

Minimum Data Set and Principle Component Analysis to Assess Inhana Rational Farming (IRF) in Terms of Soil Quality Development Leading to Crop Response - A Case Study from FAO-CFC-TBI Project on Organic Tea Cultivation in Maud T.E., Assam, India

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Abstract - Generation of Minimum Data Set (MDS) and screening of MDS through Principle Component Analysis (PCA) is the new weapon in statistical armoury. The method was used to test the effectivity of Inhana Rational Farming (IRF), *vis-a-vis*, other organic packages of practice *viz.*, biodynamic farming, microbial formulations as well as vermi compost and indigenous compost (FYM) based packages; as per crop productivity and soil development. The study was taken up during 2009 – 2013 at Maud tea estate (Assam, India) under FAO-CFC-TBI Project entitled 'Development, Production and Trade of Organic Tea' initiated with an objective to bring forth an effective pathway for sustainable organic tea production.

Under the statistical process, the huge data set was first reduced to form minimum data set (MDS) through a series of univariate and multivariate statistical methods. This was followed by Principle Component Analysis (PCA) for each statistically significant variable to choose representative variables. To reduce redundancy, Pearson's correlation coefficients were calculated to determine the strength of the relationships among variables. Then MDS was validated and indicator transformation (scoring) was done in linear scoring methods. The indicators were then integrated into Soil Quality Indices (SQI).

In the study, both additive SQI of MDS variables and weighted additive SQI of MDS variables indicated IRF as the best treatment or organic package of practice. This was followed by study of the relationship between observed and estimated yield under different package of practices using multiple regression analysis, and their close interrelation (as revealed from analysis) clearly indicated the relationship among soil quality development and crop response. The results also indicate the potentials of IRF as an effective organic package of practice for sustainable organic tea production.

Keywords – Minimum Data Set, Principle Component Analysis, Soil Quality Index, Organic Tea.

I. INTRODUCTION

Soil is a wonderful gift of nature to humankind. However, the high demographic pressure and consequently intensive cultivation caused tremendous stress on to soil. The stresses commonly inflicted on soil

because of intense cropping, ultimately manifested in declined productivity of crops even under best possible management practices and made soil "sick" to respond efficiently to fertilization and other inputs (Saha and Mandal, 2009). To arrest this deterioration, measures to correct nutrient deficiency, control of pest and disease incidences and other conservative steps were commonly recommended. However, as these were done in isolation on piecemeal basis, and not in a holistically concerted manner, it resulted in the decrease of partial factor productivity for the applied inputs. As for example, for correcting nutrient deficiency, what we did in soil testing programme, is just carrying out analysis of few parameters *viz.* soil pH, organic C, available P, available K etc. and expected to curb the declining trend in productivity and have sustainable yield. But because of the complexity of the present day high input agriculture, such tests of soil for a few parameters are proved to be very much inadequate to meet the needs of the farmers and take care of the health of their soil. In fact, the existing procedure for soil testing for measuring sustainable use of soil is ill developed. To address this, we need a more wholesome approach that encompasses all the soil degrading forces arising out of intensive cultivation.

Assessment of soil quality, which is "the capacity of a soil to produce safe and nutritious food, to enhance human and animal health and overcome degradative processes" (Papendick, and Parr, 1992) is thought to be a means to this end. In soil quality assessment tools, different attributes of soil *viz.*, physical, chemical, biological and also nutritional quality of the produce grown on the soil was considered. Again within each category of attributes, we analyzed a number of parameters, namely under physical – bulk density, maximum water holding capacity, mean weight diameter etc.; similarly under chemical – pH, organic carbon, available N, P and K, micronutrients, heavy metals etc., and under biological – microbial biomass C and N, soil enzymes, mineralizable C and N, soil biodiversity, soil fauna etc. In fact, what people are interested with is not

the absolute value of the soil quality but its changes due to adoption of different management practices and cropping systems; so that the best management practices are identified for future land-care programme. So present study was undertaken to develop a model to screen out the best systems for a collaborative study, undertaken at Maud tea estate (Assam) for Tea management practice.

II. MATERIALS AND METHODS

A. Experimental design

Eleven 'Packages of Practice' were considered in the form of eleven treatments *viz.* T₁ : Vermi compost (@ 9.4 tonha⁻¹) + conventional organic plant management (VCO), T₂ : Vermi compost (@ 9.4 tonha⁻¹) + microbial formulations for plant management (VMIP), T₃ : Vermi compost (@ 9.4 tonha⁻¹) + microbial formulations for soil and plant management (VMI), T₄ : Microbial formulations for soil and plant management, T₅ : Novcom compost @ 2.6 tonha⁻¹+ Inhana organic solutions for plant management + neem (*Azadirachta indica*) oil, (*Pongamia glabra*) karanj oil and emulsifier concoction for pest management [Inhana Rational Farming Technology -1(IRF-1)], T₆ : Novcom compost @ 4.0 tonha⁻¹+ plant management and pest management same as IRF1 [Inhana Rational Farming Technology -2 (IRF 2)], T₇ : Novcom compost @ 5.1 tonha⁻¹ + plant management and pest management same as IRF1 [Inhana Rational Farming Technology -3 (IRF 3)], T₈ : Novcom compost @ 8.0 tonha⁻¹+ plant management and pest management same as IRF1 [Inhana Rational Farming Technology -4 (IRF 4)], T₉ : Biodynamic farming (BD) with 10 tonha⁻¹ biodynamic compost, T₁₀ : Indigenous compost (IC) in recommended dose (@ 13.5 tonha⁻¹) + conventional plant management (CO) and T₁₁ : Control (C). The experimental plots were laid out in the form of randomized block design with 3 replications for a period of 3 years i.e. 2009 to 2011. The basis for dosage calculation of each organic soil input was to supply 60 kg N per hectare (target yield considered as 1500 kg made tea, with 4 percent N requirement for one kg of made tea). The dose of each soil input was determined from its total- N and moisture percent with 80 percent utilization efficiency. Plant management in the respective plots was done as per the schedule prepared by experts. Soil samples were collected from each experimental plot before the initiation of

experiment in January, 2009 and after the completion of the experiment in December, 2012. Details of the package of practice was documented by Chatterjee *et al.*, 2014.

B. Analytical Method

Soil physicochemical properties *viz.* pH, EC, organic carbon, cation exchange capacity and fertility status *viz.* available- N, P₂O₅, K₂O and SO₄²⁻ were done as per the methodology of Jackson (1973). Estimation of bacteria, fungi and actinomycetes and phosphate solubilizing bacteria was done as per plate counting method using Thornton's media, Martin's media and Jensen's media and Pikovskaya's media respectively according to the procedure outlined by Black (1965).

C. Statistical Analytical Method

The model treatments selected for the study was as follows (Table 1).

Table 1: The Model Treatments

T ₁ : Vermi compost + Conventional organic plant management (VCO)
T ₂ : Vermi compost + Microbial formulations for plant management (VMIP)
T ₃ : Vermi compost+ Biofertilizer + Microbial formulations for plant mgt. (VMI)
T ₄ : Microbial formulations for soil and plant management (MI)
T ₅ : Inhana Rational Farming 1 (IRF 1)
T ₆ : Inhana Rational Farming 2 (IRF 2)
T ₇ : Inhana Rational Farming 3 (IRF 3)
T ₈ : Inhana Rational Farming 4 (IRF 4)
T ₉ : Biodynamic Farming (BD)
T ₁₀ : Conventional Organic Practice (CO)
T ₁₁ : Control (c)

Note: Inhana Rational Farming Technology developed by Dr. P. Das Biswas, Founder Director of Inhana Biosciences and a noted scientist who was pioneering in introduction of Scientific Organic Farming in India from the last decade; is a unique Organic Package of Practice which blends ancient wisdom with scientific knowledge, ensuring an effective road map for successful and large scale organic agriculture (Barik *et al.*, 2014). To get a method for judging the system, a well-structured step by step framework was used for calculating soil quality index with analysis of a large numbers of soil parameters/indicators. The details of the parameters analysed are given below (Table 2).

Table 2: Parameters analyzed

Following variables were measured on 0, 60 and 150 days post application of soil inputs during 2010-2011		
	Top soil	Sub soil
pH	Exchangeable- NH ₄	pH
EC	Fixed- NH ₄	EC
CEC	Exch. NO ₂ +NO ₃	Organic carbon
Organic carbon	Total bacterial count	Available- N
Available- N	Total fungal count	Available- P ₂ O ₅
Available- P ₂ O ₅	Total actinomycetes count	Available- K ₂ O
Available- K ₂ O	Total ammonifiers	Available- SO ₄ ²⁻
Available- SO ₄ ²⁻	Total Nitrosomonas	Total bacterial count

Readily available- N	Total nitrofactor	Total fungal count
Total mineralizable N	Total PSB	Total actinomycetes count
Total NH ₄	Soil respiration	

This was followed by a rigorous screening for few indicators (minimum data-set/master variables) through few statistical tools (given below) from a pool of indicators and subsequently married them together to have a unique value, what we called soil quality index (SQI). The details of how the master variables were screened and integrated into a combinable soil quality index.

D. Methodology used for calculating soil quality

Data screening: We reduced the data to a minimum data-set (MDS) of soil quality indicators through a series of univariate and multivariate statistical methods using SPSS 10.0 software. Parametric (Balanced Incomplete Block Design) statistical method was used to identify indicators with significant treatment differences. Only variables with significant differences between treatments ($P < 0.05$) were chosen for the next step in MDS formation.

Choosing representative variables: We then performed standardized principal component analysis (PCA) for each statistically significant variable. There are several strategies for using PCA to select a sub-set from a large data-set. We assumed that principal components receiving high eigen values and variables with high factor loadings best represent system attributes, and examined only the principal components that explained at least 5% of the total variation or corresponding eigen values more than 1. Within each principal component (PC), only highly weighted factors, i.e., those with absolute values within 10% of the highest weight, were retained for the MDS.

Reducing redundancy: To reduce redundancy and rule out spurious groupings among the highly weighted variables within each PC, we used pair wise Pearson's correlation coefficients to determine the strength of the relationships among variables. Well-correlated variables were considered redundant and candidates for elimination from the data-set. The choice among well-correlated variables could also be based on practicality (i.e., ease of sampling, cost, and interpretability). Conversely, any uncorrelated, highly weighted variables were considered important and, therefore, retained in the MDS.

MDS validation: We ran multiple regressions analysis using the final MDS components as the independent variables and each management-goal attribute e.g., yield, as a dependent variable. This regressions analysis served to check the MDS representation of management system goals.

Indicator transformation (scoring): After determining the variables for the MDS, every observation of each MDS indicator was transformed for inclusion in the SQI methods examined. Linear scoring technique was used. In this technique, indicators were ranked in ascending or descending order depending on whether a higher value was considered "good" or "bad" in terms of soil function. For 'more is better' indicators,

each observation was divided by the highest observed value such that the highest observed value received a score of 1. For 'less is better' indicators, the lowest observed value (in the numerator) was divided by each observation (in the denominator) such that the lowest observed value receives a score of 1. For some indicators, such as pH, Bulk density, available- P etc. observations were scored as 'higher is better' up to a threshold value (e.g. pH 6.5) then scored as 'lower is better' above the threshold.

Indicator integration into indices: Two soil quality indices were compared: an additive SQI and a weighted additive SQI. The additive index was a summation of the scores from MDS indicators. In the weighted additive index after transformation, the MDS variables for each observation were weighted using the PCA results. Each PC explained a certain amount (%) of the variation in the total data-set. The percentage, standardized to unity, provided the weight for variables chosen under a given PC. We then summed the weighted MDS variables scores for each observation. Higher index scores were assumed to mean better soil quality. In essence the following statistical tools were used:

Screening of Minimum Data-Set (MDS) through:

- Balanced Incomplete Block Design,
- Principal Component Analysis (PCA), and
- Within component correlation study

Validation of the results by:

- Multiple regression analysis (full model) - using crop yield as independent variables.

III. RESULTS AND DISCUSSIONS

Comparative effectivity of different organic package of practice were evaluated and is presented in table 3A and Table 3B. Highest crop performance was obtained in IRF-3 (5518 kg ha⁻¹) followed by VMI (5267 kg ha⁻¹), IRF-1 (5241 kg ha⁻¹), IRF-4 (5223 kg ha⁻¹) and VMIP (5099 kg ha⁻¹). Crop productivity under IRF-3 is 45.67 % higher than that of control plots. However lowest cost was incurred under IRF-1 (Rs. 9552/ ha) followed by IRF-2 (Rs. 10,756/ ha), IRF-3 (Rs. 11,702/ ha) and CO (Rs. 14187/ ha). However considering the cost per kg green leaf production, out of 5 lowest per kg production cost, four IRF package took the first 4 places. Hence, in terms of economically sustainable crop production IRF is the most competent organic packages of practice.

Table 3A: Crop performance (kg green leaf/ ha) & cost per hectare under different Packages of Practice (bush population 10930/ha, 3 yrs. av. yield)

Rank	Packages of Practice	Green Leaf (kg/ha)	(% over control)	Cost/ ha (Rs.)	Cost/kg green leaf
1.	T ₁ : Vermicompost + Conventional Organic Practice (VCO)	4734	24.97	40121	8.48
2.	T ₂ :Vermicompost + Microbial Formulations for Plant (VMIP)	5099	34.61	47041	9.23
3.	T ₃ :Vermicompost + Microbial Formulations for Soil & Plant (VMI)	5267	39.04	66466	12.62
4.	T ₄ :Microbial Formulations for both Soil and Plant Management (MI)	4187	10.53	28866	6.89
5.	T ₅ :Inhana Rational Farming with 2.6 ton Novcom Compost (IRF 1)	5241	38.36	9552	1.82
6.	T ₆ :Inhana Rational Farming with 4.0 ton Novcom Compost (IRF 2)	4885	28.96	10756	2.20
7.	T ₇ :Inhana Rational Farming with 5.1 ton Novcom Compost (IRF 3)	5518	45.67	11702	2.12
8.	T ₈ :Inhana Rational Farming with 8.0 ton Novcom Compost (IRF 4)	5223	37.88	14196	2.72
9.	T ₉ :Biodynamic Package of Practice (BD)	4004	5.70	14914	3.72
10.	T ₁₀ :Indigenous compost (FYM) + Conventional Organic Practice(CO)	4716	24.50	14187	3.01
11.	T ₁₁ :Control	3788	0.00	-	-

Variation in soil quality was studied before initiation of experiment and after 2 years i.e. post completion of experiment (Table 3B). Soil of all the experimental plots were strongly to moderately acidic in reaction, pH varying from 4.25 to 4.55. After application of compost for consecutive 2 years, pH of the soil samples was found to increase. The organic carbon content in the experimental plots ranged from 0.50 to 0.82 percent and in all the cases, increase in soil organic carbon is noticed with application of compost (Bera *et al*, 2013b) Post experiment, increase in organic carbon content varied significantly among the different treatment plots ranging from 27.93 to 59.24 percent.

Microbial activity is probably the most important factor that controls nutrient re-cycling in soil. Micro organisms participate in disintegration and decomposition processes leading to the release of nutrients trapped in plant and animal debris, rock and

minerals as well as synthesize and release hormones that are essential for plant growth (Gogoi *et al.*, 2003). Soil microbial population in terms of total bacteria, fungi and actinomycetes were studied for the different treatment plots in order to assess changes in their population before and after compost application for 2 consecutive years. In general, soil microbial population (irrespective of any specific type) was found to increase post application of organic soil inputs in all the treatment plots. Similar observation was made by Chitravadivu *et al.* (2009) in their study. However increase in microbial pollution was found to be highest in case of Novcom compost applied plots as compared to other treatment plots, which might be due to the very high self-generated microbial population within Novcom compost (Seal *et al*, 2012; Dolui *et al*, 2013; Bera *et al*, 2013a; Sarker *et al*, 2012; Bera *et al*, 2012a)

Table 3B: Post – experiment soil quality parameters under selected organic packages of practices under different growth stage of tea plantation

Soil Quality Parameters	First five Organic Packages of Practices in terms of crop performance				
	T ₂ : VMIP	T ₃ : VMI	T ₅ : IRF-1	T ₇ : IRF-3	T ₈ : IRF-4
Physico-chemical and fertility parameters					
pH (H ₂ O)	4.80 (4.47)	4.96 (4.55)	4.87 (4.35)	4.79 (4.25)	4.86 (4.30)
EC (dsm ⁻¹)	0.04 (0.05)	0.04 (0.04)	0.03 (0.06)	0.05 (0.06)	0.05 (0.05)
Org. C (%)	1.04 (0.81)	1.18 (0.76)	0.99 (0.68)	1.12 (0.70)	1.05 (0.72)
Available- N	350.63 (436.36)	362.89 (427.85)	347.52 (440.13)	364.30 (425.17)	363.23 (474.81)

Available- P ₂ O ₅	62.59 (20.27)	53.43 (18.30)	53.43 (24.29)	62.59 (22.81)	76.33 (21.92)
Available- K ₂ O	210.27 (222.88)	252.96 (223.59)	218.45 (217.87)	296.04 (259.88)	264.27 (261.31)
Available- SO ₄ ²⁻	30.44 (12.59)	34.28 (11.77)	29.91 (13.06)	41.97 (10.55)	40.22 (12.36)
Total microbial count (c.f.u. per gm moist soil express in log₁₀ value)					
Bacteria	7.69 (4.93)	7.56 (4.84)	7.76 (4.77)	7.74 (4.92)	7.91 (4.90)
Fungi	5.34 (4.80)	5.43 (4.72)	5.11 (4.70)	5.69 (4.89)	5.35 (4.86)
Actinomycetes	4.68 (4.13)	4.88 (4.10)	5.11 (4.05)	5.34 (3.99)	5.01 (3.94)

Statistical Analysis: Variables studied during 2010-11 for both sub and top soils, which had significant treatment effect are displayed in Table 4a and 4b. These variables were subjected to PCA where 15 components were extracted with the criteria of eigen values more than 1. These components could explain

94.10% of the total variance. Within each component the highly loaded variables were further evaluated for their pair wise simple correlations. Only those highly loaded variables will be considered for MDS which are independent (table 6).

Table 4a: Variables which had significant treatment effect due to BIBD analysis at sub soil

Year	Day	Sub soil	Year	Day	Sub soil	Year	Day	Sub soil
2009	0	Av. P ₂ O ₅	2010	0	Fungal count	2010	150	pH
		Av. K ₂ O			Actino count			EC
		Av. SO ₄ ⁻²	2010	60	pH			Organic carbon
2009	150	Av. N			Org. C	2011	0	Av. N
		Av. P ₂ O ₅			Av. N			Av. P ₂ O ₅
		Av. K ₂ O			Av. P ₂ O ₅			Av. K ₂ O
2010	0	Av. N	2010	60	Av. K ₂ O			Av. SO ₄ ⁻²
		Av. P ₂ O ₅			Av. SO ₄ ⁻²			Bacterial count
		Av. K ₂ O			Bacterial count			Fungal count
		Av. SO ₄ ⁻²			Fungal count			Actino count
		Bacterial count			Actino count			

Table 4b: Variables (top soil) which had significant treatment effect due to BIBD analysis

Year	Day	Top soil	Year	Day	Top soil	Year	Day	Top soil
2009	60	Readily Av. N	2010	60	pH	2010	150	Ex. NO ₂ +NO ₃
		Ex. NO ₂ +NO ₃			EC			Total bacterial count
		Total Nitrosomonas			CEC			Total actino count
		Soil respiration			Organic carbon			Total ammonifiers
2009	150	CEC			Av. N			Total Nitrosomonas
		Av. P ₂ O ₅			Av. P ₂ O ₅			Total nitrobactor
		Av. K ₂ O			Av. K ₂ O			Total PSB
		Av. SO ₄ ⁻²			Av. SO ₄ ⁻²			Soil respiration
		Readily Av. N			Readily Av. N	2011	0	CEC
		Total mineralizable N			Total mineralizable N			Av. K ₂ O
		Total NH ₄			Total NH ₄			Readily Av. N
		Exchangeable NH ₄			Exchangeable NH ₄			Total mineralizable N
		Fixed NH ₄			Fixed NH ₄			Total NH ₄
		Ex. NO ₂ +NO ₃	2010	60	Ex. NO ₂ +NO ₃			Exchangeable NH ₄
		Total Nitrosomonas			Total bacterial count			Fixed NH ₄
		Total nitrobactor			Total fungal count			Ex. NO ₂ +NO ₃

2010	0	CEC	Total actino count	Total bacterial count
		Av. N	Total ammonifiers	Total fungal count
		Av. P ₂ O ₅	Total Nitrosomonas	Total actino count
		Av. K ₂ O	Total nitrobactor	Total ammonifiers
		Av. SO ₄ ⁻²	Total PSB	Total Nitrosomonas
		Readily Av. N	Soil respiration	Total nitrobactor
		Total mineralizable N	2010	150
		Total NH ₄	pH	
		Exchangeable NH ₄	CEC	
		Fixed NH ₄	Organic carbon	
		Ex. NO ₂ +NO ₃	Av. N	
		Total bacterial count	Av. P ₂ O ₅	
		Total fungal count	Av. K ₂ O	
		Total ammonifiers	Av. SO ₄ ⁻²	
		Total Nitrosomonas	Readily Av. N	
		Total nitrobactor	Total mineralizable N	
		Total PSB	Total NH ₄	
		Soil respiration	Exchangeable NH ₄	
			Fixed NH ₄	

Table 5: List of MDS variables

Year	Day	Soil	Variable	Code	Year	Day	Soil	Variable	Code
2009	0	Sub	Av. K ₂ O	v2	2010	60	Top	Total ammonifiers	v65
	60	Top	Ex. NO ₂ +NO ₃	v5		60	Top	Total Nitrosomonas	v66
	60	Top	Soil respiration	v7		60	Sub	pH	v70
	150	Top	Av. K ₂ O	v10		60	Sub	Total fungal count	v77
	150	Top	Total mineralizable N	v13		150	Top	CEC	v80
	150	Sub	Av. P ₂ O ₅	v21		150	Top	Av. P ₂ O ₅	v83
2010	0	Top	Av. P ₂ O ₅	v25	2011	0	Top	Total actino count	v119
	0	Top	Ex. NO ₂ +NO ₃	v33		0	Top	Total ammonifiers	v120
	60	Top	Total fungal count	v63					

Table 6, displays the list of MDS variables screened out by PCA followed by correlation among highly loaded variables within each component. Linear

(additive) and weighted linear (additive) soil quality index are calculated and stacked bars are drawn as displayed in Figures 1 and 2.

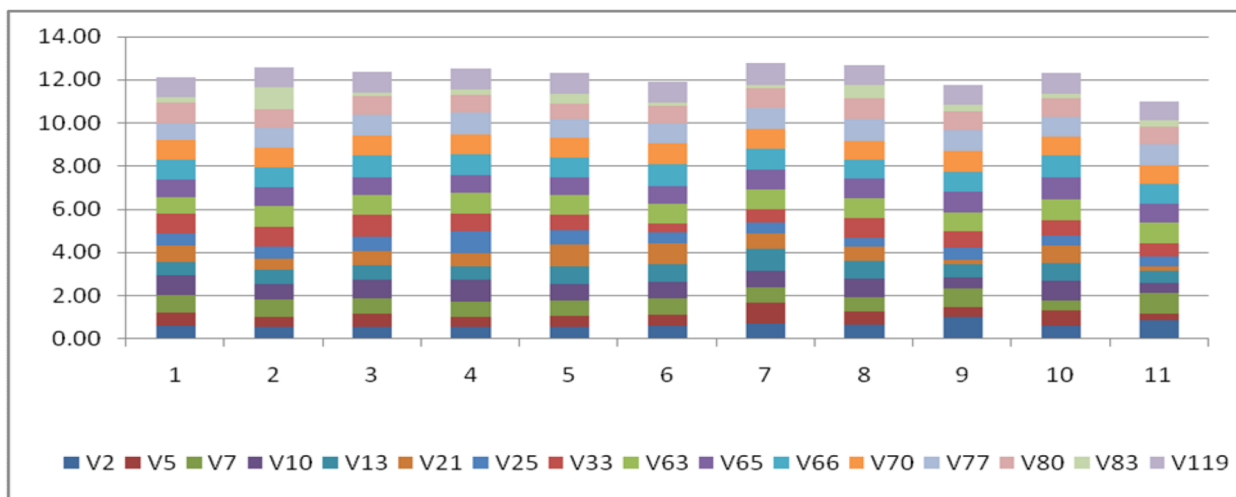


Fig.1. Stacked bar involving additive SQI of MDS variables which revealed the best treatments or package of practices with higher peaks

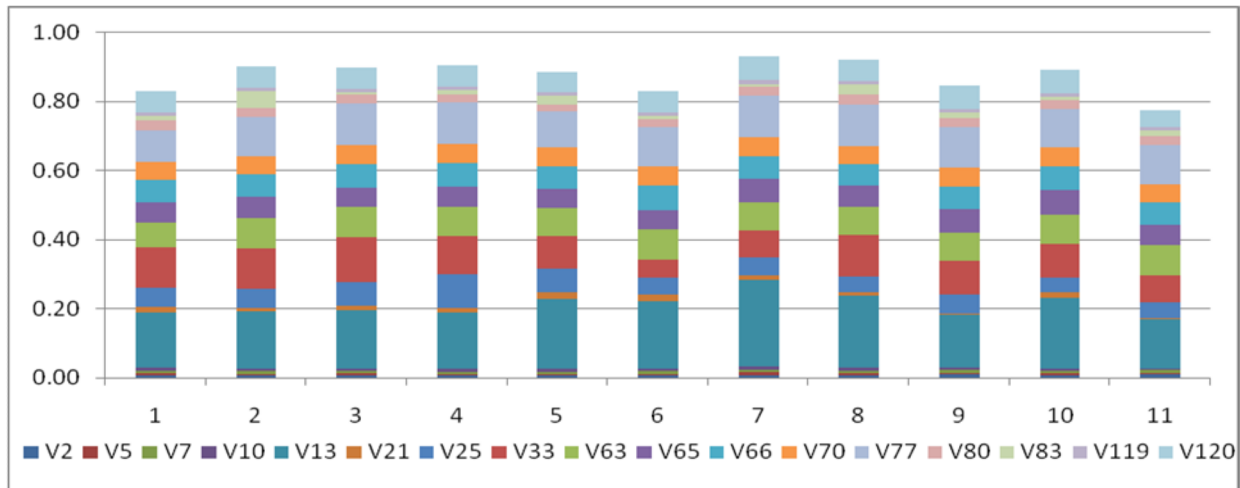


Fig.2. Stacked bar involving weighted additive SQI of MDS variables which revealed the best treatments or package of practices with higher peaks

An attempt was also made to find relationship between the estimated and observed yield following full model multiple regression technique where MDS variables are considered as predictor variables and total yield during whole study period as dependent one. Table 5 displays

the regression results and Fig. 3 includes the association between observed yield and estimated yield following such technique. Such analysis could result in R square as much as 0.58%.

Table 6: Regression results

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
(Constant)	-25023.61	21220.59		-1.18	0.26	
V2	3.22	8.85	0.11	0.36	0.72	
V5	-24.19	9.46	-0.61	-2.56	0.02	*
V7	104.12	101.35	0.21	1.03	0.32	
V10	-2.49	4.27	-0.13	-0.58	0.57	
V13	47.96	16.85	1.00	2.85	0.01	**
V21	19.13	13.26	0.35	1.44	0.17	
V25	-3.81	35.13	-0.03	-0.11	0.92	
V33	29.73	11.54	0.72	2.58	0.02	*
V63	3071.96	2381.46	0.60	1.29	0.21	
V65	-505.48	1205.84	-0.11	-0.42	0.68	
V66	-914.60	4430.23	-0.10	-0.21	0.84	
V70	4053.41	3160.07	0.32	1.28	0.22	
V77	-1971.33	1668.38	-0.46	-1.18	0.25	
V80	189.29	499.13	0.14	0.38	0.71	
V83	-36.88	63.80	-0.20	-0.58	0.57	

Regression results revealed that V13 and V33 have significant positive contribution and V5 has significant negative contribution towards total yield.

Figure 3 shows a close relationship between actual crop yield and estimated crop yield calculated through principle component analysis of soil analytical values.

This indicated that crop response has a very strong relationship with soil quality. Hence it can be interpreted that any organic package of practice which ensure soil quality development in a time bound manner will also support the crop sustainability (Bera *et al*, 2011; Bera *et al*, 2013d)

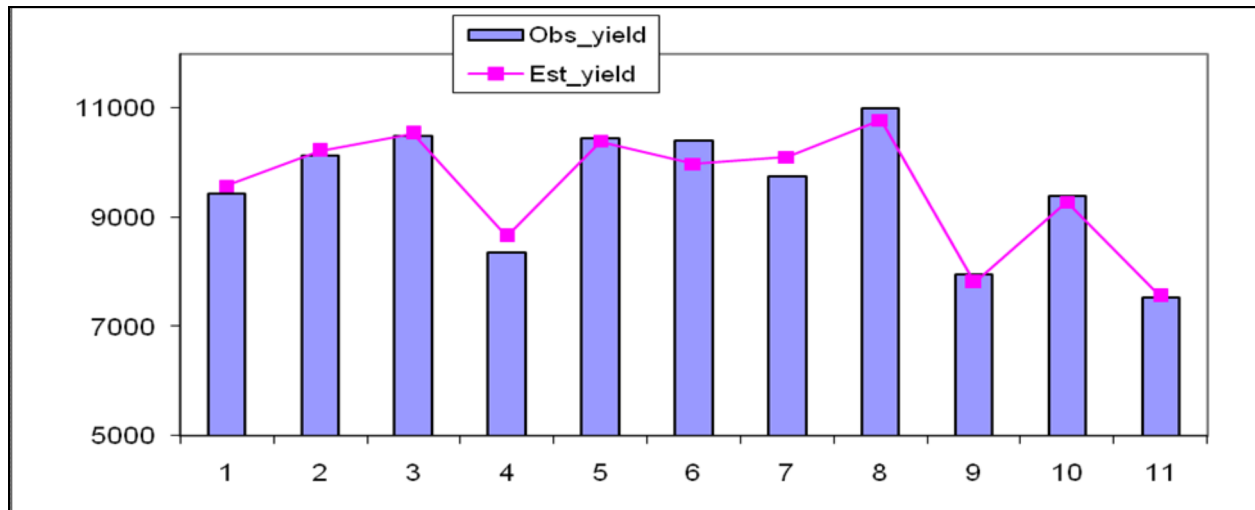


Fig.3. Relationship between observed and estimated yield under different package of practices as obtained by multiple regression analysis.

IV. CONCLUSION

Organic soil management is slowly becoming a necessary compulsion not only for organic conversion but also to restrict productivity depletion under chemical farming practice. Organic soil management will be successful only if the focus is shifted from quantitative to qualitative approach. The qualitative approach starts with the selection of good quality organic inputs through laboratory assessment using standard protocol. At the same time development of soil quality index to measure the effectivity of organic management can help in practical assessment and justification of the qualitative approach, ultimately leading to higher crop response. Inhana Rational Farming technology proved to be the most potential package of practice among all other organic management practice towards crop sustainability and soil quality development.

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