CONSUMPTION PATTERN OF BIO-FERTILIZERS IN VARANASI DISTRICT (U.P.)

काशी हिन्दू विश्वविद्यालय BANARAS HINDU UNIVERSITY

PROJECT REPORT

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master

of

Agri-business Management

Supervisor:

Prof. H.P. Singh

Submitted By:

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DEPARTMENT OF AGRICULTURAL ECONOMICS
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I.D. No. 16412ABM013 **2018** **Enrolment No. 388913**

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CERTIFICATE

To,
The Registrar
Banaras Hindu University,
Varanasi-221005, U.P. (India).

Through:

The Head,

Department of Agricultural Economics,

Dear Sir,

I have great pleasure in forwarding the project report entitled **"CONSUMPTION PATTERN OF BIO-FERTILIZERS IN VARANASI DISTRICT (U.P.)"** submitted by **Mr. Naman Pandey, I.D. No. 16412ABM013,** in partial fulfillment of the requirements for the degree of **Master of Agribusiness Management,** of the Banaras Hindu University and placing on record that he has completed the requisite requirements as contained in the statutes of the university.

I certify that the entire scheme of investigation reported here in was planned and carried out solely by the candidate under my guidance and supervision. The data presented in the report, to the best of my knowledge and belief, are genuine and have not been utilized for the award of other degree or distinction.

Thanking you,

Forwarded By: **Yours faithfully**

Coordinator Head **Prof. H.P. Singh**
Chairman

CONSUMPTION PATTERN OF BIO-FERTILIZERS IN VARANASI DISTRICT (U.P.)

By

NAMAN PANDEY

I.D. No. 16412ABM013 **2016-18** **Enrolment No. 388913**

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Master of Agri-Business Management

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PROJECT REPORT APPROVED BY ADVISORY COMMITTEE

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ACKNOWLEDGEMENT

At the outset, being the student of this great institution. I bow my head with in great reverence to the lotus of ***Mahamana Pandit Madan Mohan Malaviya Ji****, the founder of the Banaras Hindu University whose everlasting desire was to serve the mankind.*

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Date: ……/…../……

Place Varanasi. ***(Naman Pandey)***

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CHAPTER-I

INTRODUCTION

The history of bio fertilizers began with the launch of "Nitragin" by Nobbe and Hiltner, a laboratory culture of Rhizobia in 1895, followed by the discovery of Azotobacter and then the blue green algae and a host of other micro-organisms. Azospirillum and Vesicular-Arbuscular Micorrhizae (VAM) are fairly recent discoveries. In India the first study on legume Rhizobium symbiosis was conducted by N.V.Joshi and the first commercial production started in 1956.

What is Bio fertilizer?

Bio fertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Bio fertilizers add nutrients through the natural processes of Nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth promoting substances. Bio fertilizers can be expected to reduce the use of chemical fertilizer and pesticides. The microorganisms in bio fertilizers restore the soil's natural nutrient cycle and build soil organic matter. Through the use of bio fertilizers, healthy plants can be grown while enhancing the sustainability and the health of soil.

Bio fertilizers are Eco-friendly organic agro-input and more cost effective than chemical fertilizers. Bio fertilizers like Rhizobium, Azetobacter, Azospirillum and blue green algae (BGA) are in use since long time ago. Rhizobium inoculant is used for leguminous crops. Azetobacter can be used with crops like wheat, maize, mustard, cotton, potato and other vegetable crops. Azospirillum inoculants are recommended mainly for sorghum, millets, maize, sugarcane and wheat. Blue green algae belonging to genera Nostoc, Anabaena, Tolypothrix and Aulosira fix atmospheric nitrogen and are used as inoculants for paddy crop grown both under upland and low land conditions. Anabaena in association with water fern Azolla contributes nitrogen up to 60 kg/ha/season and also enriches soils with organic matter other types of bacteria, so-

called phosphate solubilizing bacteria like Pantoeaagglomerans strain P5, and Pseudomonas putidastrain P13 are able to solubilize the insoluble phosphate from organic and inorganic phosphate source. In fact, due to immobilization of phosphate by mineral ions such as Fe, Al and Ca or organic acids, the rate of available phosphate (Pi) in soil is well below plant needs.

Potential characteristics of some bio-fertilizers

Nitrogen fixers

Rhizobium: belongs to family ***Rhizobiaceae,*** symbiotic in nature, fix nitrogen 50-100 kg/ ha. with legumes only. It is useful for pulse legumes like chickpea, red-gram, pea, lentil, black gram, etc., oil-seed legumes like soybean and groundnut and forage legumes like berseem and lucerne. Successful nodulation of leguminous crops by *Rhizobium* largely depends on the availability of compatible strain for a particular legume. It colonizes the roots of specific legumes to form tumour like growths called root nodules, which acts as factories of ammonia production. *Rhizobium* has ability to fix atmospheric nitrogen in symbiotic association with legumes and certain non-legumes like ***Parasponia***. *Rhizobium* population in the soil depends on the presence of legume crops in the field. In absence of legumes, the population decreases. Artificial seed inoculation is often needed to restore the population of effective strains of the *Rhizobium* near the rhizosphere to hasten N-fixation. Each legume requires a specific species of *Rhozobium* to form effective nodules. Many legumes may be modulated by diverse strains of *Rhizobia*, but growth is enhanced only when nodules are produced by effective strains of *Rhizobia*. It is thus extremely important to match microsymbionts prudently for maximum nitrogen fixation. A strain of *Rhizobia* that nodulates and fixes a large amount of nitrogen in association with one legume species may also do the same in association with certain other legume species. This must be verified by testing. Leguminous plants that demonstrate this tendency to respond similarly to particular strains of *Rhizobia* are considered "effectiveness" group (Wani and Lee 2002).

Azospirillum: belongs to family ***Spirilaceae***, heterotrophic and associative innature. In addition to their nitrogen fixing ability of about 20-40 kg/ha, they also

produce growth regulating substances. Although there are many species under this genus like, *A. amazonense, A. halopraeferens, A. brasilense,* but, worldwide distribution and benefits of inoculation have been proved mainly with the *A. lipoferum and A. brasilense.*

The *Azospirillum* form associative symbiosis with many plants particularly with those having the C4-dicarboxyliac path way of photosynthesis (Hatch and Slack pathway), because they grow and fix nitrogen on salts of organic acids such as malic, aspartic acid (Arun, 2007a). Thus it is mainly recommended for maize, sugarcane, sorghum, pearl millet etc. The Azotobacter colonizing the roots not only remains on the root surface but also a sizable proportion of them penetrates into the root tissues and lives in harmony with the plants. They do not, however, produce any visible nodules or out growth on root tissue.

Azotobacter: belongs to family ***Azotobacteriaceae***, aerobic, free living, andheterotrophic in nature. *Azotobacte*rs are present in neutral or alkaline soils and *A.chroococcum*is the most commonly occurring species in arable soils. *A. vinelandii, A.beijerinckii, A. insignis* and *A. macrocytogenes* are other reported species. The number of *Azotobacter* rarely exceeds of $10^4$to $10^5 g^{-1}$ofsoil due to lack of organic matter and presence of antagonistic microorganisms in soil. The bacterium produces anti-fungal antibiotics which inhibits the growth of several pathogenic fungi in the root region thereby preventing seedling mortality to a certain extent (SubbaRao, 2001a). The isolated culture of *Azotobacter* fixes about 10 mg nitrogen g^{-1} of carbon source under *invitro* conditions.*Azotobacter* also to known to synthesize biologically active growth promoting substances such as vitamins of B-group, indole acetic acid (IAA) and gibberellins. Many strains of *Azotobacter* also exhibited fungi static properties against plant pathogens such as *Fusarium, Alternaria and Helminthosporium.* The population of *Azotobacter*is generally low in the rhizosphere of the crop plants and in uncultivated soils. The occurrence of this organism has been reported from the rhizosphere of a number of crop plants such as rice, maize, sugarcane, bajra, vegetables and plantation crops, (Arun, 2007a).

Blue Green Algae (Cyanobacteria) and Azolla: These belongs to eight different families, phototrophic in nature and produce Auxin, Indole acetic acid and

Gibberllic acid, fix 20-30 kg N/ha in submerged rice fields as they are abundant in paddy, so also referred as 'paddy organisms'. N is the key input required in large quantities for low land rice production. Soil N and BNF by associated organisms are major sources of N for low land rice. The 50-60% N requirement is met through the combination of mineralization of soil organic N and BNF by free living and rice plant associated bacteria (Roger and Ladha, 1992). To achieve food security through sustainable agriculture, the requirement for fixed nitrogen must be increasingly met by BNF rather than by industrial nitrogen fixation. Most N fixing BGA are filamentous, consisting of chain of vegetative cells including specialized cells called heterocyst which function as micro nodule for synthesis and N fixing machinery.

BGA forms symbiotic association capable of fixing nitrogen with fungi, liverworts, ferns and flowering plants, but the most common symbiotic association has been found between a free floating aquatic fern, the Azolla and *Anabaena azollae* (BGA). *Azolla* contains 4-5% N on dry basis and 0.2-0.4% on wet basis and can be the potential source of organic manure and nitrogen in rice production. The important factor in using *Azolla*as bio fertilizer for rice crop is its quick decomposition in the soil and efficient availability of its nitrogen to rice plants (Kannaiyan, 1990). Besides N-fixation, these bio fertilizers or bio manures also contribute significant amounts of P, K, S, Zn, Fe, Mb and other micronutrient. The fern forms a green mat over water with a branched stem, deeply bilobed leaves and roots. The dorsal fleshy lobe of the leaf contains the algal symbiont within the central cavity. Azolla can be applied as green manure by incorporating in the fields prior to rice planting. The most common species occurring in India is *A. pinnata* and same can be propagated on commercial scale by vegetative means. It may yield on average about 1.5 kg per square meter in a week. India has recently introduced some species of Azolla for their large biomass production, which are *A.caroliniana, A. microphylla, A.filiculoides and A. mexicana.*

Phosphate solubilizers

Several reports have examined the ability of different bacterial species to solubilize insoluble inorganic phosphate compounds, such as tricalcium phosphate, dicalcium phosphate, hydroxyapatite, and rock phosphate. Among the bacterial genera with this capacity are *pseudomonas, Bacillus, Rhizobium, Burkholderia, Achromobacter, Agrobacterium, Micrococcus, Aereobacter, Flavobacterium* and

Erwinia. There are considerable populations of phosphate-solubilizing bacteria in soil and in plant rhizospheres. These include both aerobic and anaerobic strains, with a prevalence of aerobic strains in submerged soils. A considerably higher concentration of phosphate solubilizing bacteria is commonly found in the rhizosphere in comparison with non rhizosphere soil (Raghu and Macrae, 2000). The soil bacteria belonging to the genera *Pseudomonas* and *Bacillus* and *Fungi* are more common. The major microbiological means by which insoluble-P compounds are mobilized is by the production of organic acids, accompanied by acidification of the medium. The organic and inorganic acids convert tricalcium phosphate to di- and- monobasic phosphates with the net result of an enhanced availability of the element to the plant. The type of organic acid produced and their amounts differ with different organisms. Tri- and di-carboxylic acids are more effective as compared to mono basic and aromatic acids. Aliphatic acids are also found to be more effective in P-solubilization compared to phenolic, citric and fumaric acids. The analysis of culture filtrates of PSMs has shown the presence of number of organic acids including citric, fumaric, lactic, 2-ketogluconic, gluconic, glyoxylic and ketobutyric acids.

Phosphate absorbers

Mycorrhiza (an ancient symbiosis in organic agriculture)

The term Mycorrhiza denotes "fungus roots". It is a symbiotic association between host plants and certain group of fungi at the root system, in which the fungal partner is benefited by obtaining its carbon requirements from the photosynthates of the host and the host in turn is benefited by obtaining the much needed nutrients especially phosphorus, calcium, copper, zinc etc., which are otherwise inaccessible to it, with the help of the fine absorbing hyphae of the fungus. These fungi are associated with majority of agricultural crops, except with those crops/plants belonging to families of *Chenopodiaceae, Amaranthaceae, Caryophyllaceae, Polygonaceae, Brassicaceae, Commelinaceae, Juncaceae and Cyperaceae.*Theyare ubiquitous in geographic distribution occurring with plants growing in artic, temperate and tropical regions alike. VAM occur over a broad ecological range from aquatic to desert environments (Mosse*et al*. 1981). Of 150 species of fungi that have been described in order *Glomales* of class *Zygomycetes,* only small proportions are presumed to be

mycorrhizal. There are sixgenera of fungi that contain species, which are known to produce *Arbuscularmycorrhizalfungi* (AMF) with plants. Two of these genera, *Glomus and Sclerocytis,* produce chlamydospores only. Four genera form spores that are similar to azygospores: *Gigaspora, Scutellospora, Acaulospora and Entrophospora.*The oldest and most prevalent of these associations are the arbuscularmycorrhizal (AM) symbioses that first evolved 400 million years ago, coinciding with the appearance of the first land plants. Crop domestication, in comparison, is a relatively recent event, beginning 10, 000 years ago (Sawers*et al*. 2007).

Zinc solubilizers

The nitrogen fixers like *Rhizobium, Azospirillum, Azotobacter, BGA* and Phosphate solubilizing bacteria like *B. magaterium,Pseudomonas striata,* and phosphate mobilizing Mycorrhiza have been widely accepted as bio-fertilizers (Subba Roa, 2001a). However these supply only major nutrients but a host of microorganism that can transform micro nutrients are there in soil that can be used as bio-fertilizers to supply micro nutrients like zinc, iron, copper etc., zinc being utmost important is found in the earth's crust to the tune of 0.008 per cent but more than 50 per cent of Indian soils exhibit deficiency of zinc with content must below the critical level of 1.5 ppm of available zinc (Katyal and Rattan, 1993). The plant constraints in absorbing zinc from the soil are overcome by external application of soluble zinc sulphate (ZnSO4). But the fate of applied zinc in the submerged soil conditions is pathetic and only 1-4% of total available zinc is utilized by the crop and 75% of applied zinc is transformed into different mineral fractions (Zn-fixation) which are not available for plant absorption (crystalline iron oxide bound and residual zinc). There appears to be two main mechanisms of zinc-fixation, one operates in acidic soils and is closely related with cat ion exchange and other operates in alkaline conditions where fixation takes by means of chemisorptions, (chemisorptions of zinc on calcium carbonate formed a solid-solution of ZnCaCO3), and by complexation by organic ligands (Alloway, 2008).

The zinc can be solubilised by microorganism viz., *B. subtilis, Thiobacillus thioxidans and Saccharomyces sp.* These microorganisms can be used as bio-

fertilizers for solubilisation of fixed micro nutrients like zinc (Raj, 2007). The results have shown that a *Bacillus sp.* (Zn solubilizing bacteria) can be used as bio-fertilizer for zinc or in soils where native zinc is higher or in conjunction with insoluble cheaper zinc compounds like zinc oxide (ZnO), zinc carbonate (ZnCO3) and zinc sulphide (ZnS) instead of costly zinc sulphate (Mahdi *et al*. 2010).

India is the third largest producer of fertilizers in the world after China and USA. The all India average consumption of fertilizers per hac. It has been estimated at 117.07 kg in 2007-08. After that productivity is stagnant due to excessive use of chemical fertilizers which reduces the fertility of the soil and also causes many ill effects to the environment. To sustain the fertility of soil and balance of environment the concept of organic farming arises which emphasis on the use of bio-fertilizers such as rhizobium, azolla, azatobactor, and PSB etc. Now a day the importance of bio-fertilizers is increasing day by day because people are aware about their health as well as sustainability of environment. The demand of organic product and material is increasing so the bio-fertilizer industries have good opportunity to cash it.

Advantages of Bio fertilizers

Cost effective relative to chemical fertilizer and reduces the costs towards fertilizers use, especially regarding nitrogen and phosphorus. It is environmentally friendly fertilizer that not only prevents damaging the natural source but helps to some extend clean the nature from precipitated chemical fertilizer that can provide better nourishment to plants.

1. Activate the soil biologically.
2. Biological control of soil pest and diseases.
3. Bridge the gap between the need of total absorbable nutrients of agricultural industry and the availability of chemical fertilizers from the fertilizer industry.
4. Consumer friendly
5. Cost effective when compared to expensive chemical fertilizers.
6. Degrades the organic residues into nutrients that can be absorbed by the plants.
7. Direct or indirect supply of nutrients to plants.

8. Eco-friendly.
9. En-action of mutualistic symbiotic relationships with plants
10. End user friendly.
11. Enhance soil chemical and physical properties.
12. Increase crop yield by 20-30%.
13. Non pollutant and non carcinogenic.
14. Produce plant growth promoting substances.
15. Provide protection against drought and some soil borne diseases
16. Reduces the costs towards fertilizers use, especially regarding nitrogen and phosphorus.
17. Replace chemical nitrogen and phosphorus by 25%.
18. Restore natural soil fertility.
19. Stimulate plant growth.
20. Supplement to fertilizers.

It is very interesting to note that most of the plants feed by releasing root exudates of precise chemical composition to activate their friendly soil fungi and bacteria which will solubilize elements required by the plant at that time. The exudate composition varies throughout the life of the plant, and any stresses imposed upon it result in further compensatory changes - in essence, the plant practices self medication. The term 'nature's smorgasbord' was coined to explain this process. 'Nature's smorgasbord' provides a possible explanation for the prevalence of pest and disease attack in crops fertilized by chemical means - applied soluble fertilizer masks the 'smorgasbord' process, eliminating correct nutrition.

Bio-fertilizers are used to supplement chemical fertilizers as also to maintain soil fertility; besides the following:-

- Bio-Fertilizers are supplement to Chemical Fertilizers.
- Bio-Fertilizers are cheap and can reduce the cost of cultivation.
- Fix Biological Nitrogen in the soil, which is readily available to the plant.
- Increase crop yield by 4-5% on an average.
- Improve soil properties and sustain soil fertility.
- Provides plant nutrient at low cost and useful for the consecutive crops.

Certification and Quality Control

The utility of bio-fertilizers has been validated by reputed agencies in India (such as NBDC and ICRISAT) and abroad. For instance field trials by NBDC have showed that application of azotobacter results in 3-25% increase in yield in cotton and 2-20% in wheat, in Haryana. But bio-fertilizer manufacturers find it difficult to consistently replicate results of bio-fertilizer usage. This is because agro-climatic conditions and soils are different in different parts of the country. Many strains do not survive in very hot temperatures. Bio-fertilizers are also prone to contamination if carriers (such as powder/liquid) are not sterilized. If farmers do not get consistent quality in bio-fertilizers it impacts yield. This further reduces their trust and consequently the purchase of bio-fertilizers. Quality control is an Achilles heel for many bio-fertilizer manufacturers as there is no standard process for isolating proper strain of microbes and also no standard technology for scaling up and fermentation. Moreover, bio-fertilizers are not a chemical formula. So manufacturers have to independently prove the merit of their product. This further increases marketing costs of bio-fertilizers. Also though Bio-fertilizers have to conform to BIS standards there is no proper certification process in place.

Bio Fertilizer Business Opportunities

Bio-fertilizers are microbial inoculants for enhancing growth of plants. They act as catalysts in providing valuable nutrients to the plant through phosphate solubilising, nitrogen fixing and growth promoting microbes. The use of bio-fertilizers has gained credence, as the negative externalities of chemical fertilizers have become well known. Chemical fertilizers are cost-intensive and lead to high yield in the short run. In the long run, however, they erode soil fertility and harm the natural predators of pests in the biosphere. All this leads to even greater use of chemical fertilizers and pesticides and therefore higher cost to farmers. The utility of bio-fertilizers has been validated through large-scale field trials by government and semi-government agencies as well as private bodies. The government has been providing subsidies for production of bio-fertilizers for over two decades. Looking upon the advantages, the specific objectives are as follows:

1. To assess the awareness and sources of information.
2. To estimate the amount used of bio-fertilizers in different crops.
3. To examine market opportunities of bio-fertilizers.
4. To study the promotional tools used in marketing of bio-fertilizers.
5. To examine farmers' perception towards bio-fertilizers.
6. To find out distribution channels of bio-fertilizers in Varanasi.

CHAPTER-II

REVIEW OF LITERATURE

The review of literature helps in the providing basic background to enable formulation of the objectives and selection of appropriate analytical tools. The review of relevant literature helped to update the research, with the knowledge about the kind of studies conducted in the past, regarding their place, period, methodology followed to handle the problem, findings of the study and limitation thereon. For achievement of the same, the various review of literature is cited. In this chapter, the most related reviews have been presented keeping in views the objectives and methodology of the present study.

Menon and Doraiswamy (1975) revealed that application of fertilizers to get high yields were known by more than 60.00 per cent of the farmers.

Bhilegaonker (1978) concluded that a little over half of the farmers had "medium" level of knowledge with reference of fertilizer use. The study also revealed that 21.00, 22.20 and 18.40 per cent of large, medium and small farmers belonged to the "high" knowledge category, respectively. Whereas, 22.30, 25.00 and 28.90 per cent of large, medium and small farmers respectively, were in "low" knowledge level category, respectively.

Kabi and Poi (1988) found that for better performance of bio-fertilizers, greater emphasis should be laid on the identification and development of location specific nodulation strain. Important constraints identified in using bio-fertilizers were; ignorance of both the users and the supervising staff at grass root level, non availabity of package of practices of inoculating bio-fertilizers, lack of improved transportation of rhizobium strain.

Verma and Bhattacharya (1990) in their study indicated that the factors responsible for the unsatisfactory use of bio-fertilizers as non availabity of quality inoculants, low shelf life of culture, improper soil condition and lack of education and training among farmers about the use of bio-fertilizers.

Murthy (1991) observed that in general, areca nut growers had knowledge about simple practices such as selection of seed material and raising seedlings, time and method of fertilizer and farm yard manure application, inter-cultivation, intercropping, time of harvesting, processing of nuts, time of planting and pit size for planting.

Bhattacharya and Dwivedi (1992) observed that with several beneficial roles of bio-fertilizers, their use is still not popular due to the constraints such as lack of awareness among farmers on the inoculants, supply of poor quality culture, lack of promotion and extension work and insufficient publicity. Further, the study suggested structured programmes like field demonstrations to educate the farmers on the use of bio-fertilizers.

Kute and Patel (1993) in their study concluded that the farmers did not have proper knowledge on use of bio-fertilizers which was a pre-requisite for driving maximum benefit. They also identified that no definite pricing policy existed for bio-fertilizers. In view of these, the study suggested educating the farmers through effective demonstration on bio-fertilizers use and having a uniform pricing policy for the bio-fertilizers.

Murthy and Rao (1994) observed that the popularity of bio-fertilizers in Karnataka suffered because of inherent constraints such as non availability of location and crop specific strain of rhizobium. To popularize the bio-fertilizer use, they suggested training of departmental personal and farmers in bio-fertilizer use, to create awareness, demonstrations and trails are to be established on the farmers field.

Marwaha (1995) found that use of bio-fertilizers has not received desire at tension. This was mainly because of inadequate awareness among the extension workers and farmers about their utility. Other identified reasons for the non adoption of bio-fertilizers are short shelf life and non availabity of bio-fertilizers in time. However, proper education to the extension workers, dealers and farmers about significant and economic feasibility of their application both by seed treatment and soil application would help in promoting their adoption. This would effectively help the nutrient management in crop husbandry by combining both chemical fertilizers and bio-fertilizers.

Saravanakumar (1996) observed that 23.33 per cent of the mango growers of Dharmapuri district subscribed news papers, farm magazines and read them regularly. While, 42.50 and 42.86 per cent of the farmers regularly listened and viewed the agricultural programmes, respectively.

Birajdar (1999) found that a large majority (71.26%) of the grape growers in Solapur district had medium level of mass media participation, while, 14.37 per cent of each of them belonged to low and high level of mass media participation.

Borkar *et al.* (2000) conducted a study on characteristics of farmers influencing their knowledge about use of bio fertilizers and observed that majority (58.67%) of the farmers had knowledge about the use of bio fertilizers to a moderate level followed by 22.67 per cent of them had high level of knowledge and 18.66 per cent of them had low level of knowledge.

Chothe *et al.* (2000) conducted a study on constraints faced by farmers in adoption of bio fertilizers and observed that 58.67 per cent of the farmers had medium level of knowledge about bio control practices, followed by 34.67 per cent and 18.66 per cent who had high and low knowledge, respectively.

Bhople *et al. (*2001) conducted a study on evaluation of KVK under NGO's in Vidharbha region and observed that 74.08 per cent of the respondent had knowledge in respect of neem seed kernel extract, HaNPV spraying (27.54%), trichocards (19.44%) and all bio control practices (23.92%).

Bhople and Borkar (2002) in their study on bio fertilizers on farmers' attitude and adoption observed that majority of the farmers (84.00%) belonged to moderate level of knowledge about different kinds of bio-fertilizers and their associated practices, about one tenth of them were adequately equipped with the knowledge about bio fertilizers and appeared in high knowledge category.

Ghosh (2004) in India the availability and affordability of fossil fuel based chemical fertilizers at the farm level have been ensured only through imports and subsidies. Dependence on chemical fertilizers for future agricultural growth would mean further loss in soil quality, possibilities of water contamination and unsustainable burden on the fiscal system.

The Government of India has been trying to promote an improved practice involving use of bio- fertilizers along with fertilizers. These inputs have multiple beneficial impacts on the soil and can be relatively cheap and convenient for use. Consistent with current outlook, the government aims not only to encourage their use in agriculture but also to promote private initiative and commercial viability of production. This paper analyses available industry side data to find only a limited extent of success till date.

There has been no accelerated growth in distribution with time, inadequate spatial diffusion and despite entry of small private units into the industry there is no clear indication of the success of privatization. The paper however argues that considering the social benefits promised the government has ample grounds to intervene to set up an effective market for the new product while encouraging private players. But the policy and the instruments of intervention need to be designed with care.

Kumar (2004) revealed that 59.17 per cent of the farmers were occasionally listening agricultural programmes in radio, whereas, 30.00 per cent of them viewed agricultural programmes in television occasionally. While, 70.83 and 85.00 per cent of the farmers never read the news papers and farm magazines, respectively.

Gowda and Gowda (2006) revealed that majority of Thompson Seedless grape growers (55.00%) belonged to medium mass media use category, followed by 33.00 and 12.00 per cent of the farmers who belonged to high and low mass media use categories, respectively.

Kharatmol (2006) in his study on impact of trainings conducted on vermicompost by Krishi Vigyan Kendra observed that trained farmers had knowledge about the practices like preparation of vermicompost pit (100.00%), construction of vermicompost pit (50.00%), pit filling (96.67%), sequential filling of pit layer wise (75.00%), watering pit (98.33%) and harvesting practice (95.00%).

Meena (2010) conducted a field experiment at MPUAT, Udaipur to study the effect of integrated nutrient management on yield and quality of forage sorghum. Results indicated that application of recommended dose of fertilizer through inorganic

fertilizer along with bio-fertilizer gave maximum plant height (301.7 cm), green fodder (490.42 q ha^{-1}) and dry matter (179.25 q ha^{-1}) yields.

Bakshi *et al.* (2018) conduct a study aimed at evaluating the economics of cultivation of Kinnow mandarin (*Citrus nobilis* x *Citrus deliciosa*) using different integrated nutrient management treatments. Three organic manures (FYM, poultry manure and vermicompost) under three different experiments were used along with inorganic fertilizers and *Azotobacter*. Total cost of cultivation was maximum (Rs 98905.00) with the application of cent per cent application of nitrogen as vermicompost augmented with *Azotobacter*. The net returns on investment were highest (Rs 186968.00) under treatment where plants were applied with 25 per cent nitrogen as vermicompost and 75 per cent nitrogen as urea augmented with *Azotobacter*. Maximum benefit cost ratio of (1:3.28) was obtained under treatment comprising 50 per cent nitrogen as poultry manure and 50 per cent nitrogen as urea augmented with *Azotobacter*. A comparison between the three integrated nutrient management experiments in Kinnow mandarin revealed that maximum returns on investments can be achieved when half of the recommended dose of nitrogen through inorganic fertilizers is replaced with organic source (vermicompost) along with the application of biofertilizer.

Hassanein *et al.* (2018) two field experiments were carried out during 2014/2015 and 2015/2016 seasons at Wadi El- Rayan Fayoum Governorate, Egypt to study the effect of ammonia gas (82%) and bio-fertilizer on yield and yield components of two wheat cultivars. The results could be summarized as follows: There were significant differences for yield and yield components characters in both seasons owing to varietal differences i.e. plant height (cm), number of tillers/ m2, number of spikes/ m2, weight of spikes g/ m2 and grain index (g), while the differences between cultivars for grain yield (g/ m2), grain yield ton/ fed., straw yield ton / fed., and biological yield ton/ fed., failed to reach significant level at 5% in both seasons.

CHAPTER-III

RESEARCH METHODOLOGY

This chapter deals with the methodology used in achieving the objective of the study. It comprises sampling design and analytical tools used to achieve final result. For cohesiveness and clarity in presentation, this chapter can be classified into two broad sections. The first section focuses on the sampling design to select the district, block, village, farmers, market functionaries' as well marketing channel and collection of data etc. The second section is related with the analytical tools and technique applied.

The methodological aspects have been discussed under the following five heads.

1. Sampling design.
2. Collection of data and method of enquiry.
3. Period of enquiry.
4. Analytical tools.

3.1 Sampling design:

Data has been collected from farmers. Multistage sampling design is used for sampling procedure.

3.1.1 Selection of District:

The total number of districts in Uttar Pradesh is 75. Out of these district, Varanasi district of Uttar Pradesh was selected for study. There are following blocks in Varanasi district:

a) Arajiline, b) Baragaon, c) Chiraigaon. D) Harhua, e) Cholapur block,
f) Kashividyapeeth, g) Pindara, h) Sewapuri

3.1.2 Selection of the Block:

Out of 8 blocks in Varanasi district, Arajiline and Kashividhyapeeth blocks were selected randomly where there are maximum number of farmers who use bio-fertilizers.

3.1.3 Distribution channel:

The most common marketing channel engaged in the marketing of bio-fertilizer in Varanasi district is as follows:

Producers –Distributors - Retailers - Consumers

3.2 Collection of Data and Method of Enquiry:

3.2.1 Primary Data:

The data on consumption pattern were collected on well structured schedule by survey method by personal interview. Several visits were made to collect correct information.

3.2.2 Secondary Data

The secondary data sources include the web portals and different magazines, thesis, project report, and journal related with Agri-business and data available with the department or university.

3.3 Period of Enquiry:

The study was undertaken for the year 2017-18.

3.4 Analytical Tools:

The collected data were classified and tabulated so that it becomes relevant to fulfill the various objectives of study. The collected data were analyzed by using descriptive statistics.

CCHAPTER- IV

DESCRIPTION OF THE AREA

4.1 General description of Varanasi district:

Varanasi, or Banaras, (also known as Kashi) is one of the oldest living cities in the world. Varanasi`s Prominence in Hindu mythology is virtually unrevealed. Mark Twain, the English author and literature, who was enthralled by the legend and sanctity of Banaras, once wrote:

"Banaras is older than history, older than tradition, older even than legend and looks twice as old as all of them put together"

Varanasi is a city on the banks of the Ganges in the Uttar Pradesh state of North India, 320 kilometres (200 mi) south-east of the state capital, Lucknow, and 121 kilometres (75 mi) east of Allahabad. A major religious hub in India, it is the holiest of the seven sacred cities (*Sapta Puri*) in Hinduism and Jainism, and played an important role in the development of Buddhism and Ravidassia. Varanasi lies along National Highway 2, which connects it to Kolkata, Kanpur, Agra, and Delhi, and is served by Varanasi Junction railway station and Lal Bahadur Shastri International Airport.

Varanasi is also one of 75 districts in the Indian state of Uttar Pradesh. At the time of the 2011 census, there were a total of 8 blocks and 1329 villages in this district. Main languages of Varanasi are Banarasi, Bhojpuri/Awadhi.

Varanasi, considered as an important seat of learning in India. Varanasi is said to be a compound of the names of two streams, the Varuna and the Assi, which still flow in the north and south of the city respectively. This name seems to have been corrupted, in medieval times to Banaras, which was in use till May 24, 1956 when it was changed to Varanasi, by an order of the Government of India. Varanasi is probably one of the most ancient living cities in India. From time immemorial it has been a great religious center for Hindus and one of their most sacred places of pilgrimage, being visited by millions of people every year.

The places worth visiting in the city of Varanasi are the several ghats that dot the riverside, and the hundreds of temples that form part of the old city of Varanasi.

4.2 History of Varanasi

According to Hindu mythology, Varanasi was founded by the god Shiva. During a fight between the two supreme gods, Brahma and Shiva, one of the five heads of Brahma was torn off by Shiva. The land of Varanasi (Kashi) has been the ultimate pilgrimage spot for Hindus for ages. Often referred to as Banaras, Varanasi is the oldest living city in the world. These few lines by Mark Twain say it all: "Banaras is older than history, older than tradition, older even than legend and looks twice as old as all of them put together". Hindus believe that one who is graced to die on the land of Varanasi would attain salvation and freedom from the cycle of birth and re-birth. Abode of Lord Shiva and Parvati, the origins of Varanasi are yet unknown. Ganges in Varanasi is believed to have the power to wash away the sins of mortals.
Ganges is said to have its origins in the tresses of Lord Shiva and in Varanasi, it expands to the mighty river that we know of. The city is a center of learning and civilization for over 3000 years. With Sarnath, the place where Buddha preached his first sermon after enlightenment, just 10 km away, Varanasi has been a symbol of Hindu renaissance. Knowledge, philosophy, culture, devotion to Gods, Indian arts and crafts have all flourished here for centuries.

Vaishnavism and Shaivism have co-existed in Varanasi harmoniously. With a number of temples, Mrs. Annie Besant chose Varanasi as the home for her 'Theosophical Society' and Pandit Madan Mohan Malviya, to institute 'Benares Hindu University, the biggest University in Asia. Ayurveda is said to be originated at Varanasi and is believed to be the basis of modern medical sciences such as Plastic surgery, Cataract and Calculus operations. Maharshi Patanjali, the preceptor of Ayurveda and Yoga, was also affiliated with Varanasi, the holy city. Varanasi is also famous for its trade and commerce, especially for the finest silks and gold and silver brocades, since the early days.

Varanasi has also been a great center of learning for ages. Varanasi is associated with promotion of spiritualism, mysticism, Sanskrit, yoga and Hindi

language and honored authors such as the ever-famous novelist Prem Chand and Tulsi Das, the famous saint-poet who wrote Ram Charit Manas. Aptly called as the cultural capital of India, Varanasi has provided the right platform for all cultural activities to flourish. Many exponents of dance and music have come from Varanasi. Ravi Shankar, the internationally renowned Sitar maestro and Ustad Bismillah Khan, (the famous Shehnai player) are all sons of the blessed city or have lived here for major part of their lives.

4.3 Geography

The city of Varanasi is located in the middle Ganges valley of North India, in the Eastern part of the state of Uttar Pradesh, along the left crescent-shaped bank of the Ganges River. It has the headquarters of Varanasi district. The "Varanasi Urban Agglomeration" an agglomeration of seven urban sub-units - covers an area of 112.26 km 2 (approximately 43 mi²). The urban agglomeration is stretched between 82° 56‘E - 83° 03‘E and 25° 14‘N - 25° 23.5‘N. Being Varanasi is situated in the agro climatic zone of eastern plain of Uttar Pradesh, bordering the district Jaunpur in the north, Ghazipur in the Northeast, Chaundauli in the east, Mirzapur in the south and Sant Ravidasnagar in the west. The total area of district is 1526.36 sq. km, supporting a population of 31.48 lakh persons. This district is densely populated, with 2063 person per square km, as against the state average 689 person per square km. This district is divided into eight blocks namely, Baragaon, Araziline, Chiraigoaon, Cholapur, Haruha, Kishividhya Peth, Pindra and Sewapuri.

Varanasi is often said to be located between two confluences: one of the Ganges and Varuna, and other of the Ganges and Assi, (Assi having always been a rivulet rather than a river.) The distance between these two confluences is around 2.5 miles (4.0 km), and religious Hindus regard a round trip between these two places—a *Pancha-kroshi Yatra* (a five mile (8 km) journey) ending with a visit to a *Sakshi Vinayak Temple* as a holy ritual.

4.4 Demographics

According to provisional data from the 2011 census, the Varanasi urban agglomeration had a population of 1,435,113, with 761,060 men and 674,053 women. The population of the Varanasi urban agglomeration in 2001 was 1,371,749 with a ratio of 879 females every 1,000 males. However, the area under Varanasi Nagar Nigam has a population of 1,100,748 with a ratio of 883 females for every 1,000 males. The literacy rate in the urban agglomeration is 77% while that in the municipal corporation area is 78%. Approximately 138,000 people in the municipal area live in slums.

4.4 Climate

Varanasi experiences a humid subtropical climate (Koppen climate classification *Cwa*) with large variations between summer and winter temperatures. The dry summer starts in April and lasts until June, followed by the monsoon season from July to October. The temperature ranges between 22 and 46 °C (72 and 115 °F) in the summers. Winters in Varanasi see very large diurnal variations, with warm days and downright cold nights. Cold waves from the Himalayan region cause temperatures to dip across the city in the winter from December to February and temperatures below 5 °C (41 °F) are not uncommon. The average annual rainfall is 1,110 mm. Fog is common in the winters, while hot dry winds, called loo, blow in the summers. In recent years, the water level of the Ganges has decreased significantly; upstream dams, unregulated water extraction, and dwindling glacial sources due to global warming may be to blame.

Through a combination of water pollution, new constructions of upstream dams, and increase in the local temperature, the water level of the Ganges has recently gone down significantly, and small islands have become visible in the middle of the river.

4.6 Economy

According to the 2006 City Development Plan for Varanasi, approximately 29% of Varanasi's population is employed.

Approximately 40% are employed in manufacturing, 26% work in trade and commerce, 19% work in other services, 8% work in transport and communication, 4% work in agriculture, 2% work in construction, and 2% are marginal workers (working for less than half of the year).

Among manufacturing workers, 51% work in spinning and weaving, 15% work in metal, 6% work in printing and publishing, 5% work in electrical machinery, and the rest work in a wide variety of industry sectors. Varanasi's manufacturing industry is not well developed and is dominated by small-scale industries and household production.

4.6.1 Weaving

Silk weaving is the dominant industry in Varanasi. Muslims are the influential community in this industry with nearly half a million of them working as weavers, dyers, sari finishers, and salespersons. Weaving is typically done within the household, and most weavers are Momin Ansari Muslims. Varanasi is known throughout India for its production of very fine silk and Banarasi saris, brocades with gold and silver thread work, which are often used for weddings and special occasions.

4.6.2 Manufacturing

In the metal manufacturing sector, Diesel Locomotive Works is a major employer.[87] Bharat Heavy Electricals, a large power equipment manufacturer, also operates a heavy equipment maintenance plant.[92] Other major commodities manufactured and traded in Varanasi include hand-knotted Mirzapur carpets, rugs, dhurries, brassware, copperware, wooden and clay toys, handicrafts, gold jewellery, and musical instruments.

4.6.3 Agriculture

Varanasi produces large quantities of langra mangoes, which are variety developed in the area.

Banarasi paan (betel leaf) and khoa (a milk product) are popular, and the related small-scale industries employ many people. Chiraigaon very famous for

cultivation Guava fruit crop. It have many small unit of food processing which makes Pickle, Sauce, Jam, and Jelly.

4.6.4 Tourism

Tourism is Varanasi's second most important industry. Nearly 6.3 million domestic tourists and 690,472 foreign tourists visited Varanasi in 2015. Domestic tourist most commonly visit for religious purposes while foreign tourist visit for ghats along River Ganges and Sarnath. Most domestic tourists are from Bihar, West Bengal, Madhya Pradesh, and Uttar Pradesh, while the majority of foreign tourists are from Sri Lanka and Japan. The peak tourist season falls between October and March. In total, there are around 12,000 beds available in the city, of which about one half are in inexpensive budget hotels and one third in Dharamsalas. Overall, Varanasi's tourist infrastructure is not well developed.

4.7 Varanasi district profile at a glance

Items		**Particulars**	**Value**
1	**Area**		
	1.1	Geographical area (Sq. km)	1526.56
	1.2	Forest (ha)	412
	1.3	Net sown area (ha)	113.946
	1.4	Total cropped area (ha)	157.096
	1.5	Cropping intensity (%)	138
	1.6	Fallow land (ha)	2587
	1.7	Land not available for cultivation	10003

Items		**Particulars**	**Value**
2	**Administrative**		
	2.1	No of block	8
	2.2	No of village (inhabited)	1262
	2.3	No of villages (electrified)	728(57.68%)
	2.4	No of villages with portable water supply	1262(100%)

Items		**Particulars**	**Value**
3	**Rain fall(mm)**		
	3.1	SW monsoon (June-Sep):	944.5
	3.2	NE Monsoon(Oct-Dec):	60.9
	3.3	Winter (Jan- March)	56.5
	3.4	Summer (Apr-May)	19.8
4	**Agro-climatic zone**		**Eastern plain region**

Items		Particulars	Value
5	**Population**		
	5.1	Male	761,060
	5.2	Female	674,053
	5.3	Total	1,435,113

Items		Particulars	Value
6	**Literacy (%)**		
	6.1	Total	67.09
	6.2	Male	83.66
	6.3	Female	48.59

Items		Particulars	Value
7	**Agriculture allied work forces**		
	7.1	Cultivators	207666
	7.2	Small and Marginal farmers	195581
	7.3	Agricultural labours	102573
	7.4	Artisans	92567
	7.5	Others workers	303283

Items		Particulars	Value
8	**Irrigation('000 ha)**		
	8.1	Net irrigated area	82.206
	8.2	Gross irrigated area	134.073
	8.3	Rainfed area	13.542

Items		Particulars	Value
9	**Major Soils , Area ('000 ha)**		
	9.1	Sandy loam	70.560
	9.2	Loam	25.000
	9.3	Clay loam	37.800
	9.3	Sandy	19.320

Items		Particulars	Value
10	**Horticultural Fruits Crops - Area ('000 ha)**		
	10.1	Mango	12.381
	10.2	Guava	16.434
	10.3	Lemon	5.405
	10.4	Ber (Indian Plum)	0.310
	10.4	Papaya	0.100

Source: http://en.wikipedia.org/wiki/Varanasi
http://agricoop.nic.in/agriculturecontingency/uttar-pradesh/2012

CHAPTER-V

RESULLTS AND DISCUSSION

In this chapter, efforts had been made to cover the analysis and interpretations of data collected for the study and present the result in the context of the stated objectives. The result covers the analysis of primary data. As mentioned earlier, schedules specially developed for this study were canvassed and information on awareness, source of information, amount of bio fertilizers, market opportunities and distribution channels were collected and tabulated. It may be recalled that the focus of the study was to consumption pattern of bio-fertilizers in Varanasi district (U.P.). The materials in this section are presented under following sub heads viz;

5.1 Farmer's Profile

5.2 Awareness and sources of information

5.3 Amount used of bio-fertilizers in different crops

5.4 Market opportunities of bio-fertilizers

5.5 Farmers' perception towards bio-fertilizers

5.6 Promotional tools used in marketing of bio-fertilizers

5.7 Distribution channel of bio-fertilizers in Varanasi

5.1 Farmers' Profile

5.1.1 Education of farmers

Table 5.1.1 Education level of farmers

S. No.	Level of Education	No of respondents	Percentage
1	Illiterate	35	35%
2	10^{th}	22	22%
3	12^{th}	20	20%
4	Graduate	22	22%
5	Post graduate	1	1%
	Total	100	100%

Table 5.1 shows that 35% farmers are illiterate in study area. 22% farmers are 10^{th} pass, 20% farmer 12^{th} pass, 22% graduate and only 1% or only 1 farmer is post graduate.

5.1.2 Age group of farmers

Table 5.1.2 Age group of farmers

S. No.	Age	No of respondents	Percentage
1	20-40	32	32%
2	41-60	54	54%
3	Above 60	14	14%
	Total	100	100%

In this table age group of farmer devided in 3 categories 20-40, 41-60 and above 60. Mostly farmers are under the 41-60 years category.

5.1.3 Irrigation status of land holdings of respondents

Table 5.1.3 Irrigation status of land holdings

S. No.	Land	No of respondents	Percentage
1	Irrigated	99	99%
2	Un-irrigated	1	1%
	Total	100	100%

The above table shows tha**t** 99% land of respondents is irrigated.

5.2 Awareness and sources of information

5.2.1 State of awareness about bio fertilizers

Table 5.2.1 State of awareness

S.No.	Awareness	No. of Respondents	Percentage
1	Aware	98	98%
2	Unaware	2	2%
	Total	100	100%

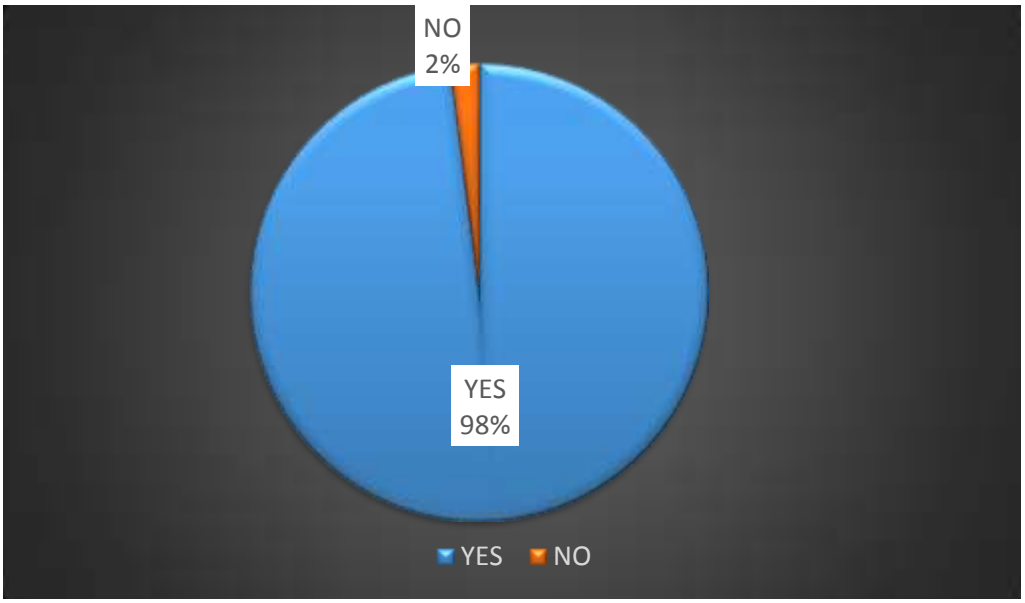


Figure 5.1 Awareness about Bio fertilizers

Almost 98% farmers replied in affirmative as far as basic awareness about bio fertilizers is concerned.

5.2.2 Awareness regarding the effects of bio-fertilizer use:

Table 5.2.2 Awareness regarding the effects of bio-fertilizer use

S. No.	Effects of Bio-fertilizer use	No of respondents	Percentage
1	Enhance Productivity	24	24%
2	Don't Know Specifically	4	4%
3	Enhance Quality	57	57%
4	Others	15	15%
	Total	100	100%

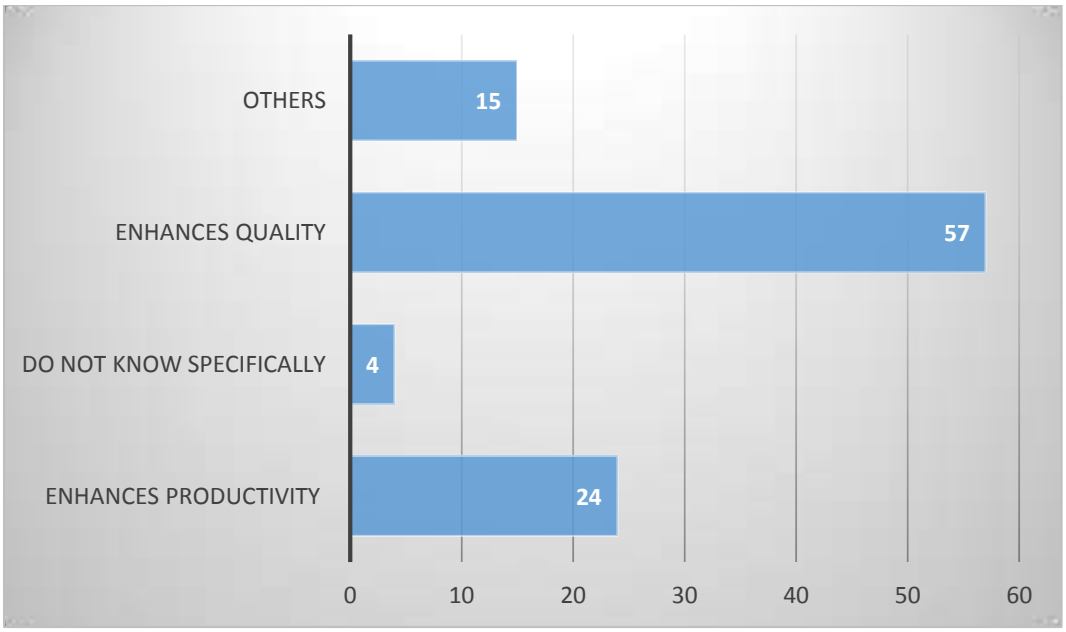


Figure 5.2 Awareness regarding to the effects of bio fertilizers use

Knowledge about the positive impacts of Bio-Fertilizer seem to be generic in nature. Though 57% farmers agreed upon quality enhancement, positive impact over yield was less recognized among farmers.

5.2.3 Sources of information about bio-fertilizer:

Table 5.2.3 Sources of information

S. No.	Source of Information	No of respondents	Percentage
1	Dealer's Advice	60	60%
2	Fellow Farmers	29	29%
3	Farmer meeting/ Social Gathering	11	11%
	Total	100	100%

Table 5.2 Shows that 60% farmers gating information regarding bio fertilizer from Dealers, 29% from neighbour's and 11% from farmer meeting or social gathering.

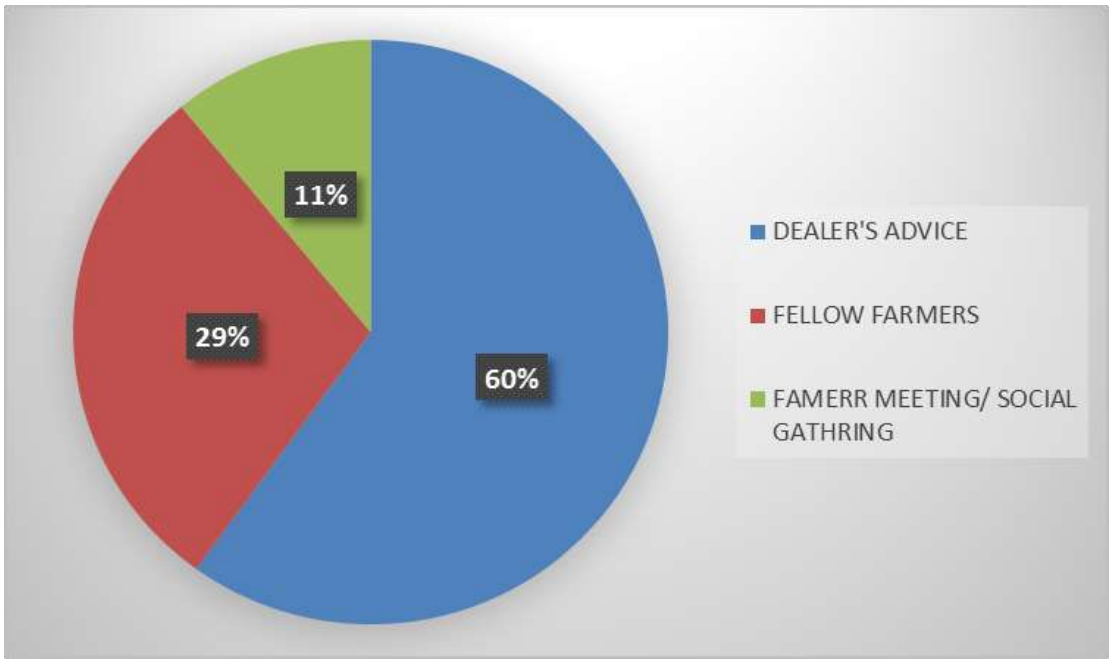


Figure 5.3 Source of information about bio-fertilizers

Role of dealer's channel has much significance in relation to the use of Bio-fertilizer. While lower role of farmer's meeting and social gathering depicts inefficient use of traditional channels for promotional activities.

5.2.4 Usage status of bio fertilizers use:

Table 5.2.4 Usage status of bio fertilizers

S. No.	Usage Status	Number of Respondents	Percentage
1	Used	60	60%
2	Never	29	29%
3	Never but want in Future	11	11%
	Total	**100**	**100%**

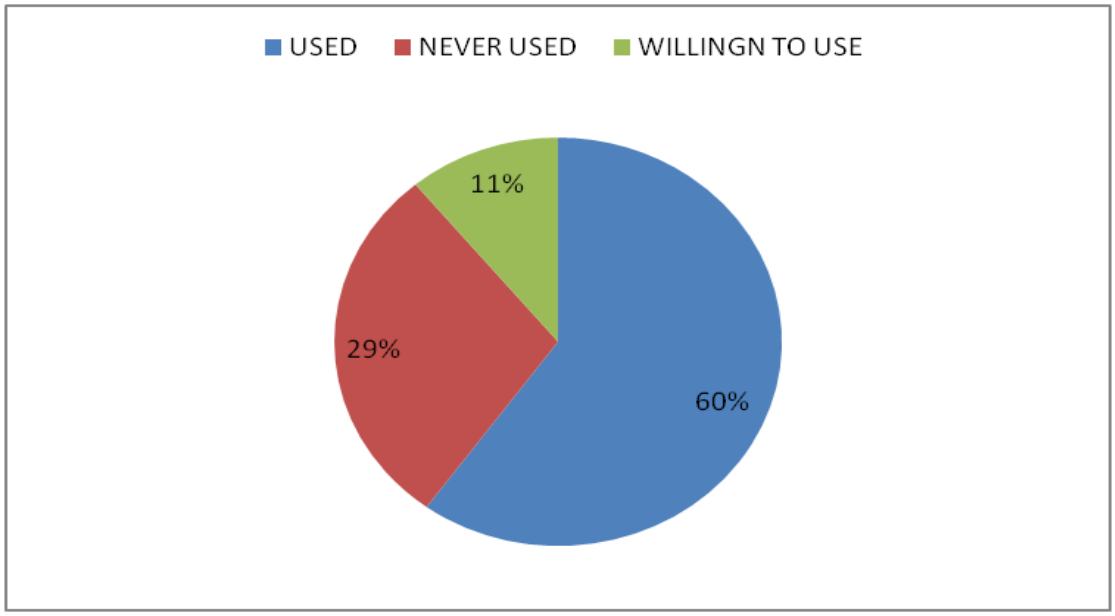


Figure 5.4 Usage status of bio fertilizers

29% of the farmers never used bio-fertilizer. While 11 % show their willingness to use in future. This indicates towards unexplored market in the bio-fertilizer sector.

5.2.5 Bio fertilizers used by farmers

Table 5.2.5 Bio fertilizers used by farmer

S. No.	Name of Bio fertilizer	Company	No of respondents	Percentage
1	Devi Dayal	Dayal	12	20%
2	Empower	Espic	8	13.33%
3	Ramban	Shriram Fertilizers	7	11.66%
4	N-zyme	Nagarjuna	19	31.66%
5	Super star	Shiv agro	5	8.33%
6	Others	-	9	15%
	Total		60	100%

Table 5.4 Shows that out of 60 farmers 20% using Devi Dayal (Dayal), 13.33% using Empower (Espic),11.66% using Ramban (Shriram Fertilizer), 31.66% using N-zyme (Nagarjuna) 8.33% using Super star (Shiv agro) and 15% farmer using other products. So according to table the large number of farmers using N-zyme product.

5.3 Amount used of bio-fertilizers in different crops

Table 5.3 Amount used of bio-fertilizers in different crops

S.No.	Crops	Nitrogen (Kg)	Phosphorus (Kg)	Potassium (Kg)	FYM (Quin)	Bio Fertilizer (Kg)
1	Paddy	129.06	105.01	100.48	90.68	60.64
2	Okra	144.16	145.39	123.97	77.76	54.78
3	Beans	144.58	118.57	114.80	77.47	60.69
4	Tomato	129.00	126.56	127.11	89.90	67.52

Above table shows that the average use of NPK, FYM and bio fertilizer in Paddy is 129.06 kg N, 105.01 kg P ,100.48 kg K , FYM 90.65q and the average use of bio fertilizer is 60.64 kg/ha.

In okra crop average use of Nitrogen is 144.6 kg , phosphorus 145.39 kg, K 123.9 kg and average use of FYM and bio fertilizer is 77.76q and 54.78 kg/ha respectively.

In Bean's average use of N is 144.58 kg, P 118.57 kg, K is 114.80 kg , average use of FYM is 77.47q and bio fertilizer use is 66.69 kg / ha.

In tomato crop the average use of N is 129.00 kg, P 126.56 Kg, K is 127.11and the. Average use of FYM and bio fertilizer is 89.90q and 67.52 kg / ha.

5.4 Market opportunities of bio-fertilizers

5.4.1 Reasons for using bio-fertilizers:

Table 5.4.1 Reasons for using bio-fertilizers

S. No.	Reason	Number of Respondents	Percentage
1	Faster Growth	37	37%
2	Better Appearance	30	30%
3	Less susceptibility to Diseases	13	13%
4	Others	20	20%
	Total	**100**	**100%**

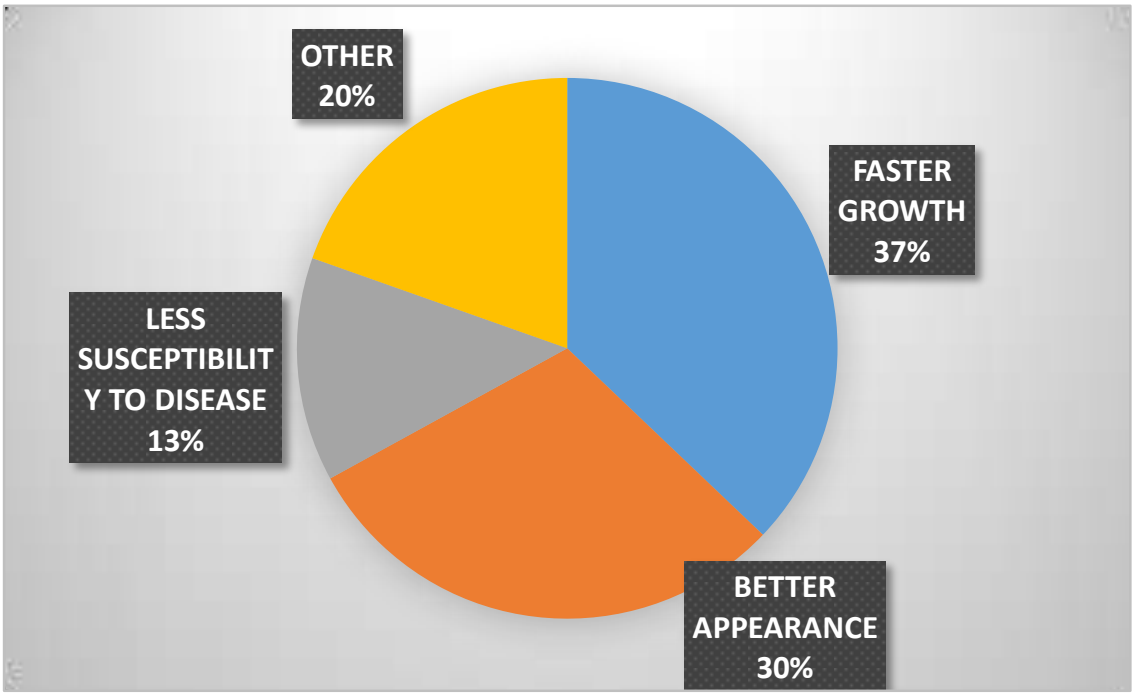


Figure 5.5 Reasons for using bio-fertilizers

Most of the reasons cited by farmers are Crop centric, Overall benefits of bio-fertilizers such as soil health are less known among farmers.

5.4.2 Prospects of use in upcoming years:

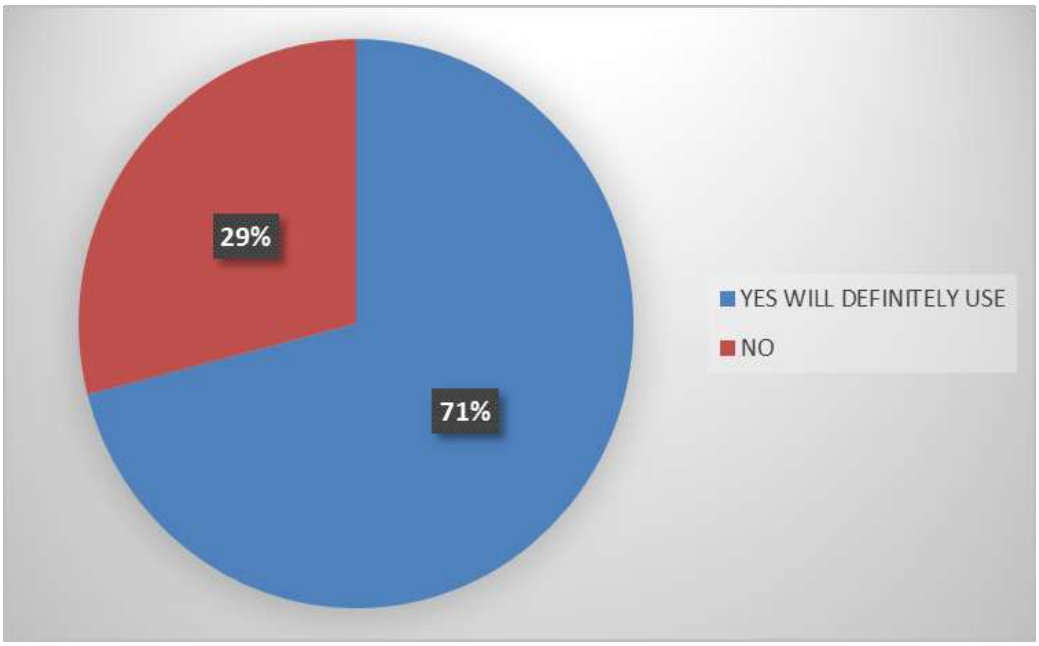


Figure 5.6 Prospects of use in upcoming years

The positive outlook is shown by farmer w.r.t. use of bio fertilizers in coming years.

5.5 Farmers' perception towards bio-fertilizers

5.5.1 Impression about cost-benefit:

Table 5.5.1 Impression about cost-benefit

S. No.	Impression about Cost-Benefit	Number of Respondents	Percentage
1	Costly	71	71%
2	Cheap	2	2%
3	Value for Money	27	27%
	Total	**100**	**100%**

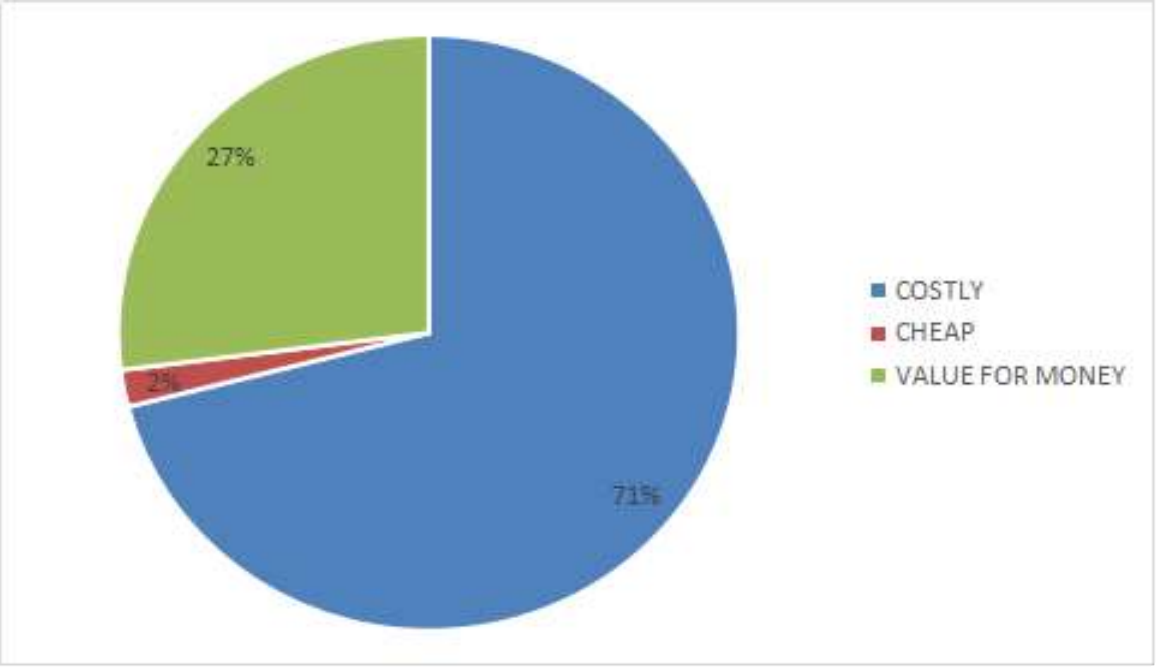


Figure 5.7 Impression about Cost-Benefit

Overwhelming percentage of farmers (71%) considers bio-fertilizers costly in comparison with chemical fertilizers. Being one of the most crucial factors determining the usage of bio-fertilizer among farmers, above graph depicts core issue related with the lower use of bio-fertilizer among farmers.

5.5.2 Knowledge about impact over soil health:

Table 5.5.2 Impact over soil health

S. No.	Impact over Soil Health	Number of Respondents	Percentage
1	Benefited for the Soil	93	93%
2	No effect on Soil	7	7%
	Total	**100**	**100%**

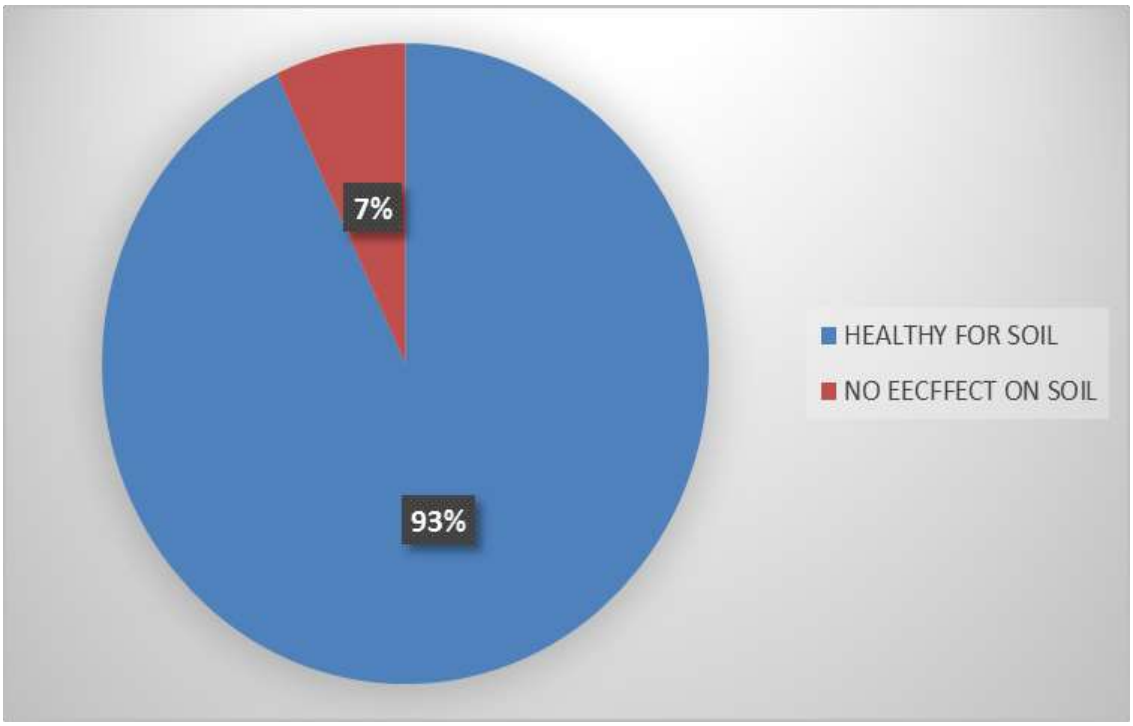


Figure 5.8 Knowledge about impact over soil health

Most farmers (93%) responded affirmatively over positive correlation between Soil health and use of bio-fertilizers.

5.5.3 Knowledge about relationship with environment:

Table 5.5.3 Relationship with environment

S. No.	Relationship with Environment	Number of Respondents	Percentage
1	Eco-friendly	88	88%
2	No Effect	1	1%
3	Don't Know	11	11%
	Total	**100**	**100%**

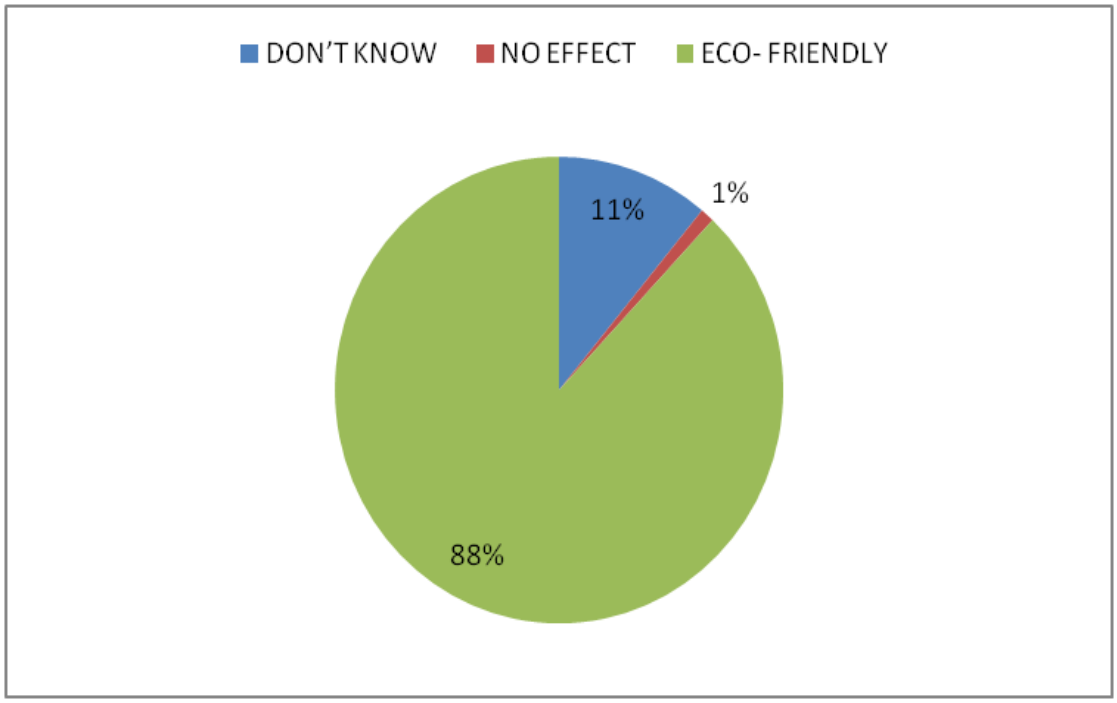


Figure 5.9 Knowledge about relationship with environment

Most farmers (88%) responded affirmatively over positive correlation between environment and use of bio-fertilizers.

5.6 Promotional tools used in marketing of bio-fertilizers

5.6.1 Tools used for promotional activities:

Table 5.6.1 Promotional activities

S. No.	Promotional Activities	Number of Respondents	Percentage
1	Pre-distribution of Product	1	1%
2	Kisan Mela	21	21%
3	Exciting offers	3	3%
4	Others	75	75%
	Total	**100**	**100%**

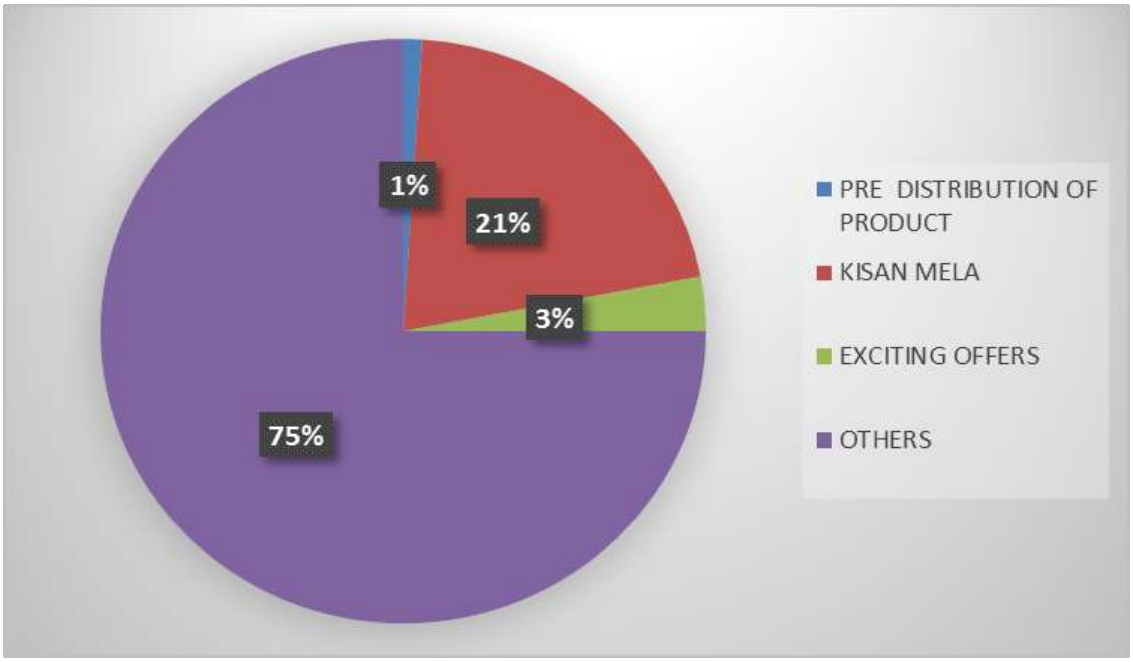


Figure 5.10 Tools used for promotional activities

Companies have relied mostly on dealer's route in order to promote the use of bio-fertilizers. Absence of novel marketing techniques such as pre-distribution of product and new offers etc. indicate deficiency in marketing strategies on the part of market players.

5.6.2 Pamphlets usages status

Table 5.6.2 Pamphlets usages status

S. No.	Pamphlets usages	Number of Respondents	Percentage
1	Yes	71	71%
2	No	29	29%
	Total	**100**	**100%**

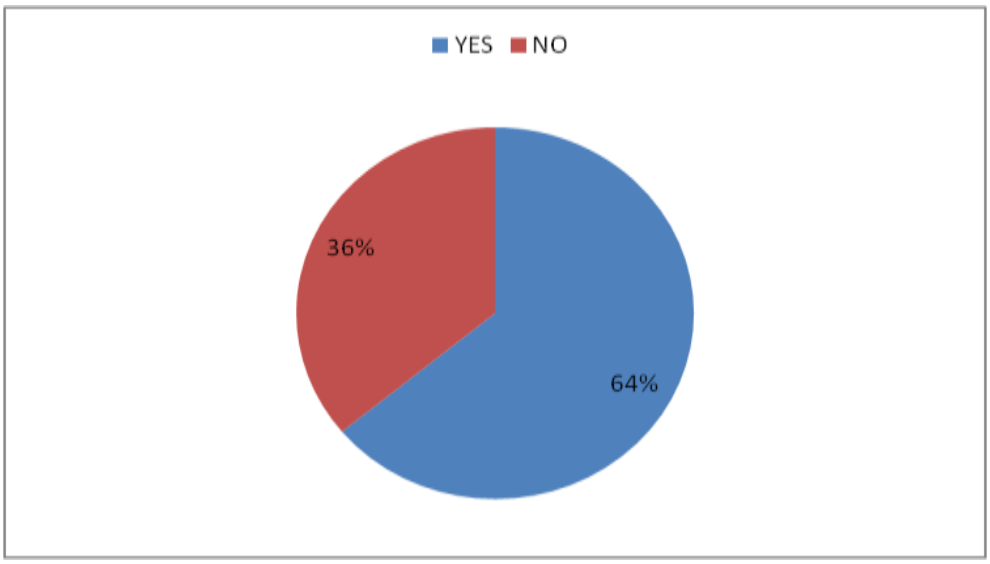
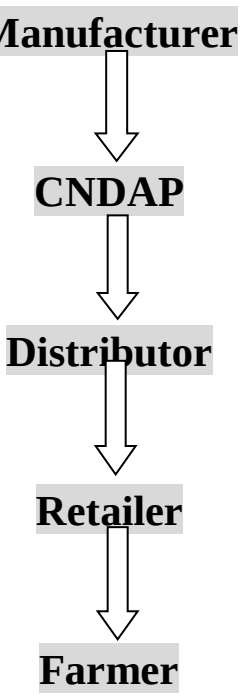


Figure 5.11 Pamphlets usages status

It is evident from the above observation that more than 64% farmers relied that upon pamphlets for information while 36% did otherwise. Given the scale of digital communication from may further see drop in future.

5.7 Distribution channel of bio-fertilizers in Varanasi



CHAPTER-VI

SUMMARY AND CONCLUSIONS

Agriculture sector in India holds immense importance not only from the perspective of employment it provides to the labor force i.e. 49 % but also from the perspective of food security it provides to the booming population.

Though being critically important for nation, the growth rate for the sector has not seen a tremendous rise since independence while staggering around 2 %. Further, inefficient use of inputs like seeds, water pesticides, fertilizers etc. has taken toll not only on the cost effectiveness of the product but also the productivity soil with severe environmental repercussions.

Fertilizer being one of the most important inputs holds immense importance for crop productivity. India represents a very peculiar case study on fertilizer use. On the one hand where average use of fertilizer per unit area in India falls way behind developed nations, imbalanced use of fertilizers heavily tilted in favor of urea and lesser use of potash and phosphorus has given rise to severe problems with soil health.

Our central theme of study, bio-fertilizers along with Farm Yard manure holds key to the revolution in the area of farming in our country. Farm yard manure not only enhances the productivity of the soil and crop but also optimizes farm waste to become a productive asset. Bio fertilizer on the other hand represents a novel way of using microorganisms as fertilizers and addressing the widespread deficiency of macro and micro nutrients in the soil.

Although awareness about both kinds of fertilizers is on increasing trend there are many hurdles are to be addressed. In this project we have taken samples of a farmers database in relation with their knowledge about Bio-fertilizers and proportion of fertilizers being used for different crops.

Keeping in view the problems the study is conducted with the following specific objectives:

1. To assess the awareness and sources of information.
2. To estimate the amount used of bio-fertilizers in different crops.
3. To examine market opportunities of bio-fertilizers.
4. To study the promotional tools used in marketing of bio-fertilizers.
5. To examine farmers' perception towards bio-fertilizers.
6. To find out distribution channels of bio-fertilizers in Varanasi.

The Primary data were collected directly from sample farmers using a pre structured schedule and questionnaire. The information pertains to agriculture year 2018. The secondary data were collected from the web portals, different magazines, thesis, project report and journal related with Agri-business and data available with the department or university. Descriptive statistics was used to analysis the data.

Findings

- Almost 98% farmers replied in affirmative as far as basic awareness about bio fertilizers is concerned.
- Knowledge about the positive impacts of Bio-Fertilizer seem to be generic in nature. Though 57% farmers agreed upon quality enhancement, positive impact over yield was less recognized among farmers.
- 29% of the farmers never used bio-fertilizer. While 11 % show their willingness to use in future. This indicates towards unexplored market in the bio-fertilizer sector.
- Most of the reasons cited by farmers are Crop centric, Overall benefits of bio-fertilizers such as soil health are less known among farmers.
- Role of dealer's channel has much significance in relation to the use of Bio-fertilizer. While lower role of farmer's meeting and social gathering depicts inefficient use of traditional channels for promotional activities.
- Companies have relied mostly on dealer's route in order to promote the use of bio-fertilizers. Absence of novel marketing techniques such as pre-

distribution of product and new offers etc. indicate deficiency in marketing strategies on the part of market players.

- Most farmers (93%) responded affirmatively over positive correlation between Soil health and use of bio-fertilizers.
- Most farmers (88%) responded affirmatively over positive correlation between environment and use of bio-fertilizers.
- Overwhelming percentage of farmers (71%) considers bio-fertilizers costly in comparison with chemical fertilizers. Being one of the most crucial factors determining the usage of bio-fertilizer among farmers, above graph depicts core issue related with the lower use of bio-fertilizer among farmers.
- The positive outlook is shown by farmers w.r.t. use of bio fertilizers in coming years.
- Among farmers of age group of 41-60 in relation to the usage of Bio-fertilizer. While younger generation (20-40) has not shown the expected level of confidence in bio-fertilizer use.

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APPENDICES

Questionnaire

Name of respondent -
Age-

Village/Block -
Education-

Subsidiary occupation -

Sing of respondent -

Date of survey -

(1)- Are you aware of bio-fertilizers?

(a)- Yes

(b)- No

(2)-Have you ever used bio-fertilizers?

(a)-Yes

(b)- No

(c)-Never used but want to use in future

(d)- Not interested at all

(3)- Please tell me what you know about bio-fertilizers?

(a)-It increase productivity

(b)-Don't know much about it

(c)-It increase quality of yield

(d)-Other

(I) Name of bio-fertilizer (ii) Name of company

(4)- Source of information?

(a)- Advise of dealer

(c)- Farmer fair/social gathering/farmers meeting

(d)-Television/radio

(5)- Size of holding (I) Irrigated (II) Un- irrigated

(III) Source of irrigation

SNo.	Crops	Area	Irri/Un-irri	FYM		NPK		Bio-Fertilizer	
				Amount	Rate	Amount	Rate	Amount	Rate

(5)- Why do you use bio-fertilizers?

(a)- Faster growth

(b)-Better appearance

(c)-Less susceptibility to disease

(d)-Other

(6)- Will you use bio-fertilizer in next year?

(a)-Yes

(b)-No

(7)- Price

(a)-Costly

(b)-Cheap

(c)- Gives value for money

(8)- Health

(a)-Does not harm to soil

(b)-Harmful for soil

(c)-No effect on soil

(9)- Environment friendly?

(a)-Yes

(b)- No

(c)-Don't know

(10)- Do you read pamphlets provided by company person?

(a)-Yes

(b)-No

(11)- Which promotional activity you have seen in your area?

(a)- Free distribution of product

(b)- Farmer fair

(c)- Exciting offer by company (d)- Other