Impact of Soil Health Card on use of Chemical Fertilizers: A study in Sriganganagar (Rajasthan)

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CONTENTS

Abstract

Soil quality has worsened due to increased use of Chemical Fertilizers especially Urea, Muriate of Potash and Single Super Phosphate as a means to increase farm output. Soil Health Card aims to improve productivity sustainably through prudent use of fertilizers. Through this paper, we seek to analyse whether or not there has been a change in behaviour of farmers in use of fertilizers after they received the cards. Our study is based out of Sriganganagar (Rajasthan), where this scheme was launched. We further sought to study what factors lead to a difference in awareness level amongst farmers. From our observation, it is evident that so far there has been no significant change in the fertilizer consumption level of farmers on receiving Soil Health Card. We analyse the role of Gram Sevak as an important link in creating awareness in between farmers. We also find, there is a difference in awareness level of the scheme and benefits of astute use of chemical fertilizers with respect to caste, landholding size and others.

Keywords: Agriculture, Chemical Fertilizers, Gram Sevak, Soil Health Cards

1. INTRODUCTION

In its bid to achieve self-sufficiency in food production and overcome chronic hunger; India ushered into a new era with advent of Green Revolution, which focused on increasing food production and agricultural yield by intervention of higher-yielding variety seeds, extension of irrigation facilities and use of chemical fertilizers. These measures did help India in its pursuit of achieving self-sufficiency in food production subsequently food security. Empirical work done by *Chand and Pandey 2009* validates the fact that growth in crop output has followed the cycle of growth in fertiliser use. However, this belief has led to a culture of reckless and incessant use of chemical fertiliser by farmers. With decreasing profit margins on food crops, land fragmentation and no scope of expansion in cultivable land; farmers use chemical fertilisers recklessly without bothering about its consequences.

Usually farmers use fertilisers to enhance productivity of their crops. In our analysis we mostly take considerations of three categories of fertilisers used by farmers, viz. Urea, Single Super Phosphate and Muriate of Potash[1]. These fertilisers mainly supply Nitrogen, Phosphorus and Potassium respectively to the plants. Nitrogen is needed by the plants for leaf growth; Phosphorus for development of roots, flowers, seeds, fruit; while Potassium is used for stem growth, movement of water in plants etc. Farmers also use different micronutrients, which are used for fulfilment of different purposes and needs to be replenished over long periods. Another category of fertilizers used is Organic Fertilizers. Organic fertilizers are basically of organic origin comprising animal and vegetable matters. Organic fertilisers are gaining prominence due to the fact that they are considered sustainable.

Chemical fertiliser usage in India comprising of Nitrogenous(N), Phosphatic(P), Potassic(K) fertilizers have increased from 2.65 million tonnes (mt) of NPK in 1971–72 to 28.12 mt in 2010–11 (*Ramesh Chand, Pavithra S 2015*). Literature suggests that fertilizer usage in India is highly skewed. Most of the farmers do not use soil testing procedures to check the requirement of various NPK fertilizers and other micro nutrients. Although ideally desired N,P and K ratio of 4:2:1 is considered sustainable. Further, as the requirement of N, P and K varies from crop to crop and from one type of soil to another type, the norm for N, P and K ratio is bound to be different for different regions representing different cropping patterns, soil types, and their nutrient status at a given point of time. But studies show that it is highly imbalanced 8.2:3.2:1(2012-13 data)[2] resulting into adverse effect on productivity of the soil(Ramesh Chand et al 2015). While in some states fertilizer usage is at more than required level while 12 major states are found deficient. The NPK ratio - a measure of balanced use of fertilizer - shows wide inter-state disparity. Though there has been an impressive growth in the consumption of fertilizers, their reckless use has been one of the reasons for declining productivity in recent years.

Investigations done by NABARD have further revealed that one reason for the unbalanced fertilizer use is due to lack of adequate soil testing facilities that has forced the farmers to rely on fertilizer dealers for advice on the fertilizer requirement.[3]

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1. Single Super Phosphate and while Muriate of Potash are denoted by SSP and MOP.
2. Source: Raising Agricultural Productivity and Making Farming Remunerative for Farmers* NITI Aayog, Government of India 16 December 2015.
3. Knowledge Bank" Establishing Static Soil Testing", National Bank for Agriculture and Rural Development

Health and sustainable use of soil has become an integral part of sustainable development agenda of United Nations; United Nations earlier having declared 2015 as International Year of Soil, to promote investment in sustainable soil management activities to develop and maintain healthy soils for different land users and population groups, as one of its objective.

In order to promote balanced use of fertilizers, Department of Agriculture & Co-operation launched during 1991-92 a Centrally Sponsored Scheme entitled "Balanced and Integrated Use of Fertilizers". In 2007-08, Government of India launched National Project on Management of Soil Health and Fertility to this end. NDA government relaunched this as a new scheme in current format at Suratgarh in Sriganganagar district on *17th February 2015*. Government of India's flagship program Soil Health Card Scheme aims to issue soil health card to 140 million farmers by end of 2017-18. Government of India, under this scheme issues soil health card to farmers which carry crop wise recommendations of different fertilisers and micronutrients required by farms which will help them grow their output sustainably.

The soil sample after being taken to soil testing laboratory undergo different tests as per the Standard Operating Procedure, and post analysis different recommendations are given for different crops based on some predefined criteria.

Since, major factor in decline of productivity is now attributed to decline in productivity of land; this scheme aims to improve productivity of the soil by focussing on imbalanced use of fertilisers, low addition of organic matter and non-replacement of depleted micro and secondary nutrients over the years.

a. Structure of Laboratory

Soil testing laboratory has got a pivotal role in making this scheme a success. Its main objective is to make farmers maintain the soil health by analysing nutrients level of the soils and suggesting the right quantity of major nutrients like nitrogen, phosphorous, potassium and other micronutrients like, Manganese, Boron, Zinc, Iron etc.

The laboratory of Sriganganagar was established with govt. initiative in 1978 in Krishi Vigyan Kendra(KVK) premise. This particular laboratory has been instrumental in extending soil testing facilities to farmers. In close collaboration with Krishi VIgyan Kendra, it has been disseminating information about balanced use of fertilizers, promoting organic farming and creating awareness about sustainable agriculture. As a part of compulsory requirement, people used to get their soil tested before planting Kinnow, a citrus fruit quite popular in Sriganganagar district. Under current format, *Gram sevak*; who is the coordinating and change agent in every village panchayat, is provided with training about soil collection procedure, then is required to disseminate this training to villagers in his area. It is a standard procedure to collect 1 sample for every 2.5hectare for irrigated land and 10 hectare for non-irrigated land.

Upon enquiry of Agriculture officer (Krishi Adhikari) at Soil Testing Laboratory; we came to know that actual analysis of the sample takes some time due to overburdening of this being the only Soil testing laboratory. Further, for the purpose of easing the burden and reaching out to people; Government has planned to set up four new laboratories in different blocks of the district under PPP (Public-Private partnership)mode. A change agent in the form of Gram Sevak has been introduced; whose one of the primary work is also to collect soil samples and teach about the procedure of same. He is the link between farmers and administration in creating awareness about such schemes and facilities.

Through this paper we aim to do a comparative study of how fertilizer usage varies among those who received soil health card and those who didn't. Specific focus has been given to the factors that play a vital role in proliferation and exchange of information among farmers.
Factors such as education, awareness about the scheme, belief in the scheme, rigidity about past consumption have also been analysed.

2. LITERATURE REVIEW:

Most of the studies are focused on sustainable use of fertilisers on the farms. While some of the research are focused on such schemes which were launched by different state governments under different formats, others are focused on projecting unbalanced use of fertilisers by farmers, where much of the work is done.

Chi and Yamada's (2002) work in Mekong Delta region, shows how technology transfer takes place in a farmer community. They also cite *Valera et al. 1987*, regarding difficulty of farmers adapting to something new, putting recommendations into practise, adjustment or rejection of proposal, bringing this into practise and further diffusion to other individuals in the community. They also cite *Mosher 1987*, defining adoption and diffusion. Adoption of an innovation according to Mosher, is the process by which a particular farmer is exposed to, considers, and finally rejects or practises a particular innovation. Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (*Rogers, 1983*).

According to Chi and Yamada, in general, homogeneity of a population in terms of problems, aspiration and needs is an important factor guiding diffusion of any idea: time is also a very important consideration. A very important role is placed on the social structure. The norms, social status, hierarchy can influence the behaviour of an individual and can impede or facilitate the rate of diffusion and adoption of new ideas. We took into considerations these factors while preparing our questionnaire and also at analysis stage.

Makadia (2012) studied regional imbalances and impact of Soil Health Card on fertiliser consumption in Gujarat, who showed positive and significant impact of Soil Health Card on per hectare yield of selected crops. Generally, with Soil Health Card farmers utilized the fertilizers judiciously as per the recommendation of Soil Health Card.

Further analysis has also been done by *Ramappa K. B. et al (2015)*, which showed that level of adoption of the recommendations was very low amongst the farmers, indicating lack of technical advice on method and time of application, difficulty in understanding and following the recommended doses.

A lot of research has also been done on the depletion of soil quality due to overuse of fertilisers. *Mulvaney et al. (2008)* focuses on depletion of soil nitrogen due to overuse of synthetic nitrogen fertilisers.

Study done by *Ramesh Chand et al. (2015)* points towards the imbalanced use of chemical fertilisers and also stressing on the need of a balanced use of fertilisers for sustainable growth and output in agriculture.

3. METHODOLOGY:

a. Sampling and Data collection:

Our analysis of the impact is based on a primary survey that we conducted in *June 2016* in four villages in Sriganganagar district of Rajasthan. Our survey began with a questionnaire related to soil health card; and included variables relevant to the topic in question. The questionnaire began with asking basic information along with other important variables including asset holding, awareness about soil health card, awareness about side effects of recklessly using fertiliser, ways of information dissemination; which we felt farmer would find necessary before taking the decision on whether to continue using the same amount of fertilizer as past. We also had certain subjective questions as to what they feel about the new scheme and role of relevant channels so as to get a holistic picture of the full scheme.

Soil Health Card in its current format was launched from Suratgarh area of Sriganganagar district on 17th February 2015. Traditionally Sriganganagar has been one amongst the highest per hectare fertilizer consuming district of the country and topmost in Rajasthan to be specific.[1]Our sample consists of 88 farmers from 4 villages in Sriganganagar, namely Koni, Fatuhi, Govindpura (18GG) and Kaliyan. These villages were selected because as per the information from Joint Directorate, Agriculture Extension and ATMA Sriganganagar, Soil Health Cards had been distributed in these 4 villages before March 2016.

We reached there after sowing of the next Kharif crop and collected information about the fertilizer use in terms of Urea, MOP and SSP per Bigha[2] in previous agriculture season(Kharif 2015 and Rabi 2014) and the current one(Kharif 2016 and Rabi 2015). In each village we went through the village randomly for the purpose of collecting information from villagers. We randomly selected farmers in villages and interviewed them in detail about their cropping patterns and production, use of fertilisers, their asset ownership. We recorded these information in detail from a total of 88 farmers from both who held Soil Health Cards and those who did not. At the very onset we also visited and interviewed soil laboratory officials, captured and learnt the basic nuances of soil collection and soil testing. We also interviewed "Gram sevak" of each village post interview of farmers. Gram sevak as a change agent is an important link between administration and the farmers in Rajasthan.

b. Study Area:

Sriganganagar also known as the breadbasket of Rajasthan is the northernmost district of Rajasthan. Sriganganagar's growth and agriculture was fuelled by 89 mile long Ganga Canal which bought the waters of Sutlej River into this region. Sriganganagar, which is a plain region with much climatic variation throughout the year. Mean average rainfall of the district is 20.70 cm. The temperature varies from a maximum of around 48 Degree C to a minimum of 0.6 Degree C. Although the region lies in the great Thar Desert, irrigation with the help of Ganga and IGNP canal have helped grow this region into a bastion of agriculture. Major crops grown in Sriganganagar include Wheat, Cotton, Mustard, Guars, Grams and Sugarcane. Kinnow, a citrus fruit is also quite popular in this region.

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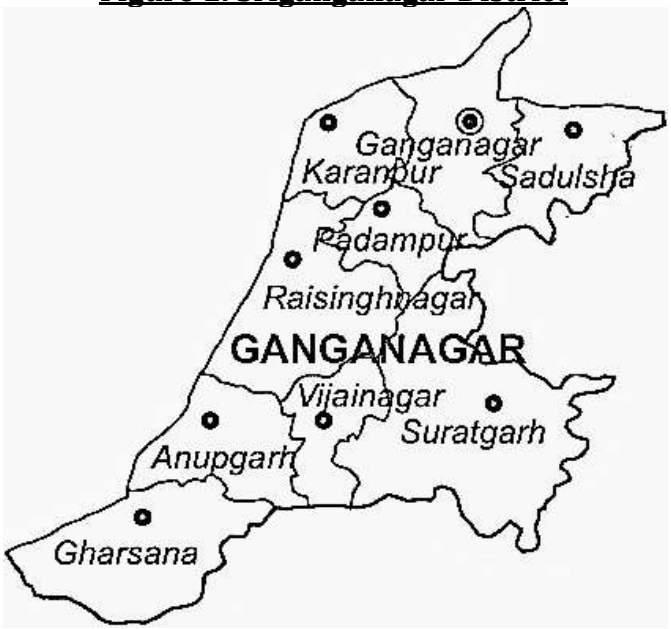
1. Compendium on Soil Health, Ministry of Agriculture, Department of Agriculture and Cooperation (INM Division) January 2012.
2. 1 Bigha = 0.25 Hectare.

Figure 1: Sriganganagar District

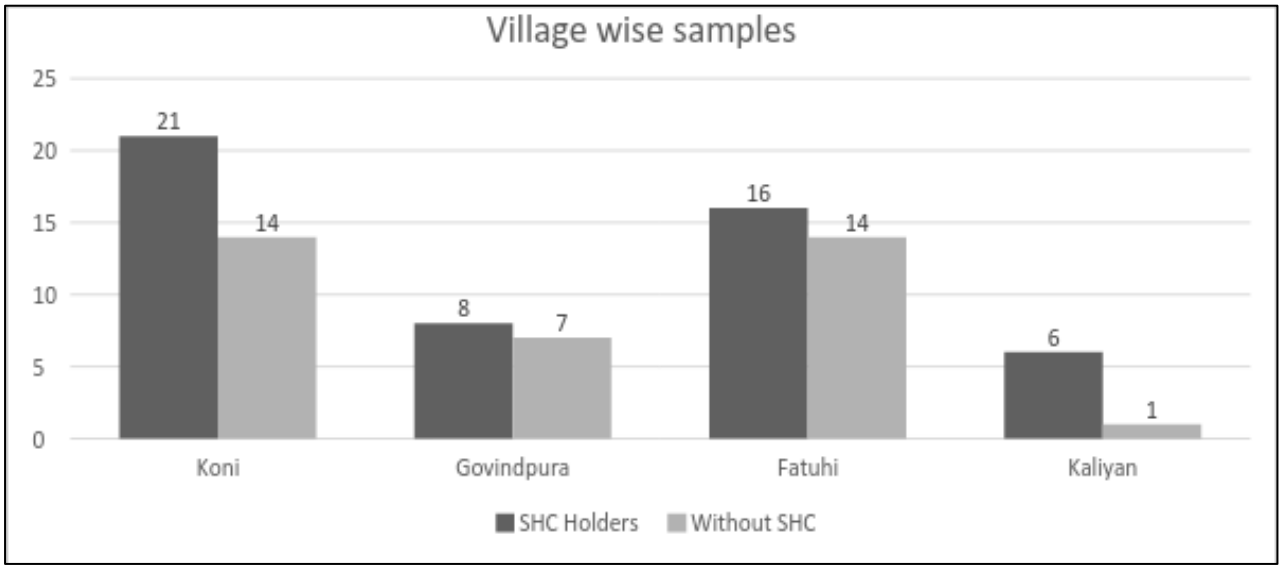


4. EMPIRICAL ANALYSIS:

a. Summary Statistics:

Our sample consisted of a total of **88** farmers out of which 52 farmers had received soil health card and 36 farmers did not. Village wise distribution of Soil health card holders out of our sample is given below in Figure 2.

Figure 2: Village wise distribution of Soil Health Cards in the sample.



Source: Based on Primary survey

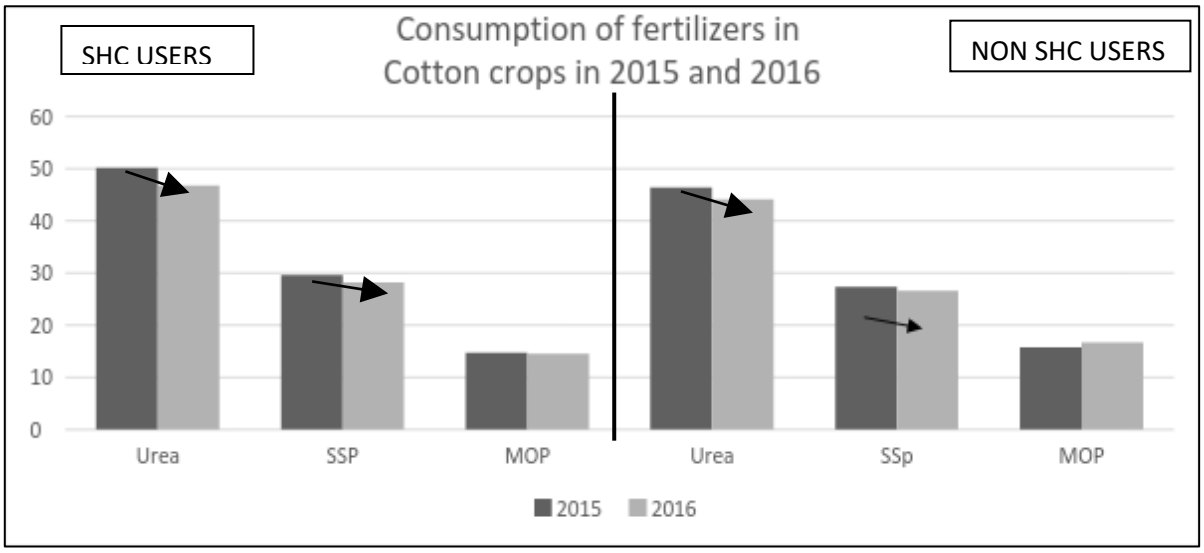
Summary statistics for the whole sample of the different fertiliser viz. Urea, Single Super Phosphate (SSP) and Muriate of Potash(MOP) used by all the farmers is entailed in the table below.

Table 1: Summary of fertilizer use across whole sample.

Fertiliser	Crop and Year	Mean fertiliser use (Kg/Bigha)	Std.Dev. (Kg/Bigha)	Min (Kg/Bigha)	Max (Kg/Bigha)
Urea	**Cotton 2015**	47.94	22.09	0	125
Urea	**Cotton 2016**	45.09	19.08	0	125
SSP	**Cotton 2015**	27.92	22.28	0	50
SSP	**Cotton 2016**	26.51	21.84	0	50
MOP	**Cotton 2015**	14.98	12.93	0	50
MOP	**Cotton 2016**	15.41	13.09	0	50
Urea	**Wheat 2014**	56.81	17.65	20	125
Urea	**Wheat 2015**	54.58	17.11	0	125
SSP	**Wheat 2014**	9.09	18.45	0	50
SSP	**Wheat 2015**	9.09	18.45	0	50
MOP	**Wheat 2014**	26.40	11.68	0	50
MOP	**Wheat 2015**	26.70	11.72	0	50

Here we see a wide variation in the usage of different fertilizers by the farmers. Fertilizer usage of farmers varies over both the years for same crops. Here, we try to capture at best the variation of fertilizer use by farmers in our sample. As can be seen, farmer's use of urea has reached a maximum of 125Kg/Bigha; which is quite large as compared to the mean as well as recommended fertilizer use on an average. As per our observation, the recommended usage of fertilizer is somewhat closer to the Mean fertilizer use. Although there was a general consensus amongst the farmers regarding decreasing the use of fertilizers; reasons of which varied from fear of yield loss to at times myths; some of the farmers still used high quantity of fertilizers since they had a belief that decreasing fertilizer use would lead to a loss of yield.
We then moved on to see the trend of different fertilizer use amongst both SHC holders and Non SHC holders in 2015 and 2016 for cotton crop (Kharif) and wheat crop (Rabi).

Figure 3: Usage of fertilizer per bigha for all the farmers in Cotton crop.



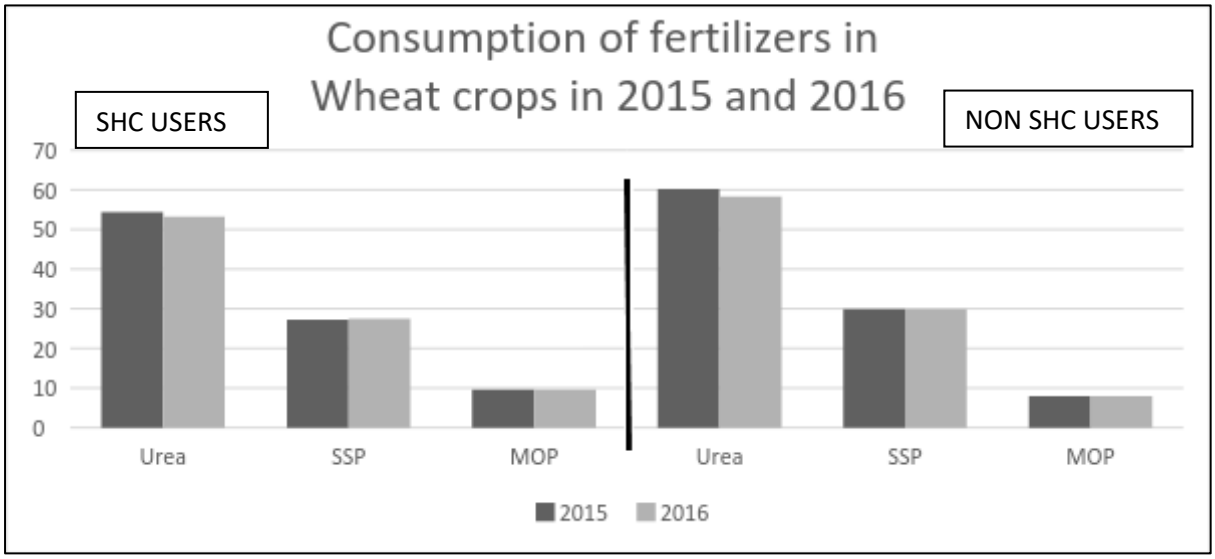
As is evident from the Figure 3, in case of cotton crop there was a decrease in the Average Urea and SSP consumption in either case, whether or not farmers received Soil Health Cards. One thing which we noticed during our interaction with farmers and may be related to decrease in Urea consumption could be increase in *whitefly infestation* for past 3 years, which has become a menace in this region. Whiteflies are small insects that typically feed themselves on the plant leaves. Theyspecially inflict severe damage to cotton crops.

As per the guidelines issued by Central Institute for Cotton Research, Nagpur[1]; the outbreak was caused mainly due to human interventions which led to conditions suitable for whitefly to survive, reproduce, spread and proliferate. Use of insecticides tend to induce whitefly infestation, mainly because their use tend to kill whitefly's natural predators. One of the other reasons that was found out to be responsible for whitefly's outbreak was the high use of fertilizers. So, CICR recommended using less fertilizers on the field and as split doses. Farmers were also following the same advice. Hence, the farmers may have been induced to use low fertiliser as compared to last year, in cotton crop.

One farmer *Mr. Jodha Ram* from *Fatuhi*, who had suffered huge losses due to whiteflies opined that government has recommended them to reduce use of chemical fertilizers and instead focus on bio fertilizers.

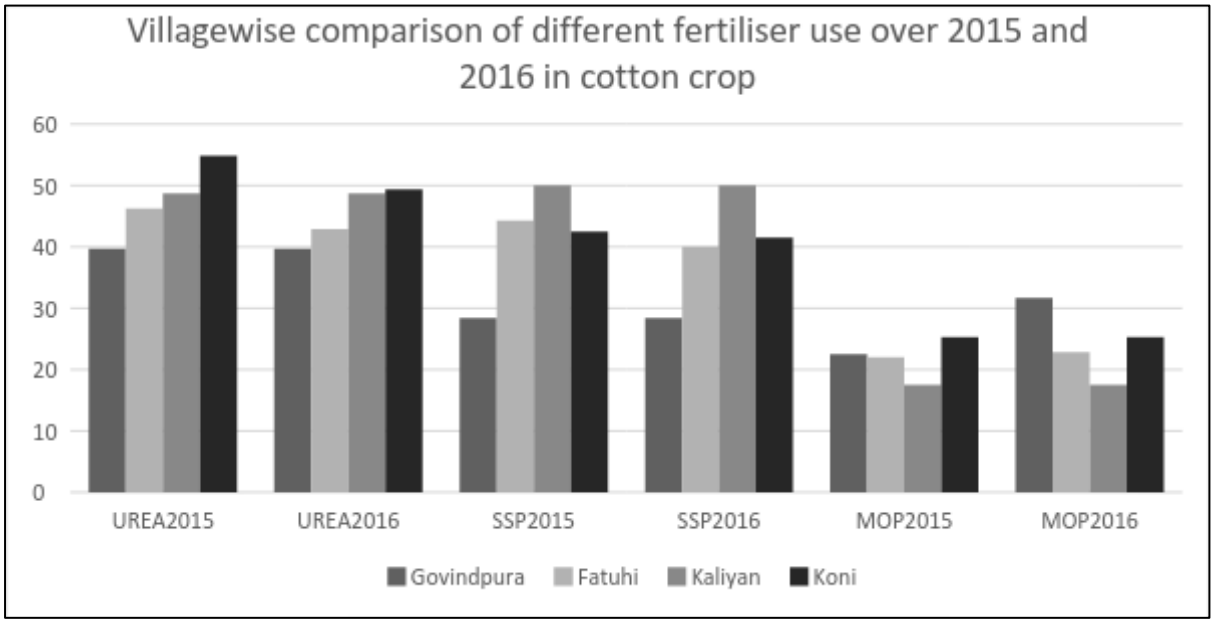
In case of wheat crop, farmers had not yet received Soil Health Cards in either case, 2014 or 2015. Also no definite pattern could be obtained from the observation of above Figure 4, although there there has been a decrease in urea usage in case each case.

Figure 4: Usage of fertilizer per bigha for all the farmers in Wheat crop.



1. Kranthi K. R. "*Whitefly – The Black Story*" Cotton Statistics and News, 23, 2015-16.

Figure 5: Usage of fertilizer per bigha for all the farmers in cotton crop over all the villages.



Evidently, from Figure 5, fertilizer use has varied a lot over the villages and also over years. Urea consumption on average is particularly high in case of Koni village.
From Figure 5,it is clear that fertilizer usage varies from village to village. In our sample we have one village where the average urea usage is as low as 39.73 Kg/Bigha, to 54.87 Kg/Bigha.
Similar variation is also found in usage of SSP and MOP fertilizers. Within a particular village also, the usage of fertilizers reached as high as 125 Kg/Bigha.

Usage of Micronutrients:

Out of the sample of 52 farmers who had SHC 19 used Micronutrients such as Zinc, Sulphur but this number has went down after they received soil health card by 3 to 16

While number of people who used micronutrients on their fields increased by 1 from 6 to 7 in case of farmers who did not receive Soil Health card.

Usage of Organic Carbon:

Similarly, not all the farmers used Organic carbon. Organic carbon is always considered to be on the forefront of sustainable agriculture. Soil organic matter is the key to soil fertility and productivity. This is made by farmers from animal waste, crop residues, urban organic waste etc. In our survey, only 26 farmers used Organic carbon in the previous Kharif season. Distribution of farmers using Organic carbon was distributed in proportion to the numbers using Soil Health Card.

5. RESULTS & ANALYSIS:

We begin our analysis by measuring the impact of various factors that we took into considerations during our survey on change in fertiliser consumption from past year to current year in both crops wheat and cotton separately. Based on our questionnaire, we create a list of variable and an asset index which we use to measure the impact of these variables on our decrease in fertilizer consumption.

Table 2: List of Variables and their definitions

Variable	Definition
village	Out of 4 villages observed; Village1: Govindpura, Village2:Fatuhi, Village 3: Kaliyan, Village 4: Koni
shc	Whether the farmer had received SHC as on March 2016. shc = 1 if farmer received SHC before April 2016 = 0 if farmer did not receive SHC before April 2016
caste	Upon enquiry of caste, we divide our sample into Scheduled Caste and Non Scheduled Caste from central database. Caste = 1, if Not a Scheduled Caste = 0, otherwise.
Gram Sevak's influence	Role of change agent (Gram Sevak) in influencing farmer's decision to change the use of fertilizer.
Change in Urea consumption in cotton as compared to past year (and similarly for other categories of fertilizers and wheat crop)	Change in the quantity of Urea applied to cotton crop in 2016 season as compared to 2015 season.

We present below a general analysis of the findings of our survey. We notice from Table 3, that there has been a decrease in consumption all three fertilizers in case of Cotton crop as compared to the past year. However, in case of wheat, the decrease is only observable in case of urea only.

Table 3: Sample Characteristics of change in different categories of fertilizers.

Variable	Observations	Mean (Kg/Bigha)	Std. Dev. (Kg/Bigha)	Min (Kg/Bigha)	Max (Kg/Bigha)
Change in Urea consumption in cotton as compared to past year	79	-3.54	12.56	-65	25
Change in SSP consumption in cotton as compared to past year	79	-1.08	14.47	-50	50
Change in MOP consumption in cotton as compared to past year	80	-.08	6.64	-25	25
Change in Urea consumption in wheat as compared to past year	69	-2.39	13.47	-100	0
Change in SSP consumption in wheat as compared to past year	71	0	0	0	0
Change in MOP consumption in wheat as compared to past year	71	0.14	1.19	0	10

Before we can move onto analysis of what factors could possibly significantly lead to a change in consumption of different fertilizers, we create two variables comprising of different categories of assets as mentioned in the following section.

Assetindex:

From our primary survey, we create two categories of asset indices;"asset1index"and"asset2index" comprising of similar assets.

"asset1index"comprised of variables including ownership of at least one 4 Wheeler, 2 Wheeler, Fridge, TV, Washing Machine, Smartphone, LPG. Similarly, we include in our analysis "asset2index"comprising of ownership of capitals Tractor, Thrasher, Harrow, Pumping set and Spray Machine. These two categories of assets quite clearly include different categories of assets.

On the basis of ownership of these assets, we declare asset1index as sum of ownerships of at least one 4 Wheeler, 2 Wheeler, Fridge, TV, Washing Machine, Smartphone, LPG, each variable declared as 1 in case it is owned, 0 otherwise.

Similarly, we declare asset2index as sum of ownerships of capitals Tractor, Thrasher, Harrow, Pumping set and Spray Machine, each variable declared as 1 in case it is owned, 0 otherwise.

Definition of asset1index:

asset1index = ∑ f(4 Wheeler)+ f(2 Wheeler)+ f(Fridge) + f(TV) + f(Washing Machine)+ f(Smartphone) +f(LPG).

Where,	f(4 Wheeler)	= 1 in case at least one 4 wheeler is owned, 0 otherwise.
	f(2 Wheeler)	= 1 in case at least one 2 wheeler is owned, 0 otherwise.
	f(Fridge)	= 1 in case at least one Fridge is owned, 0 otherwise.
	f(TV)	= 1 in case at least one TV is owned, 0 otherwise.
	f(Washing Machine)	= 1 in case at least one washing machine is owned, 0 otherwise.
	f(Smartphone)	= 1 in case at least one smartphone is owned, 0 otherwise.
	f(LPG)	= 1 in case at least one LPG is owned, 0 otherwise.

Similarly,

Asset2index = ∑ f(Tractor)+ f(Thrasher)+ f(Harrow) + f(Pumping Set) + f(Spray Machine).

Where,	f(Tractor)	= 1 in case at least one Tractor is owned, 0 otherwise.
	f(Thrasher)	= 1 in case at least one Thrasher is owned, 0 otherwise.
	f(Harrow)	= 1 in case at least one Harrow is owned, 0 otherwise.

f(Pumping Set) = 1 in case at least one Pumping Set is owned, 0 otherwise.

f(Spray Machine) = 1 in case at least one Spray machine is owned, 0 otherwise.

Hence, range of asset1index and asset2index varies from 0 to 5. In our survey, the mean values of asset indices are summarized as below in table 4.

Table 4: Summary of Asset Index 1 and Asset Index 2

Variable	Obs	Mean	Std. Dev.	Min	Max
asset1index	88	3.42	1.22	0	5
asset2index	88	2.41	1.76	0	5

In our linear multiple regression model, we try to understand what factors could possibly influence the farmers behaviour of changing fertilizer use of different categories.

In our analysis we use following regression model:

$$CFC_j = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \alpha_9 X_9 + \alpha_{10} X_{10} + \alpha_{11} X_{11} + \varepsilon_1$$

Where, CFC_j(j=1,2,3): Change in fertilizer consumption as compared to previous cropping period for a particular crop. CFC_j(j=1,2,3) have been explained in detail later in this section.

α_0: Intercept Term, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8, \alpha_9, \alpha_{10}, \alpha_{11}$: Coefficients

X_1: Education level

X_2: Whether dependent on Gram Sevak for Information about seeds and fertilizers

X_3: Whether taught about the procedure of soil collection

X_4: Whether the procedure taught was followed

X_5: Plot size

X_6 Age (Years)

X_7: Asset index 1

X_8: Asset index 2

X_9: Villages

X_{10}: Ownership of Soil Health Card

X_{11}: Caste

Dependent variable: Change in fertilizer consumption for a particular crop as compared to the past year. In our scenario, there are 3 dependent variables, each pertaining to a particular type of fertilizer and for a particular type of crop. So, we have

CFC_1: Change in urea consumption as compared to the past year for cotton crop.

CFC_2: Change in SSP consumption as compared to the past year for cotton crop.

CFC_3: Change in MOP consumption as compared to the past year for cotton crop.

Result of Regression:

Table 5: Result of regression model on change in urea consumption in case of cotton crop

Variable	Coefficient	t value	Standard error
Education level	-0.57	-0.29	1.94
Whether dependent on Gram Sevak for Information about seeds	1.01	0.21	4.86
Whether taught about the procedure of soil collection	22.83	3.31**	6.90
Whether the procedure taught was followed	-0.82	-0.13	6.31
Plotsize	-0.21	-0.91	0.23
Age (Years)	0.39	1.60	0.24
Asset index 1	-1.21	-0.51	2.39
Asset index 2	0.38	1.58	0.24
Dummy Variables			
Villages			
Fatuhi	-23.52	-2.67**	8.81
Kaliyan	-14.77	-1.52	9.70
Koni	-27.56	-3.06**	9.02
Ownership of Soil Health Card	9.28	1.63	5.69
Caste	-18.16	-2.26**	8.05
Constants	-1.98	-0.13	15.62
R sq	0.54		
Adj R sq	0.28		

****statistically significant at 5% level.***

Village Govindpura is omitted Village here.

From the above regression it is evident that intervention of Change agent (Gram Sevak) in teaching about the soil collection procedure has a positive coefficient at a level of 5% statistical significance. It is also observed from the above table that as the village dummy is found to be statistically significant, change in village may have an impact on the behavioural

pattern of the farmers. Another factor that is statistically significant is Caste dummy. It is possible that caste has a central role to play in awareness (as has been inferred in later section) and thus may have had an impact on change in behaviour of farmers.

Table 6: Result of regression model on change in SSP consumption in case of cotton crop

Variable	Coefficient	t value	Standard error
Education	-0.45	-0.43	1.04
Whether dependent on Gram Sevak for Information about seeds	-2.63	-1.00	2.62
Whether taught about the procedure of soil collection	10.52	2.86**	3.68
Whether the procedure taught was followed	1.35	0.40	3.38
Plotsize	1.35	0.40	3.38
Age(Years)	-0.15	3.12**	0.13
Asset index 1	-3.68	-2.84**	1.30
Asset index 2	-0.17	-0.21	0.83
Dummy Variables			
Villages			
Fatuhi	-13.01	-4.04**	4.83
Kaliyan	-14.60	-2.96**	4.93
Koni	-14.60	-2.96**	4.93
Ownership of Soil Health Card	7.41	2.53**	2.93
Caste	-6.84	-1.57	4.35
Constants	5.87	0.69	8.50
R sq	0.61		
Adj R sq	0.40		

****statistically significant at 5% level.***

Similar analysis if done for SSP usage leads to similar result in case of intervention of Change agent (Gram Sevak) in teaching about the soil collection procedure; which again has a positive coefficient with a level of 5% statistical significance. However, in this case; we observe that Age and Asset Index 1 comprising of 4 Wheeler, 2 Wheeler, Fridge, TV, Washing Machine, Smartphone and LPG have statistically significant negative coefficients. As per above table, it is reiterated that the village dummy is found to be statistically significant, change in village may have an impact on the behavioural pattern of the farmers. However, we do not find any statistical significance of the caste dummy.

Table 7: Result of regression model on change in MOP consumption in case of cotton crop

Variable	Coefficient	t value	Standard error
Education	0.93	-0.79	1.18
Whether dependent on Gram Sevak for Information about seeds	.28	0.09	2.98
Whether taught about the procedure of soil collection	-0.31	-0.07	4.18
Whether the procedure taught was followed	-2.54	-0.66	3.84
Plotsize	0.15	0.11	0.14
Age(Years)	0.39	2.66**	0.15
Asset index 1	-1.67	-1.13	1.48
Asset index 2	-0.83	-0.89	0.94
Dummy Variables			
Villages			
Fatuhi	-5.35	-0.97	5.49
Kaliyan	-5.21	-0.86	6.04
Koni	-6.38	-1.14	5.60
Ownership of Soil Health Card	-1.36	-0.41	3.33
Caste	-5.99	-1.21	4.94
Constants	-0.52	-0.05	9.66
R sq	0.31		
Adj R sq	-0.07		

****statistically significant at 5% level.***

Table 7 tells us a somewhat different story, where we have only single variable which is Age with certain statistical significance. No other factor including village dummy, caste, intervention by change agent has statistical significance.

We now move on to one factor which we felt was necessary in order for information dissemination. During our survey, we had asked farmers regarding their awareness of Soil Health Card; whether they knew about the scheme. It was quite natural that awareness would be quite high in Sriganganagar; because the very scheme was launched from this place.

Through following tables, we analyse the factors which could have lead to difference in awareness among different categories of people.

Table 8: Percentage of the people aware of the scheme amongst different categories of people.

CASTE	No of Observations	Number of People aware of scheme	Percentage of People aware of scheme
SC	29	10	35%
Non SC	57	44	77%

Village	No of Observations	Number of People aware of scheme	Percentage of People aware of scheme
Govindpura	14	10	71%
Fatuhi	30	20	67%
Kaliyan	8	8	100%
Koni	35	16	46%

Ownership of Soil Health Card	No of Observations	Number of People aware of scheme	Percentage of People aware of scheme
Does not have a SHC	36	18	50%
Has a Soil Health Card	51	36	71%

People whose source of information is Gram Sevak	No of Observations	Number of People aware of scheme	Percentage of People aware of scheme
Yes	30	20	67%
No & Other Sources	57	34	60%

Landholding size	No of Observations	Number of People aware of scheme	Percentage of People aware of scheme
Less than 5 Bigha	8	7	88%
5-20 Bigha	34	22	65%
20-40 Bigha	30	16	53%
More than 40 Bigha	12	7	58%

We find that awareness of the scheme is particularly *low* amongst people belonging to SC category. Since Gram Sevak is the change agent here, there may be a bias in the approach of Gram Sevak in creating awareness and spreading information about the scheme. There is also a difference of awareness amongst different villages. In our sample, Koni village had lowest awareness of 46% in our sample while all villagers from Kaliyan were at least aware of the scheme. However, one thing which could be noted is that even people having Soil Health Card are not aware about the scheme. Upon asking such farmers we noted that some of them had simply been provided with cards, without even consulted and being told about the benefits.

Mr. Krishna Kumar from Kaliyan told us that Gram Sevak took the sample all by himself even without consultation of farmer and never bothered to explain them various terminologies. Another farmer from Koni village who was facing similar situation of not being consulted, told he was not sure if the recommendations were correct and that he will change his usage only on the recommendations of local seed shop, of whose advice he has always listened to.

Several farmers were apprehensive of the scheme and whole government machinery, instead preferring recommendations by private testing laboratories. One farmer from Govindpura Mr. Govind, reiterated this point and talked of his strong faith and belief in another private laboratory by name of Chambal Fertilizers (defunct now).

Quoting Mr. Guru Charan Singh from Koni, "*Zameen Nashili ho gayi hai*"(Farm has become addicted); we would like to points out that there is some sort of fear amongst the farmers in reducing fertilizer usage, that it might lead to adverse impact on their output. An interesting thing revealed by him was that he kept 1 Bigha aloof of any use of chemical fertilizers for his personal consumption.

The difference is also there in case of different landholding size with people having lower landholdings being more aware of the scheme.

Delving a little bit deeper into the role of Gram Sevak, we realise that their role is critical in creating an environment for proper functioning of this scheme. In the present format, the Gram Sevaks are provided with a prefixed monthly target for collection and distribution of samples. It might be possible that in some scenarios they are simply filling up the requisite targets. In this context we cite, Mr. Rameshwar Lal from Fatuhi who talks about Gram Sevaks merely doing their work to meet the targets and it would be better if the procedure is performed by farmers themselves. Apart from collecting samples for Soil Health Card, Gram Sevaks provide information about crops, seeds, fertilizers and also about elections and other initiatives of the government to the farmers.

Gram Sevak from Govindpura, Mr. Pappu Ram, in relation to above problem talks that farmers at times are not available at field, so they take samples in their absence (while Standard Operating Procedure mandates collecting samples only in presence and cognition of farmers).

Another Gram Sevak from Koni Village, Mr. Jaswant talks of overburdening of their job. He also talks of delay in changing behaviour of farmers due to inertia. According to him farmers approach and listen to his advices only when they are faced with an adverse scenario. Further, farmers approach them only with a view of extracting seeds, fertilizers and agricultural machineries.

Mr. Khemaram, Gram Sevak of Fatuhi, reiterated his position with regards to their jobs being overburdened, while also mentioning the fact that farmers are not taking this very scheme seriously.

Soil Testing Laboratories on the other hand were also constrained with respect to them being overburdened due to huge rush in the ongoing campaign. According to Mr Rajendra Nain, Agriculture Officer at the Soil Testing Laboratory; huge rush had lead to increased queue time for testing and compilation of Soil Health Cards. In case of any malfunction, they needed to send samples to nearest district which is Hanumangarh. To tackle these issues with regards to laboratories, government has planned to open up four new Soil Testing Laboratories in four blocks of Sriganganagar in PPP mode. It is hoped had this initiative will help address some of aforementioned issues.

6. CONCLUSION:

As has already been noted by Chi and Yamada; apart from homogeneity, social structure and behaviour of an individual; *time* is also an important consideration for behavioural change in farmers. Diffusion and adoption of any idea or change needs some time to permeate through common farmers. They also highlight the impact of *change agent* ("*Gram Sevak*" here). As per our analysis Gram Sevaks seems to have an important role in the same. Their role in creating awareness needs to be highlighted, since there appears to be a bias in teaching about the procedures to different categories of people. We find difference in the awareness level of different categories of people. People belonging to SC category were less aware of the scheme as compared to people belonging to Non-SC category. We also saw problems associated with the distribution of Soil Health Cards. Testing Laboratories seem to be overburdened due to huge rush. It is in this light that opening of four new laboratories would pave way for greater diffusion of information and reduced queue time. There is also a problem of farmers not being able to comprehend cards with ease. It can be countered with making them more aware and more engaged with Gram Sevaks. With our study, we strongly recommend strengthening of testing laboratories and other facilities including making Gram Sevaks more accountable in generating awareness.

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