CHAPTER 5: RESEARCH METHODOLOGY

5.1. Importance of the Study

This study emphasizes on the various factors which influence the farmer while buying the fertilizer for his/her land. It also helps in understanding the behavioural changes in farmers after the implementation of NBS subsidy regime. The study also helps in understanding whether the farmer can afford fertilizers and whether their buying capacity has increased or decreased after the subsidy regime.

In farming for better yield, it is very important to check the soil quality time to time. It has been seen in past years that the soil quality has been hampered because of not using the required nutrients that are needed for the better fertility of the soil. This study helps in knowing whether the farmer is well informed about the importance of getting their soil tested and what are the advantages of it.

The study helps in gaining the overall knowledge about the usage of urea and non-urea fertilizers by the farmers. Whereas it also helps in understanding the affordability of fertilizers by the farmers, after NBS policy.

The study also highlights on how the utilization pattern of fertilizers has impacted after the implementation of NBS policy.

5.2. Objectives of the Study

Major objectives of the study were:

- To study the factors which influence farmers while buying fertilizers.
- To study the behavioural change in farmers for fertilizers.
- To study the usage of urea & non-urea fertilizer by the farmer.
- To study the affordability of fertilizers by the farmers, due to the NBS policy.
- To study the post effect of the NBS policy on the agriculture sector.
- To study the production & consumption pattern of Fertilizers in India.
- To study the impact on utilization pattern of fertilizers after the implementation of Nutrient-Based subsidy (NBS).

5.3. Research Design and Tools

5.3.1 Data Sources

To conduct this study data was collected from both primary and secondary sources. The source of primary data is responses from Farmers, Fertilizer Industry Officers, and Fertilizer Distributor/Retailer for better understanding the buying behaviour.

Data was collected from *Farmers* to gather their opinion about the factors which can influence while buying fertilizers, whether their affordability pattern has changed or not. The farmers were from major fertilizer consuming States of India.

Fertilizer Industry Officers were the second source of data collection as they are the people who are into the real business of fertilizer. They have the broad idea of what changes have occurred in the market pre and post the implementation of the NBS policy. Fertilizer Industry Officers were from junior, middle, and senior management of different Public sector, Co-operative sector, and Private sector Fertilizer Companies. The officers were from major fertilizer consuming States of India. Officers were having experience of working at field level, regional level, state level and corporate level. Their experience of working in different states were categorized in two broad categories, i.e., 1-4 states and 5 or more states.

The third source of data collection was the *Fertilizer Distributor/Retailer*. As they play the key role in influencing the farmers while selling the fertilizer products to them. They also helped in understanding how their business has affected after the policy implementation. The distributors/retailers were from major fertilizer consuming States of India, such as Uttar Pradesh, Punjab, Gujarat, Madhya Pradesh, etc. Efforts have been made to collect feedback from distributors/retailers representing important fertilizer consuming belts of the Indian States.

Secondary data was collected from various websites, government reports, books, journals, and newspaper articles.

5.3.2 Data Types

The nature of the data relevant to the research was demographic and behavioural. The demographic profile of the respondents and their behavioural aspects were gathered for the fulfilment of the objectives of study.

5.3.3 Communication Approach

The questionnaire method was adopted for data collection. A self-administered questionnaire was designed for farmers, due to the language constraints it was personally executed for maximizing the response rate.

Similarly, separate open-end questionnaire was prepared for Fertilizer Industry Officers and Fertilizer Distributor/Retailer. The main reason for choosing the open-ended questionnaire was that it allows the language individuals use when responding to a query can provide valuable insights into their beliefs and emotions. They provide more varied and textured information than closed ended questions. The questionnaire was floated through hard copies and some official requested the soft copy, so it was shared through E-mail.

5.4. Sample Design

5.4.1 Sample Population Determination

Snowball sampling and judgmental sampling techniques were used for the sample population determination. Both methods involve the selection of participants based on subjective criteria, they differ in terms of how the sample is recruited and how the researcher uses their judgment to select participants.

With the snowball sampling method, participants are chosen based on recommendations from other participants. Starting with a small initial set of respondents, the researcher invites them to suggest more people who would be good study prospects. Up till the appropriate sample size is obtained, the procedure is repeated. This method is often used when the population of interest is difficult to identify or access, such as hidden populations or marginalized groups. *Biernacki & Waldorf, (1981)*

Judgmental sampling, participants are chosen based on the researcher's knowledge or judgement. Based on specific traits that are probably representative of the population being investigated, the researcher chooses participants. This approach is frequently utilised when the researcher has a solid grasp of the population and can use that understanding to choose a sample that is likely to yield detailed and pertinent information. *Berg, B. L. (2007)*

For the study total 300 number of respondents of farmers were taken, and 100 respondents each for fertilizer industry officers and fertilizer distributors/retailers. All these three categories of respondents were chosen considering major fertilizer consuming areas/states. Such as 100 fertilizer distributors were selected from the following states.

- Uttar Pradesh: 26
- Gujarat: 21
- Punjab: 18
- M.P.: 9
- Bihar: 5
- Maharashtra: 5
- Telangana: 4
- Karnataka 3
- Haryana: 3
- West Bengal: 2
- Andhra Pradesh: 2
- Rajasthan: 2

5.4.2 Sample Frame

The sample frame for the farmers was generated by taking help of the major stakeholders of the fertilizer industry, like the industry officers.

Sample frame for the Fertilizer Industry Officers was developed by first getting the list of fertilizer companies in India from the Ministry of Chemicals and Fertilizers, Department of Fertilizers, and then personally contacting the officers through snowball technique. Same way the sample frame of Fertilizer Distributors/Retailer was created by the help of Fertilizer Industry Officers.

5.4.3 Sample Size

In order to select the representatives among the three categories of respondents i.e., the Farmers, Fertilizer Industry Officers and Fertilizer Distributor/Retailer, Snowball sampling technique which is a non-probability sampling method was used. It is also known as chain referral sampling, referral sampling or network sampling. *Biemer, Lyberg, Billups, Murphy, and Collins (2017)*

Considering the large population of the respondents, in all the three categories, 300 respondents were chosen for farmers, 100 respondents were chosen for fertilizer industry officers and 100 respondents were chosen for the distributor/retailers. All these three categories of respondents were chosen considering major fertilizer consuming areas/states.

5.1. Data Collection

5.5.1 Data Collection Objectives

The data was collected for the purpose of the study to fulfil the following objectives:

- To obtain the demographic profile of all three categories of respondents.
- To obtain the opinion of Farmers, Fertilizer Industry Officers, and Fertilizer Distributor/Retailer.
- To understand the real scenario of the market from the view of Farmers, Fertilizer Industry Officers, and Fertilizer Distributor/Retailer.

5.5.2 Questionnaire Design

An introductory letter was attached along with the questionnaire to make the respondent aware about the purpose of the study. The flow of the questionnaire, for all the sample elements, was divided into two components:

1. Demographic profile

2. Behavioural information.

The following guidelines were followed while designing the questionnaire:

- The questions were framed in such a manner that they were unambiguous, clearly comprehensible and used simple language.
- Care was taken to ensure that the language of the questions did communicate the purpose of the study.
- The question content was consciously kept adequate, and the numbers of questions were also restricted to minimum possible.

5.5.3 Data Compilation

Appropriate tabular formats and various other statistical tools were used to compile the research findings. The interpretation and conclusions were drawn based on the statistical analysis.

5.5.4 Statistical Analysis

Statistics is basically a science that involves data collection, data interpretation and finally, data validation. Statistical data analysis is a procedure of performing various statistical operations. It is a kind of quantitative research, which seeks to quantify the data, and typically, applies some form of statistical analysis. Quantitative data basically involves descriptive data, such as survey data and observational data.

Statistical data analysis generally involves some form of statistical tools, which a layman cannot perform without having any statistical knowledge. There are various software packages to perform statistical data analysis. This software Statistical Package for the Social Sciences (SPSS). Data in statistical data analysis consists of variable(s). Sometimes the data is univariate or multivariate. Depending upon the number of variables, the researcher performs different statistical techniques. If the data in statistical data analysis is multiple in numbers, then several multivariate can be performed. These are factoring statistical data analysis, discriminant statistical data analysis, etc. Similarly, if the data is singular in number, then the univariate statistical data analysis is performed. This includes t test for significance, z test, f test, etc.

5.5.4.1 SPSS

SPSS is short for *Statistical Package for the Social Sciences*, and it's used by various kinds of researchers for complex statistical data analysis.

The SPSS software package was created for the management and statistical analysis of social science data. It was originally launched in 1968 by SPSS Inc. and was later acquired by IBM in 2009. *Statistical Package for the Social Sciences. (2021)*

5.6 Reliability and Validity

5.6.1 Reliability

The degree to which an instrument produces consistent results is referred to as reliability. Internal consistency, test-retest, and inter-rater reliabilities are examples of common reliability metrics.

- Internal consistency reliability examines the agreement between the scores of a set of items, or subscale, on an instrument, which normally consists of numerous items to assess a single construct. One of the most popular techniques for assessing internal consistency reliability is Cronbach's alpha. The Cronbach's alpha value can be influenced by several factors, including group variability, score dependability, item count, sample sizes, and the instrument's degree of complexity.
- Test-retest measures, often within a window of two to three weeks, the correlation between scores from one administration of an instrument to another. For test-retest reliability, there is no treatment between the first and second administrations of the instrument, unlike pre-post-tests. Using slightly varied forms or versions of an instrument to test if several versions produce consistently reliable data is referred to as alternate forms, which is a similar sort of reliability.
- Inter-rater reliability evaluates how well raters agree with one another (i.e., those completing items on an instrument). When more than one person performs classroom observations, employs an observation procedure, or grades an open-ended test using a rubric or another standard technique, it is common for more than one rate to be engaged. Some of the often-reported metrics for inter-rater dependability include kappa statistics, correlation coefficients, and the Intra-Class Correlation (ICC) coefficient.
  Chen, H. T. (2018)

5.6.2 Validity

Validity is the extent to which the scores from a measure represent the variable they are intended to. But how do researchers make this judgment? We have already considered one factor that they consider—reliability. When a measure has good test-retest reliability and internal consistency, researchers should be more confident that the scores represent what they are supposed to.

Validity expresses the degree to which a measurement measures what it purports to measure. Several varieties have been described, including face validity, construct validity, content validity and criterion validity (which could be concurrent and predictive validity). These validity tests are categorized into two broad components namely, internal, and external validities.

- Internal validity refers to how accurately the measures obtained from the research was actually quantifying what it was designed to measure whereas.
- External validity refers to how accurately the measures obtained from the study sample described the reference population from which the study sample was drawn.

Maxwell, S. E., Delaney, H. D., & Kelley, K. (2018)

Cronbach's alpha

Cronbach's alpha is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the extent to which it is a consistent measure of a concept, and Cronbach's alpha is one way of measuring the strength of that consistency.

Cronbach's alpha is computed by correlating the score for each scale item with the total score for each observation (usually individual survey respondents or test takers), and then comparing that to the variance for all individual item scores:

Cronbach's α is defined as

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N}\sigma_{Y_i}^2}{\sigma_X^2}\right)$$

Where *N* is the number of components (items or test lets), $\sigma_X^2$is the variance of the observed total test scores, and $\sigma_{Y_i}^2$is the variance of component *i*.

Alternatively, the standardized Cronbach's α can also be defined as

$$\alpha = \frac{N \cdot \bar{c}}{(\bar{v} + (N-1) \cdot \bar{c})}$$

Where N is the number of components (items or test lets), $\bar{v}$equals the average variance and $\bar{c}$is the average of all covariance's between the components.

Cronbach's alpha is thus a function of the number of items in a test, the average covariance between pairs of items, and the variance of the total score.

Kline, P. (2004)

Content Validity of the Questionnaire and its Reliability

The validity of the questionnaire (instrument) is the degree to which an instrument measures what it is intended to measure. The content validity refers to an extent to which an instrument represents the factors under study.

5.6.3 Reliability Analysis

The consistency and stability of a measure or instrument are evaluated using the statistical technique known as reliability analysis. It entails assessing how consistent a measure's or instrument's results are throughout time, between different raters or observers, or between various forms or versions of the measure.

Many statistical techniques, including Cronbach's alpha, test-retest reliability, inter-rater reliability, and split-half reliability, can be used to analyse reliability. The best way to adopt will depend on the particular research topic and design, as each of these methods has advantages and disadvantages of its own. *DeVellis, R. F. (2017)*

Reliability Analysis using Cronbach Alpha analysis has been administrated and the alpha values have been shown in the following table.

Case Processing Summary

		N	%
Cases	Valid	300	100.0
	Excluded	0	0.0
	Total	300	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.999	0.999	68

Table 5.1: Reliability Analysis using Cronbach Alpha

The calculated value of alpha is more than minimum required value i.e., P> 0.5. Hence this test result is relevant and significant.

5.7 Data Interpretation and Analysis

5.7.1 Quantitative Analysis

Mean, Standard Deviation, t-tests were used to calculate the overall variance among the samples.

Finally, the inferences drawn from the analysis were discussed with a few industry experts, known to the researcher, to cross-check the results from the study.

5.7.1.1 Mean

In statistics, the "mean" is a measure of central tendency, which represents the average of a set of numerical values. It is calculated by adding up all the values in a dataset and then dividing that sum by the total number of values in the dataset.

The mean is sometimes referred to as the "arithmetic mean" to distinguish it from other types of means, such as the median and mode. It is commonly used in descriptive statistics to summarize a set of data or to compare different groups of data. *Triola (2018)*

5.7.1.2 Standard Deviation

In statistics, the "standard deviation" is a measure of the spread or variability of a dataset. It is a numerical value that indicates how much the data deviates from the mean.

The standard deviation is calculated by taking the square root of the variance, which is the average of the squared differences of each value from the mean. A high standard deviation indicates that the data points are spread out widely from the mean, while a low standard deviation indicates that the data points are clustered around the mean.

The standard deviation is an important descriptive statistic because it allows us to better understand the distribution of the data and to make inferences about the population from which the data is drawn. *Triola (2018)*

5.7.2 Qualitative Analysis

For the open-ended questions in the questionnaire, the responses were grouped for each of the questions and fed into the conclusion as they show similar behavioural trend.

5.7.3 T – Test

In statistics, a "t-test" is a type of hypothesis test that is used to determine whether there is a statistically significant difference between the means of two groups. It is used when the sample size is small, and the population standard deviation is unknown.

The t-test measures the difference between the means of the two groups in terms of the variability of the data within each group. It calculates a t-value, which is the ratio of the difference between the means and the standard error of the difference.

The t-value is then compared to a critical value from a t-distribution table to determine the level of statistical significance. If the t-value exceeds the critical value, the null hypothesis (which assumes that the means of the two groups are equal) is rejected and it is concluded that there is a significant difference between the means of the two groups.

There are two types of t-tests: the independent samples t-test, which compares the means of two independent groups, and the paired samples t-test, which compares the means of two related groups.

The t-test is a commonly used statistical test in many fields, including psychology, education, and business. It is particularly useful in determining whether an intervention or treatment has a significant effect on a specific outcome.

The formula for calculating the t-value depends on the specific type of t-test being used, as well as the sample size, sample means, and sample standard deviations. *Triola (2018)*

The complete statistical test observations table is given in *Annexure 16.*

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