Intelligent System for Smart Cultivation - to Integrate Technology in Rural Economic Development

B V A N S S Prabhakar Rao, Kadupukotla Satish Kumar, Rabindra Kumar Singh, P Sundeep

Abstract*: *Since all living organisms require food and farming is the best key division of any country's economy development. In many developing countries the price of agriculture commodity is very low due to many issues. From a billionaire who has bread and jam for breakfast to the poor who eats rice porridge everyone who needs food for living on this earth has a relation to agriculture. The farmer, even if he is or isn't profited for years together with the crop that he has sown he keeps searching for his life in every seed he sows in hope of succeeding. Hence, along with the price hikes in the market, adulteration is also on the rise, if this continues similarly, the wealth you'd give your children in the future won't be enough even for their hospital expenses. Price of land is growing day by day and the value of farmer is coming down, if we start constructing everything on this land then there would be no place for cultivating food. This work is based on gaining good returns for farmers by farmers meeting their own customers, but no relation to dealers this helps in farmers getting their price for the work they do. This helps in good food without adulterant products that leads in good health, hence good business returns in good benefits of returns to the economic growth of the country. Major contribution is required to implement minimum support price. Lots of researchers reported the need of MSPs but no implementation strategies so far in many products. The main focus of this work is to provide food for our growing population; we need to adopt certain agricultural practices with the help of technology in terms of machine intelligence with smart cultivation for crop production and management.

Keywords*: Crop, *Fertilizer, Harvesting, Insurance, Intelligent, Irrigation, Kharif, MSP, Plough, Rabi, Smart, Sowing, & Weeds.

I. INTRODUCTION

India is the world's largest producer of pulses, rice, wheat, spices and spice products. As per the recent report Indian agriculture sector accounts for eighteen per cent of GDP and provides direct or indirect employment to fifty percent of India's labor force [1& 9].

Hard Worker – Why Poor?

The farmers of many countries are the hardest worker, farmer from all over the world. They are being always busy in the farming for the crops by working day and night. They use to plough the land and in that they sow the seeds for the growth of the crops [6].

Fig. 1 Hope - Farmer Waiting for ….

Research Objective:

As per the fig. 1 all most all the farmers are waiting for support in many ways right from human being to god almighty including may insects, trees, sun, etc.. They are the real backbones for the society in many forms. But, their returns are almost peanuts. We can't imagine our life without their support and encouragement. This research work mainly focused on farmers. Since directly or indirectly, without our knowledge, agriculture is one of the significant areas of national economy [2-5]. In many zones the price of agriculture commodity is very low due to some issues. In spite of their life style their direct contribution to the society is as follows:

1. Contribution to National Income
2. Source of Food Supply
3. Prerequisite for Raw Material
4. Provision of Surplus
5. Shift of Manpower
6. Creation of Infrastructure
7. Relief from Shortage of Capital
8. Helpful to Reduce Inequality
9. Based on Democratic Notions
10. Create Effective Demand
11. Helpful in Phasing out Economic Depression
12. Trade Revenue with respect to Foreign Exchange
13. Agriculture Capital Formation in different ways
14. Employment Opportunities for Rural People
15. Agriculture plays vital role in the Indian economy.
16. Health via unlimited wealth

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II. PROCEDURE FOR CULTIVATION

Now a day everyone speaks about the need for organic product development without the usage of fertilizers to save lives. The following practices have been monitored to cultivate land to produce rice, wheat and other food crops in traditional agricultural:

- Preparation of Soil
- Sowing
- Adding manure and fertilizers
- Irrigation
- Protecting from weeds
- Harvesting
- Storage

In general, if you see the above stage of cultivation it is very simple and we may feel that entirely easy process. But to get crop out how the farmers are struggling their life we may not know the actual difficulties. When we see the nature or the process or preparation of food grains in a movie or song or pic are always so beautiful like ice-berg tip. Fig. 2 clearly shows the imaginary process of cultivation most of us may visualize without knowing the ground reality in detail [7 & 8].

Fig. 2 Cultivation - Ice-berg Process

Why Farmer Suicide?

Many studies suggested to Government authorities to prevent farmer suicide.

But, no use!

Why?

It's a million dollar question

– Till date unsolvable!

Of course, these unfortunate incidents are not an isolated one in our country.

Fig. 3 No Hope Cultivation Process – Ice-berg Reality

Fig. 3 shows one horrible situation based by the farmer clearly. Also shows that real farmers only face day to day process struggle with the ground reality. Hence, there is an urgent need to think for better intelligent system instead of speaking too much on the issues faced by the farmers.

III. SMART CULTIVATION PROCEDURE

Cultivation has been used since ancient times for tilling the soil, adding fertilizers, removing the weeds, scraping of soil etc. For this purpose our ancestors used pair bulls, horses, camels, etc., based on their availability.

Smart Cultivation procedures discussed in detail with the help of the following steps:

1: Preparation of Soil

Prepare soil by tilling and leveling. Develop different modern tools for the purpose of ploughs and levelers.

2: Sowing

Seed drills, Use appropriate measures for Sowing of seeds at depths and distances provides better yield.

3: Adding manure and fertilizers

Soil needs replenishment and enrichment through the use of organic manure and fertilizers. Use of chemical fertilizers has increased tremendously with the introduction of new crop varieties.

4: Irrigation – Modern Methods

At appropriate intervals water supply of crops.

5: Protecting from weeds

Weeding involves removal of unwanted and uncultivated plants.

6: Harvesting with Modern Machines

Include scientific methods with respect to cutting of the mature crop by modern machines.

7: Threshing

Separation of the grains from the chaff

8: Storage – Natural / Cold storage / FCI goo downs

Proper storage of grains is necessary to protect them from pests and microorganisms

9: Marketing – Fix Minimum Support Price (MSPs)

With the help of technology the system need to suggest appropriate price for the product

IV. INTELLIGENT SYSTEM - SMART CULTIVATION

Smart Cultivation with Machine Learning Approach:

To solve an issue with man-made machines we require a procedure, which should be approved out to convert the given source input in different formats to a machine readable one as output to complete the given task within the prescribed time frame. Machine Learning approach is not a new one but, train the computer system with the learning tradition just like a human how he/she trained and learned with the help of past

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experience and data to complete the given job with the optimized performance.

Many farmers know the procedure without depending on the machine. Hence our job is to inculcate the habit of self-learning the machine in order to take the decision in the cultivation process.

For example, after the rain, the farmer can easily identify the soil, whether it is fit for or not!

Fig. 5 Intelligent System with Machine Learning

Fig. 5 clearly show that different phases of Intelligent System design with Machine Learning such as

- **Problem Assessment**
  - ***Specify the Objective***

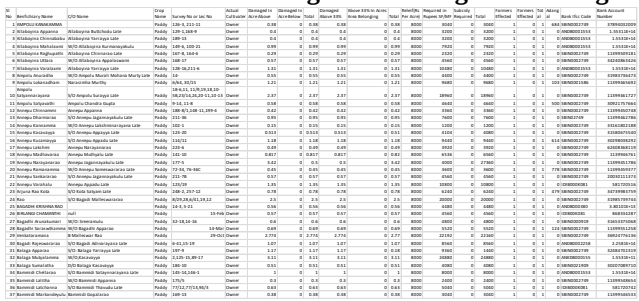
Beneficiary fund transfer as per the need and season with respect to type of the crop

- Sl No
- Beneficiary Name
- C/O Name
- Crop Name
- Survey No or Lec No
- Actual Cultivator
- Area Damaged In Acre Above 33%
- Area Damaged In Acre Below 33%
- Area Damaged Above 33% In Acres Area Belonging to SF/MF
- Area Damaged Above 33% In Acres Area Belonging other than SF/MF
- Scale Of Relief(Rs Per Acre)
- Input Subsidy Required in Rupees SF/MF
- Input Subsidy Required in Rupees Other than SF/MF
- No Of Farmers Effected SF/MF
- No Of Farmers Effected OF
- Total
- Adangal
- Bank Ifsc Code
- Bank Account Number

- **Data and Knowledge Acquisition**
  - ***Analyze Data with available knowledge***

Table 1 provides sample data with respect to a village on a particular season available crop detail with acres or cents and if there is any damage what are level say for example 33% above damage, etc. Since the insurance, bank people or any Government benefit schemes can be applied to that particular survey number and the system can process the fund or resource transfer to the beneficiary.

- **Table- II: Data Processing for Training & Learning**



- **Development of a Prototype System**
  - Tool Identification with the situation

Table- III: Process Tool Identification with situation

S.NO.	VILLAGE NAME	DOCUMENTATION NUMBER	CITIZEN NAME	ACTION TAKEN	SUBJECT
1	Akkayyavalasa	2018-176862612193	Tulugu Narayanarao	ACTION_TAKEN	Teak trees damage
2	Cheepurlapadu	2018-177027812263	Chennamsetti Pentayya	ACTION_TAKEN	Roof rakes flown away
3	Cheepurlapadu	2018-177027661685	Chennamsetti Rambabu	ACTION_TAKEN	Trees fell down
4	Cheepurlapadu	2018-177035014255	Sadunapalli Adinarayana	ACTION_TAKEN	Trees fell down
5	Cheepurlapadu	2018-177032466668	Sadunupalli Ramamurty	ACTION_TAKEN	Trees fell down
6	Cheepurlapadu	2018-177034556062	Sadunupalli Siva	ACTION_TAKEN	Trees fell down
7	Cheepurlapadu	2018-176913242606	Sadunupalli Srinu	ACTION_TAKEN	Roof rakes flown away
8	Chinavenkatapuram	2018-176817724460	Boddepalli Raminaidu	ACTION_TAKEN	Teak trees damage
9	Chittivalasa	2018-177146011448	Patta Kasipathi	ACTION_TAKEN	HORTICULTURE CROP DAMAGE
10	Chittivalasa	1100-17664467	Patta Kasipathi	ACTION_TAKEN	Water Scarcity
11	Chittivalasa	2018-177492418745	Pattu Simhadri	ACTION_TAKEN	Crop damaged
12	Chittivalasa	2018-176819423360	Santha Rao Ampolu	ACTION_TAKEN	Trees fell down
13	Chittivalasa	2018-176824478138	Santha Rao Ampolu	ACTION_TAKEN	Teak trees damage
14	Chittivalasa	2018-176827017257	Santha Rao Ampolu	ACTION_TAKEN	Palm trees damage
15	Dantha	2018-176873376026	Goddu Kavitha	ACTION_TAKEN	Roof rakes flown away
16	Dantha	1100-17699662	VELAMALA JANARDHANARAO	ACTION_TAKEN	Trees fell down
17	Duppalapadu	2018-2018077525	Gollapalli Venkateswararao	ACTION_TAKEN	Cattle Injured
18	Duppalapadu	1100-17661009	Guruvelli Tirupathirao	ACTION_TAKEN	ELECTRIC POLES FELL DOWN
19	Duppalapadu	2018-177021519076	Kuna Appanna	ACTION_TAKEN	Teak trees damage
20	Duppalapadu	1100-17664288	Mamidi Prasada Rao	ACTION_TAKEN	ELECTRIC POLES FELL DOWN
21	Duppalapadu	2018-176909343778	Yenda Narisimhamurthy	ACTION_TAKEN	Teak trees damage
22	Gangaram	2018-176788874738	Korrai Chalapatirao	ACTION_TAKEN	Roof rakes flown away
23	Gangaram	1100-17722599	Sakalabhaktula Hariprasad	ACTION_TAKEN	Roof rakes flown away
24	Gunjilova	2018-2018080238	Bendi Appayya	ACTION_TAKEN	Crop damaged

The System can take a decision on the given situation and appropriate action will takes place with a proper measure.

- **Development of a Complete System**
  - User Interface Design

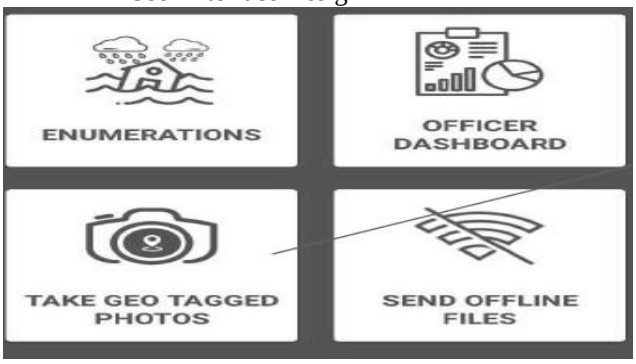


Fig. 6 Intelligent System for Data Collection UI

- **Evaluation and Revision of the System**
  - Revise as per Performance Criteria

Beneficiary Name	:	B V A N S S Prabhakara Rao
Actual Cultivator	:	Owner
Crop Name	:	Paddy
Survey Number	:	8/29,28,6/41,19, 12
Total damaged area in acres	:	2.5

- **Integration and Maintenance of the System**
  - Technology to fix the problem

As per the estimation, what amount of fertilizers required or what kind of remedial actions should be taken to bring the situation into our control.

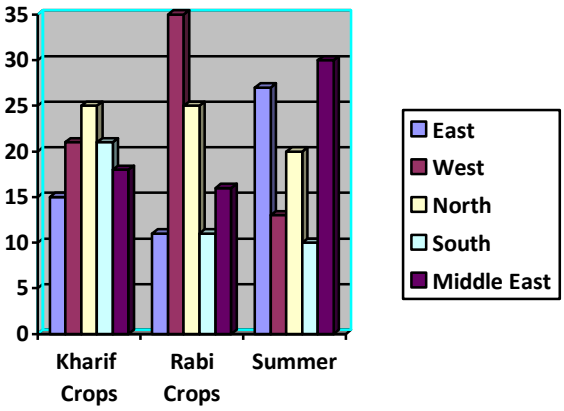


Fig. 7 Crop Production as per season

Hence, as shown in the fig. 7 different crops with various season how it develops an Advisory system for better yielding. Generally, these ML models need more data for processing to manage the situation than only training and learning can happen in a better way. For that reason we can collect the data from the revenue village as per the survey number and boundary of the village. India has the capacity to produce lots of foodstuffs. No doubt that can make a remarkable change in the country's economy. Also, the government wishes to offer support in case of crop insurance, farmer health card schemes to support their health and stop suicides, bank loans and other instruments for cultivation to the farmers' adoption of the technology that improves the economy.

V. FUZZY LOGIC IN INTELLIGENT SYSTEM FOR BETTER RECOMMENDATIONS

SNo	Horticulture Department	Total Area Damaged	Damaged (above 33%)
1	BANANA	2936.975	2630.32
2	Banana	41.8	49.25
3	COCONUT	2.6	2.6
4	COCONUT`	1.83	1.83
5	Cashew	65208.77	61233.99
6	Coconut	42571.3	44663.37
7	MANGO	4.5	2.5
8	Mango	5666.254	5605.781
9	OILPALM	0.6	0.6
10	Oil Palm	77.29	76.94
11	Others	772.36	735.95
12	Papaya	92.1	78.74
13	Vegetables	1547.617	1533.716

Fuzzy Logic provides an effective solution in a beautiful way for many problems. Since this provide the correct methodology for decision making with accurate results.

Say, for example the present system is simple deciding the farmer's category like a marginal farmer, small farmer, or other category i.e., the existing system always classifies based on the location, how many acres land they have, caste or religion where they belongs. But, in reality a person may have a land of 20 acres in his or her name but no water source for a number of years. Or the cost of water source may be high, that means bore cost or electricity cost, etc. Similarity labor and infrastructure cost may not be properly included. In some case yielding of the food grains may not calculated properly for that reason proper estimation methods used or not! These factors play a vital role, if not we need work on those attributes.

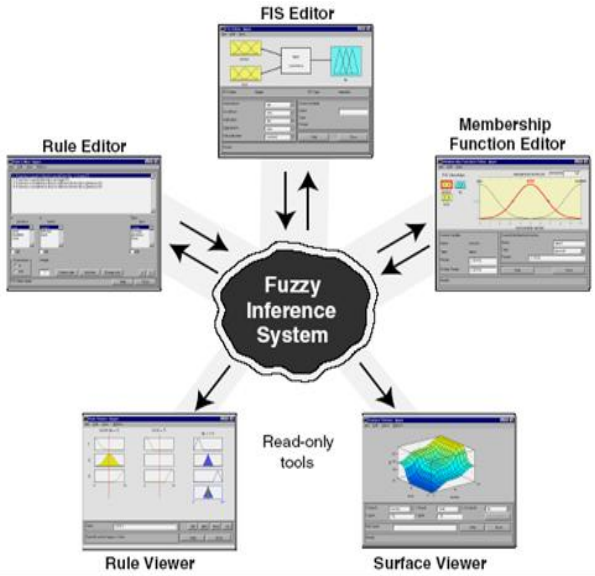


Fig. 8 FIS view

Hence, the proposed Fuzzy Based Intelligent System provides farmers to know the soil condition, type of the fertilizer, water usage / availability, optimizing these resources in a systematic way will provide the best solution.

VI. RESULT AND DISCUSSION

The Weather forecasting situation and market strategies should be identified properly. Since the same commodity may available in the same location with a bulk. But, in another area the same may be a shortage. How to overcome this? What kind of business, strategies we need to follow? How can get maximum profit?

How we can minimize product cost? If we find the market somewhere else! What about the distance and mode of transportation along with shipment cost and damage of the product?

The FIS will discover these solutions in a better meaningful way with optimal time.

Fuzzy Viewer:

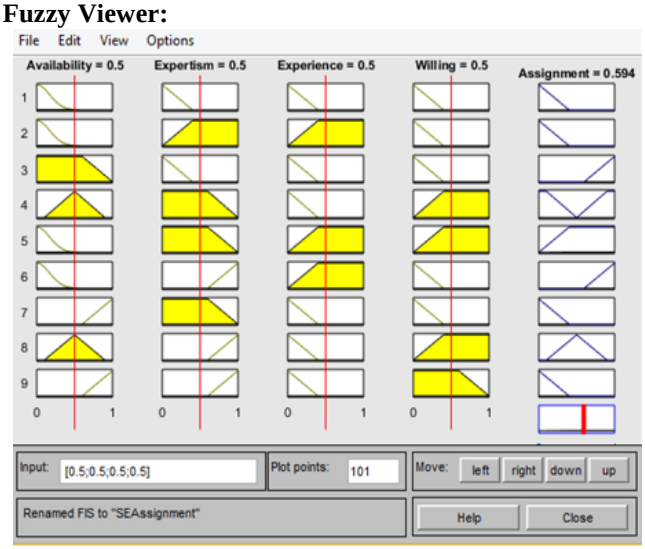
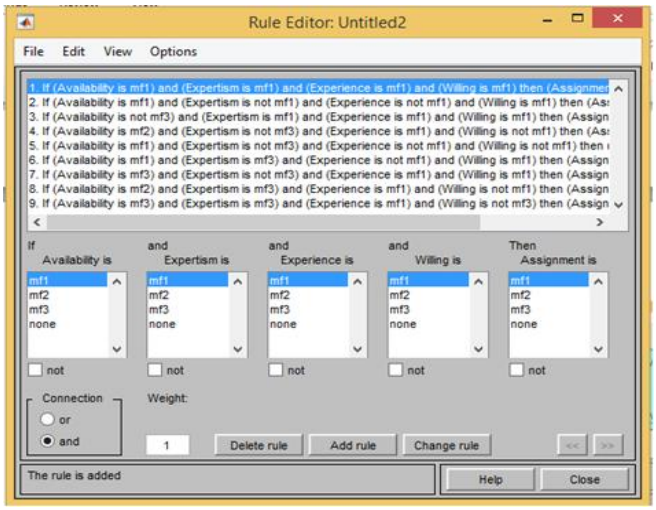


Fig. 8 Satisfaction of product quality as attributes

Fuzzy Rule Editor:



Animal Husbandry & Fisheries:

Food is also obtained from animals for which animals are reared at home or in farms.

Sl No	AnimalH	No.of Livestock Lost	qualifying
1	Buffalo/Cow	1146	1104
2	Buffalo/Cow with PTD	2810	42
3	Sheep/Goat	5778	5533
4	Bullock/He Buffalo	140	110
5	Calf	262	261
6	Backyard Poultry	1731	1443
7	Broilers	48273	48235
8	Layers	38317	35085
9	Cattle Sheds	36902	36618
10	Poultry Sheds	353	320

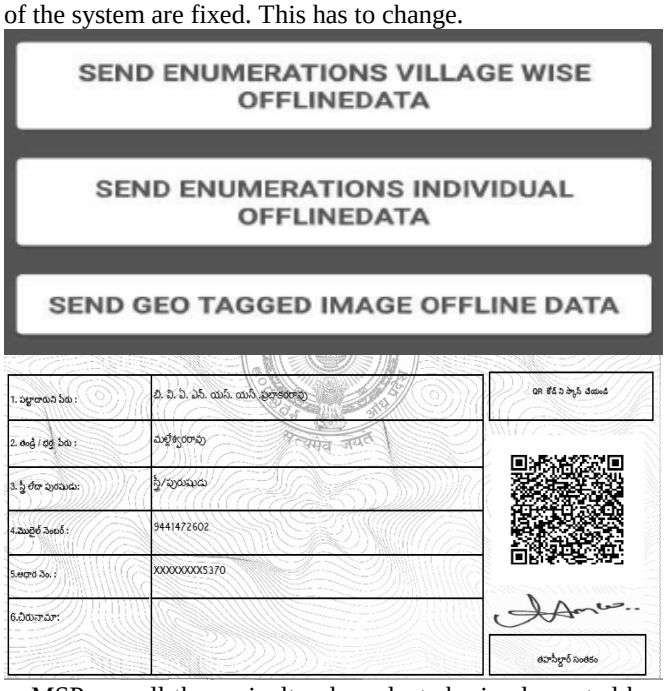
Fisheries like Fish, Prawn, Tank Fish, Sea Fish & River side etc…

Sl No	Fisheries Department	Units
1	Partially Damaged of Boats	7494833
2	Partially Damaged of Nets	7970769
3	Fully Damaged of Boats	11969420
4	Fully Damaged of Nets	23517781.1
5	Boats or Nets fully damaged	324
6	FISH/PRAWN ponds damaged	556821

Fig. 8 Satisfaction Metrics - Animal Husbandry & Fisheries

The price fixing strategies for petrol, oil, gas, gold, and many more products completely produced by the corporate sector are different. As a common man when we are asking to person having complete knowledge why petrol price or gold price is rising or changing daily? They are saying something, but that in not true for all the well-developed countries. Why partiality on food grains? Probably no well-known corporate sector not involved in the agricultural sector!

Always there is a limit for budget with respect agricultural sector. Without knowing the ground reality few who are part of the system are fixed. This has to change.



MSPs on all the agricultural products be implemented by State or Central Governments. Of course not on paper, but in real!

How? To answer this we need to identify the person having agricultural land in acres with survey number must be linked with crop he or she cultivated in that season. How much quantity he or she cultivated what kind of support is required form the government sector should recorded by the enumerator through this FIS system [11-13].

Sl No Agriculture Area Damaged (above 33%)
1 Blackgram 3.27 3.27
2 Cashew 8.24 8.24
3 Coconut 40 0.7
4 Cotton 4755.256 4494.471
5 Maize 18.67 18.67
6 Mango 4.67 2.67
7 Others 58.33 47.93
8 Paddy 196251.83555 241574.13275
9 Redgram 2.602 2.602
10 Sugarcane 174.068 170.918
11 Vegetales0.33 0.33

For example a person owns a costly car. Assume that there was an incident like theft, accident; own damage something, then what about an insurance claim. This is the situation in most of the countries with respect to car damage, but not to personal income, social status location where he or she belongs to. When claim settlement comes into reality a person having millions of dollars he or she may die then the amount will release to the nominee or not.

Now, the issue the same rule applicable to farmers with respect farming a particular food grain or not! What kind of mechanism we are following to recover the loss or damage for Animal husbandry & Fisheries?. Whether we are doing the social/nation damage or not?

జిల్లా : శ్రీకాకుళం మండలం: కోటబొమ్మాళి

పేరు : బి. వి. ఏ. ఎస్. యస్. యస్ .ప్రభాకరరావు తండ్రి / భర్త పేరు : మల్లేశ్వరరావు

వరుస సంఖ్య	సర్వే నెం. / సబ్ డివిజన్ నెం.	విస్తీర్ణం (ఎ-సెం.)లో	వర్గీకరణ (మెట్ట/మాగాణి)
1	8-29	0.0600	నంజ
2	8-28	0.1200	నంజ
3	6-8	0.1600	నంజ
4	6-41	0.1200	నంజ
5	62-3	0.0300	పుంజ
6	6-19	0.0700	నంజ
7	6-12	0.0500	నంజ
8	5-21	0.0300	నంజ
9	5-2	0.2500	నంజ
10	4-2	0.2600	నంజ

సర్వే నెం.	భూధార్	స్వభావం	విస్తీర్ణం(ఎ.సెం)
103-9	**99.560.667.958**	పట్టా	0.0400
15-13	**99.723.965.235**	పట్టా	0.0600
15-4	**99.281.034.432**	పట్టా	0.0700
155-26	**99.424.295.713**	పట్టా	0.0300
155-40	**99.708.065.389**	పట్టా	0.0300
175-7	**99.921.287.889**	పట్టా	0.0800
18-23	**99.185.422.714**	పట్టా	0.0800
18-24	**99.676.153.840**	పట్టా	0.0800
18-26	**99.856.317.061**	పట్టా	0.3100
18-27	**99.291.589.408**	పట్టా	0.1100

Insurance: This scheme can be implemented in a better way with help of Budhar like Aadhar for a person Bhudhar for land which is being partly implanted in a few states so that we can easily track. The schemes were adopted as a pilot project in respect to paddy, wheat, etc., in many states. But real farmers were not benefitted due to some reason. When a natural calamity happened, at that particular situation there was no proper field visit with respect revenue records or survey numbers. Instead other party persons or political or fake people would get the benefit. Whatever it was certainly lose to the nation in many ways in general and lose to farmers in particular [14-16].

Code	:	9
Beneficiary Name	:	B V A N S S Prabhakara Rao
Actual Cultivator	:	Owner
Crop Name	:	Mango
Survey Number	:	8/29
Total damaged area in acres	:	.05

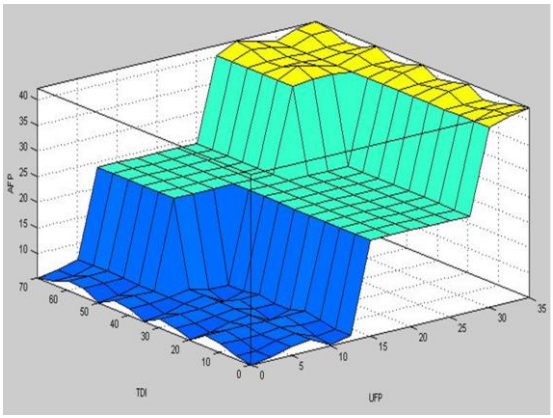


Fig. 9 Estimating Consumers Gain – Surface View

VII. CONCLUSION

This research work concludes that any country' economic development is basically depends on the cultivation with respect to different food grains & commodities. The main focus is to remove the role of middle man in each and every activity pertaining to the tasks carried by all the stakeholders of farming. With the help of the present proposal the gap between consumer and farmer reduced up to some extent. Finally, this work is based on gaining good returns for farmers by farmers meeting their own consumers, but no
relation to dealers this helps in farmers getting their price for the work they do. In future we need to focus on this area, Not only that, but also how to get the minimum support price for the products at their door step in all the seasons. In the future, of course we need to supply different instruments with the help of technology to complete their tasks for planting, processing, and harvesting with an affordable price. Last but not least, many labors may not show interest to work in the field of agriculture so that the Government officials and NGOs must thin on this. Hence, the proposed intelligent system should suggest a better mechanism to eradicate this problem for smart cultivation.

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