, and other necessities. It is here recommended an irrigation administrators prototype to determine farming parameters applying scientific computations with rational humidity sensors. Computers or PDA are used as monitoring display. In [6], the authors added a smart system utilizing sensor to detect moisture and temperature of soil in a red bayberry greenhouse. The humidity, temperature, illumination and other parameters are collected by the system. To monitor the system, GPRS gateway is employed for transmission of data. Solar and storage batteries provide the energy of sensors. On a sugar farm [7] proposed a novel method for providing energy efficiency to the solar system by using WSN. In [8] the author presents, the routing protocol based on cluster methodology which confirms remarkably increase the network lifetime. For monitoring the fier, Group-based energy efficiency concept is utilizing WSN is presented [9]. In [10, 11], the author manifests cluster approach on fuzzy logic and extending to the energy prediction and hence lengthen the network lifetime and also scattering the workload equally.

In [12] authors discuss on cluster-based routing optimization methods in DSNs through Bayesian arrangements. To elect cluster heads, the BN based approach is used. This strategy combines the energy, bandwidth of individual node and link efficiency of the link and also thus reduces overhead [13].

In multipath Routing protocol [14, 15], a key point to be addressed is on multiple successful paths. To do this, it is advised that, first considering them to build a tree-like structure that carries nodes between beginning and target. In multipath focus is given on the quality of services. Protocols manage to minimize transportation overhead and increase loyalty in various paths.

In the stated effort, the network is divided in to clusters to avoid overlapping of groups and increasing lifetime of the sensor. Each cluster should have a CH node. The CH node election is based on a combination of different parameters such as residual energy, delay, and path loss, and the chance value indicates the chance of becoming CH in a network.

Most of the existing protocol has not used the combination of bandwidth, Residual Energy, Delay, Packet loss to selects multiple paths to give efficient data transmission through the nodes and best shortest path finding which offers different services. Our effort is enthused by observing the limits of the existing routing protocols.

## III. PROPOSED SYSTEM

This section explores, the system architecture, cluster creation by neighboring nodes with cluster head election utilizing fuzzy logic by the inferences rules, fuzzy membership functions, and DSS wit rules are used to take the further decision which too is displayed on the Mobile.

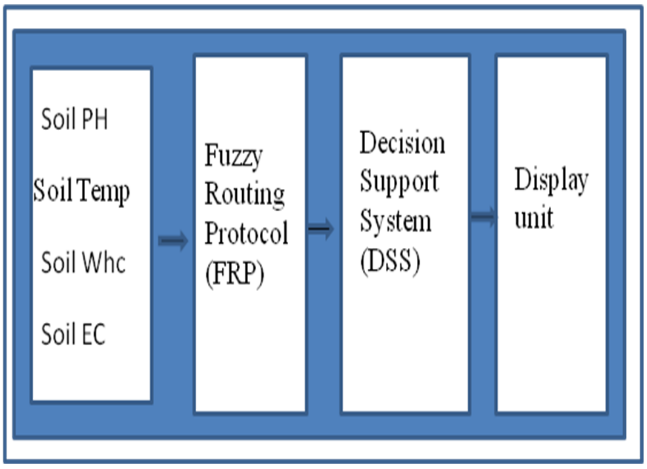



Fig 1. The Proposed System Architecture

**Phase I:** In this phase, the different sensor like soil ph detection sensors, soil WHC detection sensors, and detection of soil EC are used. The sensor is used in the scene to sense and for data collection. SO that required parameters are identified for the red gram crop soil quality. The work has more benefit for farmers, so they succeed in reducing the time, energy and costs. System nodes will collect data, and transmits this data to sink through fuzzy routing protocol in effective and efficient manner.

**II: Phase** The proposed scheme consists of a collection of sensor nodes and are arranged randomly. The system design consists of the subsequent phases.

1.CHs selection for every closer in a network and data transfer to sink node.

2.It is assumed that all nodes in the system are static and sensor nodes are computing the routing path across the CHs.

3.Each node senses data periodically and send it to the CH and transmits the data to the sink.

Fuzzy Inference is based on a non-linear input-output mapping [16,17,18] process. FLS works with_fuzzy a set that continues the idea of crisp sets. A membership function is used as a characteristic for fuzzy set. The fuzzy systems has four components :

(1) The fuzzifier being crisp facts into fuzzy sets by employing the membership functions,

(2) The fuzzified contents receive the fuzzy rules The collection of IF-THEN statements are used as rules.

(3) The fuzzy inferring engine combines the fuzzy precepts to get an aggregated fuzzy output.

(4) Conclusively, the de-fuzzifier outlines the fuzzy production that can be used for obtaining decisions .

- Rules of Fuzzy Inferences

Fuzzy inferences are used in taking the logical decision .Consider di be the distance between nodes in the network. Euclidian Distance is used for calculating the di given by Eq. (1).

$$di = \sqrt{(x_1 - x_2)^2 +} \quad (1)$$

- **Fuzzy Membership Function**

The defined membership function for the proposed work is as shown in the table I.

Table I. Fuzzy Membership Function

| Input parameter | Input fuzzy parameter | Membership function |
|---|---|---|
| RE | Low($L_E$),Medium($M_E$),Heigh($H_E$) | Trapezoidal |
| Disatance(d) | Low($L_d$),Mediul($M_d$), Heigh($H_d$) | Trapezoidal |
| Packe Loss(PL) | Low($L_{PL}$),Medium($M_{PL}$),Heigh($H_{PL}$) | Trapezoidal |

- ***Fuzzy sets of input parameter***

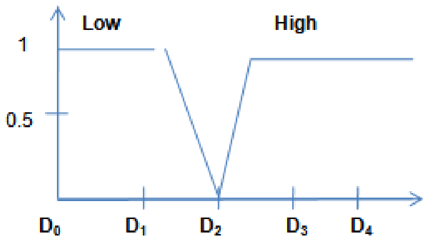



Fig 2. Fuzzy set - distanc

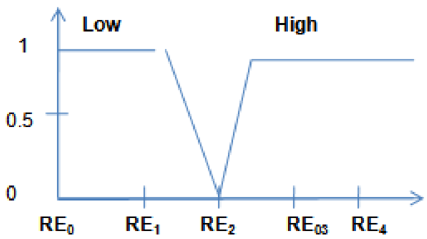



Fig 3. Fuzzy set -- residual energy

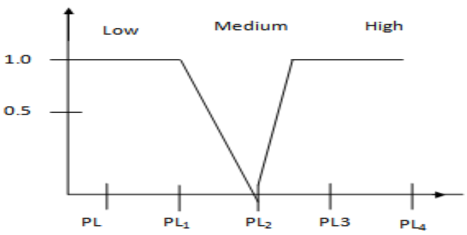
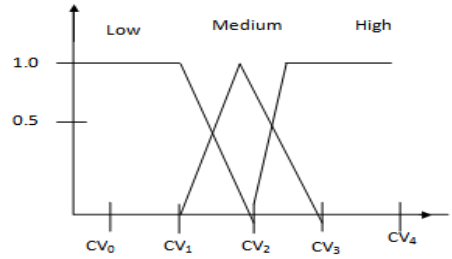



Fig 4. Fuzzy set -Packet Loss




5. Fuzzy set of output Chance Values

The fuzzy membership functions and fuzzy rules, are shown in fig. 2 and fig. 3 and table I and table II respectively

TableII. Fuzzy Membership values

| S.No | Distance(d) | Resicual Energy(RE) | Packet Loss(PL) | CV (Chance Value) |
|---|---|---|---|---|
| 1 | $L_d$ | $M_E$ | $H_{PL}$ | $M_{CV}$ |
| 2 | $L_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 3 | $L_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 4 | $M_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 5 | $M_d$ | $L_E$ | $L_{PL}$ | $W_{CV}$ |
| 6 | $M_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 7 | $H_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 8 | $H_d$ | $L_E$ | $L_{PL}$ | $W_{CV}$ |
| 9 | $H_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 10 | $L_d$ | $M_E$ | $H_{PL}$ | $M_{CV}$ |
| 11 | $L_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 12 | $L_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 13 | $M_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 14 | $M_d$ | $L_E$ | $L_{PL}$ | $W_{CV}$ |
| 15 | $M_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 16 | $H_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 17 | $H_d$ | $L_E$ | $L_{PL}$ | $W_{CV}$ |
| 18 | $H_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 19 | $L_d$ | $M_E$ | $H_{PL}$ | $M_{CV}$ |
| 20 | $L_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 21 | $L_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 22 | $M_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |
| 23 | $M_d$ | $L_E$ | $L_{PL}$ | $W_{CV}$ |
| 24 | $M_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 25 | $H_d$ | $H_E$ | $H_{PL}$ | $H_{CV}$ |
| 26 | $H_d$ | $L_E$ | $L_{PL}$ | $W_{CV}$ |
| 27 | $H_d$ | $M_E$ | $M_{PL}$ | $M_{CV}$ |

## IV. DATA DIVIDING PROCEDURE FOR SUCCESSFUL PATH

Assume there is Kp will be multiple routes [3] of source to sink. For example divide the original packet in Kn-mini packets to a number of equal numbers of sub packets. These Kn mini-packets continue communicating through separate Kn multiple paths from source to destination. For the reconstruction of the original message, sink requires all kn mini-packets. Successfully build the original word only be done if all k mini-packets reach to sink successfully. But if sink receives less than k sub-packets, then it is needed to retransmit the lost sub-packets from source to sink. The original message is built entirely in the sink node is possible only after receiving the retransmission of the missing packets. The data diving procedure is explained below:

Assume that to send a data packet from a source to destination, and forms the routes which result in $k_n$ different paths. Each path has some rate (Pi = 1, . . . , kn) that resembles to the possibility of successfully transferring a information to the destination corresponds to a reconstructed Bernoulli analysis, the in-the sub-run corresponding to the message delivery in the path.

Consider Sk: {0, 1}kn-> Nn denote the random variable for the number available routes. (For Sk, each sub- run is labeled a 1 if it has successful transmission along with the respective route, and 0 if it failed. Then, Sk depicts the sum for the sub runs and Sk k.) Then, the expected total number of successful paths is given by Ek. The number of lost packets by below equation.

$$EK = max\left\{Xu\sqrt{\sum_{i=1}^{k} Pi(1-Pi) + \sum_{i=1}^{k} Pi}\right\} \quad (2)$$

This Ek delivers successful path. Then from here, w indicates number of lost packets

This Ek delivers successful path. Then from here $W_L$ will be the number of lost packets

This Ek delivers successful path and lost packet resend them through different paths. Destination node regains all the packets. The proposed Data Diving method minimizes traffic overhead and congestion in the network.

**System Algorithm:**

---------------------------------------------------------

Step 1. Nodes are deployed randomly

Step 2. Calculate required distance

Step 3. Calculate expected residual energy

Step 4. Get expected packet loss

Step 5. Evaluate residual energy, bandwidth and packet loss as parameter using Fuzzy

Step 6. CH is selected based on the chance

Step 7 In CH is not selected relpeat step4

Pass the request to next node and repeat step through step 6

end if CH sends the data DSS

Step8 DSS: Agriculture Decision Support System

Step 8.1. PH value, WHC , EC and Temp are all in the range as shown in the III best crop , no fertilization is needed and very best quality crop

Step 8.2. If PH value is less and Whc, EC and Temp are in the not in the range then decision is to give fertilization which balances the PH value parameter and poor crop

Step8.4.If PH value is less and Whc ,EC and Temp is less in the range then decision is to give fertilization which balances the PH value parameter very poor crop

Step 8.6. If PH, Whc, EC and Temp are not in the range then worst crop and all deficiency supplement has to be applied

Step 9.0.The decision is displayed on the display device

---

**Table III. The range of values for different parameter for Red Gram crop in dry land Irrigation**

| Sr No | Parameter | Range |
|---|---|---|
| 1 | Temperature | 26 to 30 |
| 2 | PH | More than 5 |
| 3 | Ec | 450MicroS |
| 4 | Whc | 15-200 mm for 2m soil |

## V. SIMULATION

Simulations are conducted out for 10 iterations with NS-2 Tool. This section presents the simulation model, performance parameters, and outcomes and discussions

Network model: It is here considered an area of 500*500 square meters for WSN. A network consists of number of randomly deployed sensor nodes.

The communication of packets is expected to happen in discrete time at intra and intercommunications.

The subsequent performance parameters were used in the proposed scheme:

1) Average Throughput: It is the relationship between the number of packets sent to the number of packets received successfully. It is denoted in percentage (%).

2) Average Energy consumption: The total amount of the energy that is spent during transmitting and receiving of data sensor devices.

3) Average End to End Delay: It is the total time needed for the movement of the packet from the source to the destination.

4) Average Normalized Over Head:

**Packet Drop:**

| Time | FRP | DAAPTEEN |
|---|---|---|
| 175 | 53 | 150 |
| 200 | 60 | 168 |
| 225 | 72 | 205 |
| 250 | 85 | 234 |
| 275 | 94 | 261 |

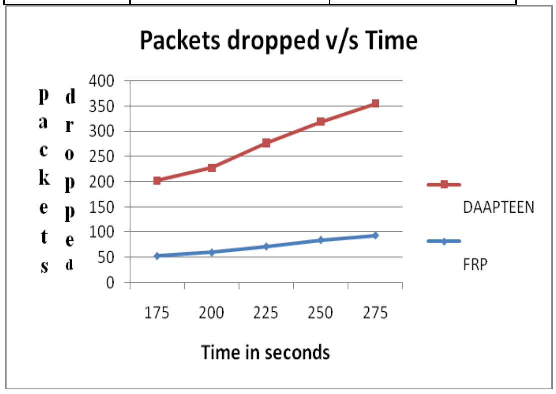



Fig 6.Packet dropped vs Simulation Time

The fig. 6 depicts the Average number of packets dropped with different simulation times in WSNs. The increase the number of selection of CH nodes based on the fuzzy chance having high plat loss probability combination will be selected and ignoring the lowest probability CH selection and transformation of data to the sink .So it achieve the end to end delay as compared to the existing protocol. The proposed DSBDL system will get less delayed message at the remote location

**PDR:**

| Time | DAAPTEEN | FRP |
|---|---|---|
| 175 | 97 | 96.2143 |
| 200 | 97.1618 | 96.3834 |
| 225 | 97.2632 | 96.2105 |
| 250 | 97.0547 | 96.0557 |
| 275 | 97.125 | 96.0833 |

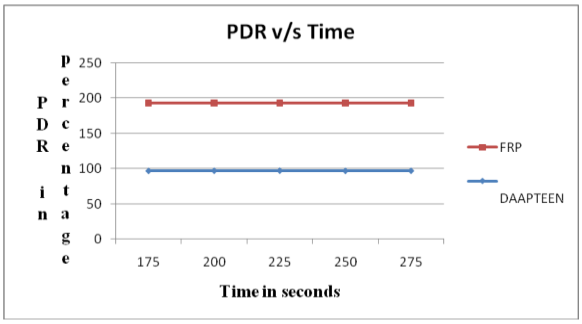



Fig7. PDR v/s Simulation Time

The fig. 7 presents PDR with simulation time in WSNs. The PDR increases, as the simulation time Increases in the networks. The proposed FRP approach is more effective than the DAAPTEEN protocol because CH choice is based on the highest probability concerning residual energy, distance and packet lass among CH nodes in the routing path. But in the existing protocol, it is used to select the_CHs randomly in the network, which appears in the limited optimal choice of CHs more and PDR is less.

**Overhead:**

| Time | FRP | DAAPTEEN |
|---|---|---|
| 175 | 9.60972 | 10.0319 |
| 200 | 9.35985 | 9.76861 |
| 225 | 9.25866 | 9.71171 |
| 250 | 9.19412 | 9.58309 |
| 275 | 9.08837 | 9.53426 |

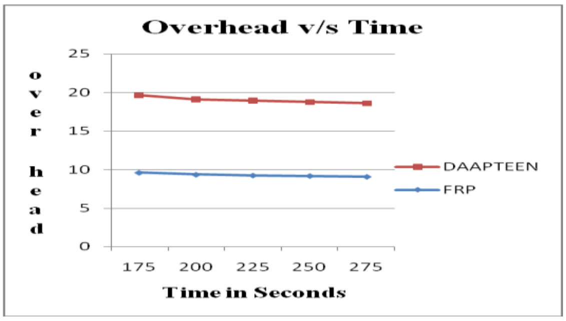



Fig 8.Routing Overhead vs Simulation Time

Figure 8 represents Routing Overhead with different simulation time as a function of Reporting Rate. As the number of packets in traffic in the network increases, then the routing overhead further progresses respectively. When it moves ahead, the traffic in the network slightly moderates, so the the overhead gradually comes down .The Proposed FRP shows the comparative improvement is the overhead reduction as compared with the existing protocol DAAPTEEN and by this the proposed protocol reach the data to the remote location without overhead.

**Delay:**

| Time | FRP | DAAPTEEN |
|---|---|---|
| 175 | 0.00437 | 0.0048455 |
| 200 | 0.00439 | 0.004834 |
| 225 | 0.00438 | 0.0048452 |
| 250 | 0.00439 | 0.0048459 |
| 275 | 0.00437 | 0.0048478 |

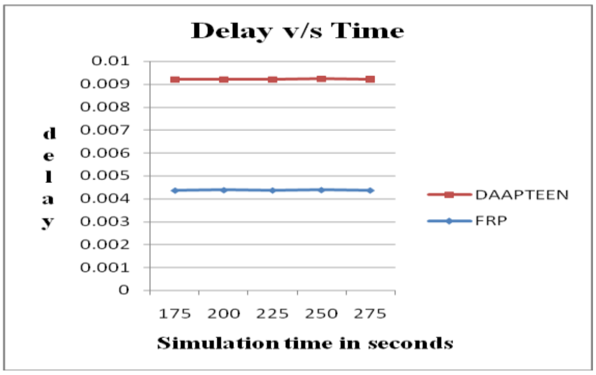



Fig 9. End to End delay v/s Simulation Time

The fig. 9 depicts the Average End to End delay with number with different simulation times in WSNs. The increase the number of active nodes based on the fuzzy chance having heigh probability combination will be selected and ignoring the lowest probability CH and transformation of data to the sink .So it achieve the end to end delay as compared to the existing protocol. The proposed DSBDL system will get less delayed message at the remote location.

## CONCLUSION

The proposed system designed is mainly a Agriculture decision support system for dry land irrigation by using WSN which is energy efficient in route selection and responding efficiently with proper decision to network system in optimized way. It includes sensing of the different parameter of soil and with the consideration of the successful path to the destination. The sensed data of the Soil PH ,tempt, Ec and Whc parameters are sent to the sink through FRP where fuzzy logic is used to select better CH selection for energy efficiency and also providing decision what type of actions to be taken for deficiency of different parameter. The Proposed work perform better as compared with the existing approach. The successfully received data from the sink are then preceded to DSS for analyzing and for taking the decision of fertilization. As compared to existing protocol the proposed model FRP executed better.

## .REFERENCES


1. Awasthi, A., & Reddy, S. R. N. (2013). Monitoring for precision agriculture using wireless sensor network-a review. *Global Journal of Computer Science and Technology*.
2. Kiani, F., & Seyyedabbasi, A. (2018). Wireless sensor network and internet of things in precision agriculture. *Int. J. Adv. Comput. Sci. Appl*, *9*(8), 220-226.
3. Biermacher, J.T.; Brorsen, B.W.; Epplin, F.M.; Solie, J.B.; Raun, W.R. The economic potential of precision nitrogen application with wheat based on pla sensing. Agric. Econ. **2009**, 40, 397–407
4. Aubert, B.A.; Schroeder, A.; Grimaudo, J. IT as enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology. Decis. Support Syst. **2012**, 54, 510–520.
5. G. Mendez, M.A. Yunus and S.C. Mukhopadhyay. "A WiFi-based smart wireless sensor network for monitoring an agricultural environment ".IEEE Conference in Instrumentation and Measurement Technology Conference (I2MTC), pp. 2640-2645, 2012
6. K. Shinghal and S. Neelam. "Wireless Sensor Networks in Agriculture: For Potato Farming". Available at SSRN: https://ssrn.com/abstract=3041375, 2017.
7. X. Jianfa. "An environment monitoring system for precise agriculture based on wireless sensor networks". IEEE International Conference Mobile Ad-hoc and Sensor Networks (MSN), pp. 28-35, 2011.
8. P. Milind. "H2E2: A hybrid, hexagonal & energy efficient WSN green platform for precision agriculture". IEEE 12th International Conference on Hybrid Intelligent Systems (HIS), pp.155-160, 2012.
9. Bager. Z, Mohammad. Z, Vahid. M., N, "A Novel Cluster Based Routing Protocol in Wireless Sensor Networks", International Journal of Computer Science Issues, vol. 7, no 1, pp. 32 -36, 2010
10. Young.g., H, Heemin. K, Yung. C., B, "Energy Efficient Fire Monitoring Over Cluster Based Wireless Sensor Networks", International Journal of Distributed Sensor Networks, vol. 2012, pp. 1-11, 2012.
11. Ali. N, Faezeh. S., B, Abdul. H., Z, "A New Clustering Protocol for Wireless Sensor Networks using Genetic Algorithm approach", Journal of Wireless Sensor Network, vol. 3, no. 11, pp. 362-370, 2011
12. Hemavathi. N, Sudha. S, "A Fuzzy Based Predictive Cluster Head Selection Scheme for Wireless Sensor Networks", In proceedings of 8th International conference on Sensing Technology, pp. 560-566, 2014.
13. Lokesh B.B, Nalini. N, "Cluster Based Optimization of Routing in Distributed Sensor Networks using Bayesian Networks with Tabu Search", International Journal of Electronics and Telecommunications, vol. 60, no. 2, pp. 199-208, 2014
14. AbdulAlim, M. A., Wu, Y. C., & Wang, W. (2013). A fuzzy based clustering protocol for energy-efficient wireless sensor networks. In *Advanced Materials Research* (Vol. 760, pp. 685-690). Trans Tech Publications.
15. Rogaia. M, Nauman. A, William. P, Frank. C, "An Energy Efficient Fuzzy Logic Cluster Formation Protocol in Wireless Sensor Networks", In proceedings of 3rd International Conference on Ambient Systems, Networks and Technologies, vol. 10, pp. 255 – 262, 2012.
16. [Maryam. J, Abolfazl. T., H, "A Routing Algorithm based on Fuzzy Clustering and Minimum Cost Tree (FCMCT) in Wireless Sensor Network" Journal of Advances in Computer Research, vol. 5, no. 3, pp. 113-123, 2014.
17. Sachin Sharma, Dharmendra Kumar and Rajesh Kumar,"QOS-Based Routing Protocol in WSN" Department of Electronics & communication, KIET, Ghaziabad, India; Department of Physics, SMIT, Sikkim, India
18. Ke Guan, Li-Ming He, "A Novel Energy-Efficient Multi-Path Routing Protocol for Wireless Sensor Networks," School of Information Engineering Chang'an University, Xi'an, China, ,School of Information Engineering, Chang'an University, Xi'an


## AUTHORS PROFILE

Dr. Jayashree V. Agarkhed Currently working as professor in the Computer Science and Engineering Department at Poojya Doddappa Appa College of Engineering, Gulbarga, Karnataka, India. She received the BE degree from Gulbarga University, Gulbarga, Karnataka, India M.Tech. and Ph. D degree from Visveshwaraya Technological University, Belagavi, Karnataka, India in 1999, 2003 and 2013 respectively. He has guided many BE and M.Tech. Projects, and guiding more than 8 Ph.D students. She is a life member of Indian Society for Technical Education (ISTE), India Member of Institute of Electrical and Electronics Engineers (IEEE), Member of Institute of Electronics and Telecommunication Engineers (IETE), India and Member of Institute of Engineers, India. Her research interests are in the area of wireless networking with a Quality of Service (QoS) provisioning, scheduling and routing algorithm design in sensor network, Ad Hoc Networks and cloud computing. She has published more than **125** scientific articles in top-tier journals and conferences, including **Springer journal, IEEE** conference proceedings and **Springer Book chapters**. She has chaired various international conferences and is the reviewer for various National and International journals and Conferences. She is the Member of Board of Studies (BOS) and Board of Examiners (BOE) of computer science and engineering department and also the member of IEEE, ACM-W and IEI, life member of CSI and fellow member of ISTE and IETE.

Ms Vijayalaxmi Kadrolli is currently Research Scholar of Computer Science and Engineering department at Poojya Doddappa Appa (PDA) college of Engineering, Kalaburagi, Karnataka, India, an autonomous institute affiliated to Visvesvaraya Technological University (VTU) , Belagavi, Karnataka, Indian. She has obtained M.Tech in Computer Science and engineering in 2004 from PDA college of Engineering from VTU. Her main research areas are in Wireless sensor network, Artificial Intelligence, Soft computing.

Dr. Siddarama R. Patil received BE degree in Electronics and Communication Engineering from Gulbarga University, Gulbarga, Karnataka, India the M.Tech. in Telecommunication Engineering, and Ph. D from Indian Institute of Technology (IIT), Khargpur, India in 1990, 1999 and 2009 respectively. Currently, he is Professor and Dean Academics at Poojya Doddapa Appa College of Engineering, Kalaburgi, Karnataka, India. He has published more than 50 research papers in top-tier journals and conferences, including **Springer journal, IEEE** conference proceedings and **Springer Book chapters.** He has guided many BE and M.Tech. Projects and guiding more than 8 Ph. D students. He is a life member of Indian Society for Technical Education (ISTE), India Member of Institute of Electrical and Electronics Engineers (IEEE), Member of Institute of Electronics and Telecommunication Engineers (IETE), India and Member of Institute of Engineers, India. His current research includes Information Theory and Coding, Turbo Codes, LDPC codes, Iterative decoding algorithms, wireless sensor network, Mobile Ad Hoc Network, Cognitive Radio.