Original Research Article

Achievement of target yield by using required quantitative fertilizers in rice crop cultivation by using optimum solutions.

Abstract: -

Studies of soil-based tests pertaining to different crops in Vindhyan alluvial plains from 2001 to 2004 show effect of production on specific rice crop by IR-36 testing leveraging on soil stoichiometric testing and recommended balanced fertilizers and organic matter amelioration by application for the niche area of impact to targeted yield of rice crop. Findings reinforce that soil micro-flora and micro-organisms accelerate aeration, porosity, drainage and optimum crumby structures, resulting in nascent fertility and support to crop plant for profuse and vigorous growth through optimum soil texture under different agro-climatological divisions in specificity. Primary and secondary data are tabulated after administration of research questionnaire, structure, queue, flow and research objectives, first hand data fulfilment through field notes and experimental block designs under study in rice-based ecosystem of control and treatment blocks. The study of nutrients requirement for specific accelerated productivity of rice crop by applying control and treatment with particular fertilisers which is structured in the mathematical model of [CF (%)] and [CS (%)] gradient. Further data in relation to studies of nutrient dose recommended model development through incursion into stoichiometric trends, analysis, models, algorithms, principles, procedures and quantisation. Regression based studies support the experimental design blocks. Studies by experimental design of blocks replication and finding of experimentations led to outcome of best efficacy and efficient recommended fertiliser dose to enrich, replenish the gap of inadequate fertilizers to the paddy crop to meet our targeted yield of paddy crops. Analytical trends and comparison experimentation sheet led to the effort for how much fertilizer is actually required for crop growth by applying mathematical quantization and qualitative. Under experimental controls and originality of this innovative findings, this research supports systems approach for simplicity, spirituality and sustainability.

Keywords: - Non-linear equations without constraint, Quasi-Newton Method, Marquardt method, Multiple Regression Analysis, N-P fertilizers.

Introduction: -One of the finest places in paddy cultivation in India is Damodaran catchment particular in monsoon season and winter season [10]. As paddy needs more water, henceforth more than 80% lands in heavy rainy season (Monsoon) and more than 60% lands in winter season are cultivated. For getting more yield paddy farmers take care soils fertility as well as crops more fertility and more yield crops which is expected can be achieved by the help of up taking nutrients and fertilizers [8]. Most of the paddy lands farmers using Nitrogen, Phosphorus fertilizers to meet and fulfil targeted yield in paddy crops. Somehow ph factor of soils [6] must be taking into account for paddy cultivation and yield crops. Both short term and long-term period fertilizers are used. Here most of the time farmers faced severe problem in cultivation of paddy crops due to natural calamities (flood, draught, low quantity of raining etc) and attacked by insects and other out sources. To enhance the production of crops and targeted yield of paddy we have taken different mid points for smooth paddy cultivation and giving up taken fertilizers[4][5].To find some optimum value to calculate targeted yield data for paddy crop we are taking some mathematical model and created some formula to achieve it. We have also created one algorithm for solving it. After finding the targeted yield of rice crop, we are also comparing the data to meet the targeted crop production by graph. After finding graph we have analysed it to find good results to achieve the targeted yield. We have taken two methods" Quasi- Newton method and Marquardt Method." which shows optimum solutions as well as optimizing the solution

which has given the optimum solution. We have taken two medium points (intermediate points P1 for 60% fertilizer up taken and P2 for 40% fertilizer up taken) for up taking fertilizers (N and P) when we assume for monsoon season and winter season in heavy or more heavy rain fall and flood is the main cause for wiping out of fertilizers from paddy lands which cause inadequate fertilizer supply to the paddy plant [3[and it will directly affect the production of paddy crops ang fulfil the yield paddy crop. Similarly in winter season some other soil problem may arises and also insects' problems too. To irradicate deficiency of fertilizers we take one intermediate point(P3) where we have decided how many quantities of N and P are going to supply to the plant intaking.

Suppose we have to take 250kg/h Nitrogen and Phosphorus both, but we divide it in two parts one is 60% (150kg/h) and other is 40%(100kg/h)ratio by taking it approximate value.Similary we have taken 180kg/h Phophrous.Quantity 60%(108kg/h) in monsoon season and 40%(72kg/h) in winter season. Needed balanced amounts of N, P in field were prescribed based on crop-based estimates of the indigenous supply of N, P by modelling the expected yield response as a function of nutrient and fertilizers [9] interaction was done by many workers (Dobermann and White 1998; Witt et al., 1999). The present investigation aimed to study the relationship between the added fertilizers(uptake) and yield of paddy and to develop a optimum solution by using mathematical optimization methods for fertilizers up taken for maximum production of paddy in the same prescribed area. We have also compared the traditional method data with our proposed model data.

2.1) **Methods and Mathematical Model:**

Naopara, Kantia and Syamsundarpur in Bardhhaman district, West Bengal, India for the year 2001 to 2004.Crop trials were conducted in four soil series Syamsundarpur I, Syamsundarpur II, Naopara and Kantia, in the farmer's field. Irrigated rice (IR-36) [10] was also used as the winter crop in the third week of February and harvested in the third week of May. The crop was transplanted at a spacing of 14 cm×12 cm with 5 seedlings/hill. The crop received one fourth N and full dose of P2O5 and K2O as basal application and remaining half and one fourth N were applied at 22 d after transplanting (DAT) and 45 DAT respectively. Nitrogen was applied through urea, phosphorus through diammonium phosphate (DAP) and potassium through muriate of potash. Five to seven centimetres deep good quality water was maintained in the field. Fifty-six soil samples (0~0.15 m depth) were collected, dried and passed through 2 mm sieve ananalyzed for physicochemical characteristics as described by Jackson (1973). Available nitrogen was analysed by alkaline permanganate method (Subbaiah and Asija, 1956), available phosphorus by Olsen et al. (1954)'s method and available potassium by ammonium acetate method (Hanway and Heidal, 1952). The layout was based on the approach developed by Ramamoorthy et al. (1967). Four levels of fertilizer treatment viz. N1P1K1 (farmers practice), N2P2K2 (soil test based i.e., recommended by the agricultural department of the district on the basis of soil test values), N3P3K3 [soil test crop response (STCR) for 7 t/ha] and N4P4K4 (STCR for 8 t/ha) with three replications each was done. Pre-sowing and post-harvest soil samples were analysed [12] according to the standard procedures. Plant sampling was done according to the procedure followed by Witt et al.(1999). In targeted yield approach for formulating fertilizer recommendations, the basic data viz. nutrient requirement (NR) (kg/t), percent contribution from the soil [13] available nutrients [CS (%)] and the percent contribution from the applied fertilizer nutrients [CF (%)] were transfer into workable adjustment equation (Rao and Srivastava, 2000) [13].Fertilizer dose=[Nutrient requirement (kg/t) of grain]/ [CF (%)]×100×T (t/ha)−[CS (%)]/ [CF (%)]×[Soil test value (kg/ha)],where T is targeted yield (t/ha).[10].]. In traditional Method fixed fertilizer dose only available to meet targeted yield. But in our method, we have used two intermediate state of rice crop where no excess fertilizer or inadequate fertilizer has needed to meet targeted yield. We have taken P for P_2O_5.We have also grasped 16 no of data.[10].

2.1.1. Model: - We have applied different mathematical methods. We have taken Multiple regression formulas for our non-constraint nonlinear equations for finding required fertilizers. (Data taken for N and P fertilizers which is table1 and table2). We have taken 16 numbers of data [10]. Then we have solved it by the help of some mathematical methods like Quasi -Newton method and

Marquardt Method for optimising data. We have model by taking regression formula and p-value (always less than 0.05) of the absolute intercept value and other coefficient of regression equations (1), (2) and (3).

2.1.2 Method: - We have taken regression formulas and two methods of optimization for optimizing our solutions and compared with the data. In this paper [1] which is obtained by traditional method like CS% and CF%. We have shown it by graph and analysed which is the best method. Our data obtained by optimization methods and data from traditional methods (CS% and CF%) is given in different tables. (Table-1 and Table-2).

2.2 Statistical Analysis I:- For our mathematical framework, we need three response surfaces depicting the effect of different levels of N and K fertilisers in trial plantation. They are

(i) The yield response surface of potato due to application of N and K fertilisers at the beginning of cultivation.

(ii) Response surfaces of plant N and K uptake at the intermediate stage of cultivation, expressed as functions of applied N and K fertilisers at the beginning of cultivation. Instead of studying effect of N and K fertilisers separately on yield, the combined effect of both the fertilisers on the yield has been considered because significant correlation between levels of N and P and yield has been reported by Singh et al.[7], Ali et al.[8]. The effect of different level of N and P on yield of rice is given in Table1 and Table2.The response surface for yield, after application of multiple linear regressions [2] using data in Table 1, is given by :-Y (N, P) $=a+bN+cNP+dN^2$----(1), where P-value of a=0.001808, b=0.042999, c=0.017685, d=0.019724 for function Y (N, P) We have other regression data are: Multiple R 0.0.660431021,Rsquare=0.436169133,Regression=3.094326,Residual=1.548566,Significance F=0.067584821.So equation (1) is Y(N,P)= 15.17212631+ (-0.082130963)N+1.47712e-05NP+(-0.001554713)N^2--------(2).Similarly Y(N, P)= a+bPN+c(P+2N) +d(N^2+2P)---(3), where P-value a=0,0084, b=0.031654, c=0.031867 and d=0.025063. for Y(P)only. So theequation(3)isY(N,P)=25.14085+0.001307PN+(-0.14344)(P+2N)+0.00101(N^2+2P)----(4).Again Y(N,P)= a+bP+cN+2dNP----(5) where P-value is a=0.000555, b=0.003823, c=0.008145, d=0.003777 for Y(N) only. So, equation (5) Y (N, P) =20.53141+(-0.26407) P+(-0.1318) N+2*0. 00125NP.Table for Regression:

(i)Table1 optimization methods and data from traditional methods (CS%)

Phosphorus level in plant	Nitrogen level in plant	60% Phosphorus Intake	40% Phos -phorus intake
80	100	48.0000000	32.0000000
50	120	30.0000000	20.0000000
61	104	36.6000000	24.4000000
73	126	43.8000000	29.2000000
80	100	48.0000000	32.0000000
50	120	30.0000000	20.0000000
57	100	34.2000000	22.8000000
70	121	42.0000000	28.0000000
80	100	48.0000000	32.0000000
40	100	24.0000000	16.000000
46	84	27.6000000	18.4000000
59	106	35.4000000	35.400000
80	100	48.0000000	32.000000
40	120	24.00000000	48.000000
54	100	32.40000000	21.6000000
66	120	31.32000000	22.2400000

(ii)Table 2 optimization methods and data from traditional methods (CF%)

Phosphorus intake	Nitrogen	60%Ntrogen Intake	40%Nitrogen
80	100	73.1316282	26.8683718
50	120	74.5046426	45.4953574
61	104	73.6836772	30.3163228
73	126	74.1046258	51.8953742
80	100	74.1316282	25.8683718
50	120	73.5046426	46.4953574
57	100	73.5046372	26.4953628
70	121	73.6754321	47.3245679
80	100	74.1316282	25.8683718
40	100	73.0496033	26.9503967

46	84	73.3199042	10.6800958
59	106	74.2321345	31.7678655
80	100	74.1316282	25.8683718
40	120	73.0496043	46.9503957
54	100	73.7649031	26.2350969
66	120	73.6837672	46.3162328

1(iii)Table3 Yield crop ratio

Phosphorus Level in plant	Nitrogen Level in plant	Yield crop(Q/h)
80	100	6.549952428
50	120	8.552713678
61	104	5.549995242
73	126	7.544995242
80	100	5.544995242
50	120	7.507709595
57	100	6.749338782
70	121	6.765443875
80	100	7.507709595
40	100	7.656679084
46	84	8.720224128
59	106	8.720224129
80	100	6.549952428
40	120	7.236654796
54	100	7.5647986745
66	120	7.5644342196

2.2 Statistical Analysis II: - For our mathematical model, we need three response surfaces depicting the effect of different levels of N and P fertilisers in trial plantation. They are in second column in table1 and table2.

(i) The yield response surface of paddy due to application of N and P fertilisers at first intermediate of cultivation (ii) Response surfaces of plant N and P uptake at second intermediate stage of cultivation, expressed as functions of applied N and P fertilisers at the beginning of cultivation. Instead of studying effect of N and P fertilisers separately on yield, the combined effect of both the fertilisers on the yield has been considered because significant correlation between levels of N and P and yield has been reported by Singh et al. [7], Ali et al. [8]. The effect of different level of N and K on yield of rice is provided in Table In this traditional method they have used data like approximation format (CF and CN fertilizer dose ratio) which is not completely given correct result and which is not also optimized. In our method we have optimized up taken nitrogen and phosphorus fertilizers by using Quasi newton method and we have found optimized targeted yield crop (Rice) by using Marquart method. We have taken two assumed values one for nitrogen fertilizer and other is for phosphorus. We have also displayed in two different pictures in figure1 and figure2.In Figure1 all traditional data and in figure2 all our modified data by applying optimizing methods are displayed.

C)Figure-1 Graphical presentation 1

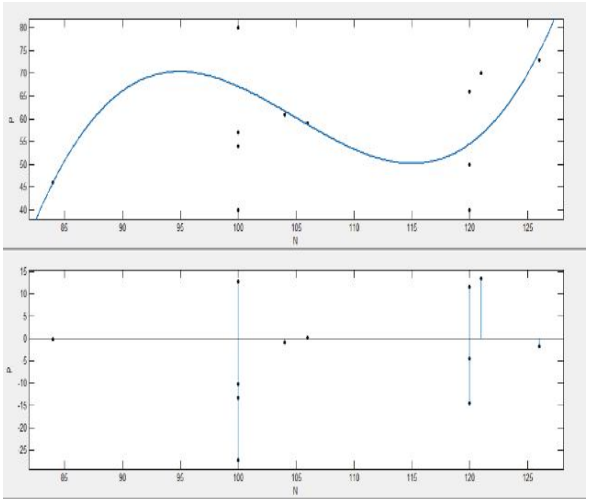
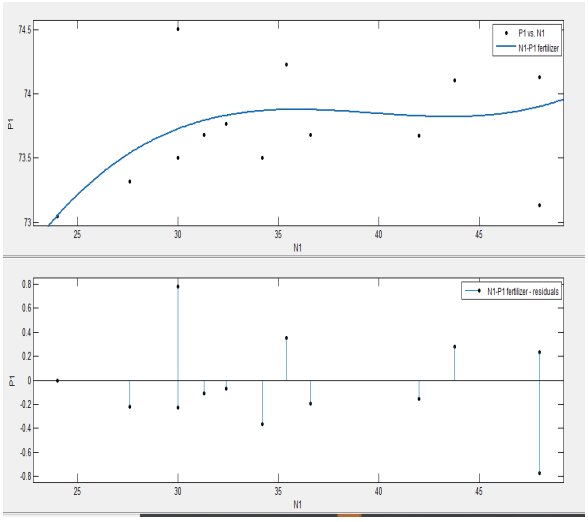


Fig-2 Graphical presentation 2



2.3 Result and Discussion :-We have taken in accounts two values f_{max} and fo_{ptimum} for both given fertilizers (Phosphorus and Nitrogen). We have assumed that $f_{max}(N)=250kg/h$ and $f_{max}(P)=180kg/h$. We have calculated the optimum value of both fertilizers by taking Quasi Newton method and multiple regression formula (2) and (3) and found optimum fertilizers both Nitrogen (128.4432 976) and Phosphorus (102.8000000).

2.3.1 Algorithms: -

Step: -1 When we have taken intermediate point (60%), $f_{max}<f_{optimum}$, then $f_{max}-f_{optimum}=60\%$ Required fertilizer.

Step: -2 If $f_{max}\geq f_{optimum}$, then no fertilizer required.

Step-3: If second intermediate point (40%), then f_{max}- foptimum, then $f_{max}-f_{optimum}=40\%$ required fertilizer.

Step 4: -If $f_{max}>f_{optimum,}$ then excess of fertilizer, automated aborted fertilizer.

2.3.2 Analysis: -From table-1 we have taken data from 2nd column and 3rd column and 4th column finding optimum nitrogen by applying fsolve with Quasi Newton method and from table-2 we have taken data from 1st column and 3rd and 4th column by applying same method. By taking Marquart method and taking 3rd table we have calculated targeted yield crop(rice) by taking optimum fertilizers (Both Nitrogen and Phosphorus). Again, we have compared between traditional data and our method and we have shown it in pic1 and pic2. In pic1 data of traditional method has given less yield than in pic2 where we have taken by our optimum methods which has given more targeted yield crop.

2.4 Conclusion: -By using optimizing in different optimization(Quasi-Newton and Marquardt's)we have concluded that we find better and more accurate approximation result than other traditional methods to find targeted yield of any crop by intake different level of nitrogen and phosphorus up taken for rice crop in different season to produce more crop. We have also compared the data and shown in graph. We have also checked by taking two mathematical methods and two intermediate points. In first case if crop need more fertilizers if it has inadequate amount of fertilizers and in second case if crop needs less fertilizer to fulfil or met its targeted yield (targeted production of crops.). By taking the reference of this paper researchers can use other optimization methods and also taking other conditions to meet its target and produce more crop in different condition/situation with adequate fertilizers (More/Less quantity if needed)

2.5 Reference: -

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