UNIVERSITY FOR DEVELOPMENT STUDIES

COMMUNICATION MEDIA USAGE AND UPTAKE PATTERNS OF INOCULANT TECHNOLOGY IN TOLON DISTRICT AND SAVELEGU MUNICIPAL OF THE NORTHERN REGION, GHANA

BY

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DECLARATION

I hereby declare that, except for references to other peoples‟ work, which have been duly acknowledged, this thesis is the result of my own research work carried out in the department of agricultural extension, rural development and gender studies under the supervision of Dr. Francis K Obeng and Mr. Paul Adraki Kwami. It is further declared that this thesis has never been presented either in whole or in part for the award of any degree in this University or elsewhere.

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DEDICATION

This theses is dedicated to my family and love ones

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The product of a graduate degree is never the result of one person's labour, but rather the result of the goodwill, sacrifice and support of many people. My appreciation and thanks go to my supervisors, Dr. Francis K Obeng and Mr. Paul Adraki Kwami, whose scholarly insights and academic rigor helped me to develop a better understanding of the issues involved in this thesis. I am very grateful to Mr. Eric Doe of IITA for his support and advice as well as and the farmers, for their tolerance and their willingness with which they answered my questions. I am grateful to all my colleagues for their generosity and support, particularly during a challenging phase of writing this thesis. I extend my heartfelt appreciation to my parents, from whom I acquired the virtues of diligence and patience, and for having confidence in my ability to succeed. My greatest inspiration for academic pursuit comes from my friend, Mr. Confidence Agbeko, from whom I learned the importance of education, and also the tenacity to follow my academic dream.

ABSTRACT

The purpose of this study is to investigate the influence of communication media usage and uptake pattern of inoculant technology in the northern region of Ghana. The study was conducted in the Tolon District and Savelegu Municipal respectively of the Northern Region of Ghana. Close and open-ended questionnaires and personal interviews were all used in collecting data from 210 legume farmers sampled for this study. The study results revealed that, communication methods used by promoters of rhizobium inoculant in the dissemination of information on rhizobium inoculant are radio, demonstration and video as well as combination of these methods. However, the most communication method frequently used in accessing on information on agricultural innovation is radio, followed by demonstration and video. The types of communication method used to promote and disseminate information on agricultural innovation to farmers had a strong influence on awareness creation among farmers in the study area. However, the types of communication method used to disseminate innovation to farmers did not influence respondents' knowledge on rhizobium inoculant in the study area. On farmers' intention to use rhizobium inoculant for their farming, over 74.3% of farmers are intending to use rhizobium inoculant for their farming operation. With, predictors of farmers' intention to use rhizobium inoculant, attitude towards the technology as well social pressure were the strongest predictors of farmers' intention to use the rhizobium inoculant. The study recommends among others things, the combination of all the three methods to enhance farmers' knowledge on rhizobium inoculant and the need for redeveloping of new brand of rhizobium inoculant with long shelf life to help boast farmers' confidence on rhizobium inoculant usage.

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ABBREVIATION AND ACRONYM

CTA	Center for Transforming Agriculture
FFS:	Farmer Field School
IITA	International Institute of Tropical Agriculture
MDGs	Millennium Development Goals
MOFA	Ministry of Food and Agriculture
NGO	Non-Governmental Organisation
SARI	Savannah Agricultural Research Institute
UNDP	United Nations Development Programme
WARDA:	West Africa Rice Development Centre
ZIZO:	Zooming-in Zooming-out

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Communication media, according to Center for Transforming Agriculture, (2003) are seen as technologies which facilitate communication and information dissemination among actors. These media are useful in improving linkages between research and agricultural extension systems (Mishra and Williams, 2006). They also boost agricultural production and improve rural livelihoods, (Arokoyo, 2005), providing essential benefit in the transfer of information and knowledge, (Rao, 2004), facilitating collaboration and knowledge exchange, (Nikbakhsh, 2011) as well as increase efficacy in extension service and market information on product price at all levels, (Adetumbi, Olaniyi, and Adewale, 2013).

Common communication media used to disseminate agricultural information are the radio, video, internet, computers and mobile phones, (Kajogbola, 2004; Murage, 2011). Though, Rogers, (2003) grouped communication media into two forms, namely; mass media and interpersonal media, it is perceived that, mass media is more effective in creating awareness of an innovation, whereas personal contacts are more effective in forming an individual opinion about an innovation. The use of these communication media among people are influence by several factors such as age, educational level, cost, availability and accessibility of communication media, (Kajogbola, 2004).

Nevertheless, different communication media are more suited for different categories of people thus, the young and old; male and female; educated and non-educated, (Cheboi, 2014) and implementation of integrated approach on uptake and usage of an innovation among farmers, will depend on appropriate selection of communication media in the dissemination of information among targeted beneficiaries.

In the case of rhizobium inoculant promotion, radio, demonstration and video as well as combination of methods have been extensively used to disseminate information on rhizobium inoculant. These media empower individuals, groups and communities to effectively access, share and use agricultural knowledge in addressing their information needs.

The information disseminated aims at influencing human behavior on an innovation and subsequently leading to adoption of rhizobium inoculant. Effective and efficient use of these communication media will increase farmers' awareness of rhizobium inoculant with regard to accessibility as well as enhance their knowledge on the handling, storage and use, which ultimately affects their decision to use rhizobium inoculant. Notwithstanding the massive promotion of this technology by promoters, the usage of rhizobium inoculant among farmers is still low (Kannaiyan, 1993; Dogbe, Etwire, Martey, Baba and Siise, 2013). The country is still far from realizing wide-scale use of rhizobium inoculant among farmers. Thus, this study sought to investigate the influence of communication media usage on uptake patterns of rhizobium inoculant and the factors that influence farmers' intention to use rhizobium inoculant technology in the Savelegu Municipal and Tolon District of the Northern Region, Ghana.

1.2 Research Problem

Researches on inoculation of legumes with rhizobium inoculant have been developed to boost legumes production and improve soil fertility at a cheaper cost, (Bala, Karanja, Murwira, Lwimbi, Abaidoo and Giller, 2011). Despite this demonstrated benefit and the high cost of using inorganic fertilizers, adoption of the technology among farmers in Ghana have generally been low, (Dogbe et al. 2013).

In attempt to address the low usage of this technology, radio, video, demonstration and several strategies have been used to promote the use of rhizobium inoculant to farmer. Despite the use of these communication media by promoters to disseminate the innovations (information) to farmers, it is perceived that the information needs of farmers on inoculants availability, access and use among end-users, (Dogbe et al. 2013; Woomer, Karanja, Mekki, Mwakalombe, Tembo, Nyika, Silver, Nkwine, Ndakidemi, and Msumali. 1997) in the Northern Region of Ghana is largely unmet.

Therefore, this study sought to find out the influence of communication media usage on uptake patterns of rhizobium inoculant technology among farmers in the Savelegu Municipal and Tolon District of the Northern Region.

1.3.0 Research Question of the Study

In order to address the problem above, the following questions were formulated to guide the study.

1.3.1 Main Research Question

What is the influence of communication media usage on uptake patterns of rhizobium inoculant technology in the Savelegu Municipal and Tolon District of the Northern Region?

1.3.2 Specific Research Question

1. What are the socio-demographic characteristics of legume farmers in the Savelegu Municipal and Tolon District of the Northern Region?

2. What are the influences of communication media usage on uptake of rhizobium inoculant among farmers in the Savelegu Municipal and Tolon District of the Northern Region?

- What is the effectiveness of communication methods usage on awareness creation of rhizobium inoculant technology among farmers?
- What is the effectiveness of communication methods usage on farmers' knowledge enhancement of rhizobium inoculant technology?
- What is the effect of awareness creation and knowledge enhancement on farmers' intention to use rhizobium inoculant technology?

3. What are the factors that affect farmers' intention to use rhizobium inoculant technology in the Savelegu Municipal and Tolon District of the Northern Region?

1.4.0 Objectives of the Study

1.4.1 Main research objectives

To determine the influence of communication media usage on uptake patterns of rhizobium inoculant technology in the Savelegu Municipal and Tolon District of the Northern Region.

1.4.2 Specific research objectives

1. To examine legume farmers in the study area by their socio-demographic characteristics.

2. To examine the influences of communication media usage on uptake patterns of rhizobium inoculant technology among farmers in the Savelegu Municipal and Tolon District of the Northern Region.

- To examine the effectiveness of communication methods usage on awareness creation of rhizobium inoculant technology among farmers.
- To examine the effectiveness of communication methods usage on farmers' knowledge enhancement of rhizobium inoculant technology.
- To examine the effect of awareness creation and knowledge enhancement on farmers' intention to use rhizobium inoculant technology.

3. To examine the factors that affect farmers' intention to use rhizobium inoculant technology in the Savelegu Municipal and Tolon District of the Northern Region.

1.5 Justification of the Study

Findings of the study will serve as a guide to bringing about sustainable flow of information among all relevant stakeholders in the agricultural sector. Agricultural development requires much more of technology and since the use of communication media in information dissemination is the gateway to innovation communication, policy recommendations of the study will provide direction in bringing about increased accessibility and utilization of communication media for information service coverage and hence encourage the adoption of rhizobium inoculant technology in the Northern Region of Ghana.

The study will make useful suggestions that will serve as a guide for MoFA, research institutions and NGOs on how to fully commercialized rhizobium inoculant to farmers through the use of communication media

Policy recommendations from the study can also serve as a blue print for research institutions to better integrate communication media policies and strategies regarding innovation (information) dissemination to farmers to enhance agricultural production thus bringing about an improvement in the standard of living of the people in the Northern Region of Ghana.

1.6 Definition Key Concepts

Uptake: Using of the technology as soon as hearing and getting access to the technology

Communication Methods: These are strategies used to promote the rhizobium inoculant among farmers, such as the use of radio program, showing of inoculant technology through video show and farmers learning from demonstration plot.

Information: External and internal knowledge that flows among farmers to enable them make decisions on their farming activities.

Innovation: A practice that is perceived as new by farmers.

Inoculant: Inoculant is the means of bacterial transport from the factory to the living plant. The desired effects of the inoculant on plant growth can include nitrogen fixation in legumes, bio control of soil-borne diseases, the enhancement of mineral uptake, weathering of soil minerals, and nutritional or hormonal effects of crops.

1.7 Organization of the studies

The thesis is organized into five chapters. Chapter one is deal with the introduction of the study. It focuses on the background of the study, problem statement of the research, objectives and questions of the study, the justification of the study, and definitions of key terms use for the study.

The chapter two reviews and discusses literature relevant to the topic to establish a theoretical approach for the research. The areas of literature considered very relevant to the study and provides enough evidence for analytical discussion to support the study.

Chapter three focuses on, instrument used to collect needed information for this study, it also presents research design, sampling procedure, data collection and analysis.

Chapter four presents results and discussions of findings of the research within the context of the study objectives. It discussed findings on farmers' socio-demographic characteristics, the influences of communication media usage on uptake patterns of rhizobium inoculant among farmers and the factors that affect farmers' intention to use rhizobium inoculant among legume farmers in the study area.

Chapter five, the last chapter focuses on conclusion, implications and recommendations base on the findings of the research.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter reviews related research which are relevant to this study. The chapter is divided into two parts. In the first part, the theoretical concepts that guide the study are discussed. They are the Diffusion of Innovation Theory and Theory of Planned Behaviour. Then in the second part of the chapter, related studies are reviewed.

2.1.0 Diffusion of Innovation Theory

Diffusion of Innovations is a communications theory that suggests an explanation on the processes, the motive and the degree at which new ideas and technology spread through a society (Dearing, 2009). The Diffusion of Innovation Theory developed by Everett Rogers in 1962 is significant to this study because the research is gear towards understanding how information on Rhizobium inoculant technology, can be fully adopted among legume farmers in the Northern Region. There are many theories that deal with the generation of innovations, and their diffusion and adoption or non-adoption by a public. Such theories include the technology acceptance theory, theory of reason action, and diffusion of innovations theory (Rogers, 2003). Among the theories, Rogers (2003), claims the diffusion of innovation theory is the theory that has dominated the understanding and practice of agricultural innovation all over the world for more than half a century. Dearing (2009) also observed few social science theories have had a history of abstract and experimental study for as long as the diffusion of innovations theory.

The theory has been used widely to study the spread of a variety of new ideas, practices, programs, and technologies across several fields. This theory offers insight into approaches for agricultural information sharing and rural community capacity building (Dearing, 2009). From the above, the researcher can conclude that the Diffusion of Innovation Theory is the best fit theory for examining the introduction and spread of information on new agricultural technologies among social groups such as farmers. Hence, this study will use the theory in investigating communication media and rhizobium inoculant technology uptake pattern among farmers in the Savelegu Municipal and Tolon District of the Northern Region.

2.1.1 Elements of Diffusion of Innovation Theory

Diffusion of innovations among individuals is considered important in the life of society because it is relatively difficult to develop useful innovation necessary for the advancement of societies (Rogers, 1995). Developing an innovation usually take more time and require more resources than transferring an already established innovation from one environment to another. Rogers (1995), stated four main elements of Diffusion of Innovation Theory. These are:

A) Innovation

An innovation is an idea or practice that is perceived as new by an individual or unit of adoption (Rice and Atkins, 2009; Roger, 2003). Rogers (2003), noted that, the successful adoption of a particular innovation should score higher in terms of its relative advantage over existing practices, compatibility to users' needs, trialability and observability, and lower in its complexity to use.

The relative advantage of one technology over another is a main determinant of the adoption of new technology. The issue of relative advantage has been shown to have a positive relationship with adoption of innovation. Users need to be shown that inoculant technology offers considerable benefit compared to chemical fertilizer. Compatibility of the innovation needs to align with individual's current values and experiences.

The more compatible inoculant technology will be to farmers the less a change of behaviour is required, therefore, allowing for faster adoption of inoculant technology into soybeans production. If inoculant technology requires users to adjust their existing behaviour or is in contrast to their attitudes the more unlikely they are to adopt. In addition the user's previous experience of adoption of inoculant technology in farming, whether this was a positive or negative experience will also influence the adoption of inoculant technology. A negative previous experience can result in innovation negativism which is where a negative previous experience with one innovation can negatively impact the adoption of another.

This could be very likely to be an issue in new chemical fertilizer with which existing users experience of fertilizer may impact on the perception and future adoption of inoculant technology. Trialability, is the extent that the innovation can be tested and experimented before its inclusion. Inoculant technologies have not enjoyed extensive diffusion, though, inoculant has immersed benefits, and it has not been widely adopted.

The complexity (its ease of use) of inoculant technologies will also impact on adoption. If the use of inoculant technologies requires considerable practices it is less likely that farmers will persevere with inoculant used. In addition the perceived complexity of the technology can lead to increased uncertainty and perceived risk, and these in turn could lead to a resistance to adopt (Ebojei, C. O., Ayinde, T. B. and Akogwu, G. O (2012). Observability, is whereby the innovation use and effects must be visible by other.

The introduction of inoculant technologies must be visible and the effects that it has on farming must also be visible for other farmers to notices. Overall for inoculant technologies to be adopted into farming, it needs to show relative advantage, compatibility and lack of complexity. In addition users, especially farmers need to see inoculant technologies in action and be given a chance to try out this technology themselves. According to Rogers (1962), the higher the observability and communicability of results, the higher would be the rate of adoption.

Once the innovation is disseminated to individuals in a society, a decision is taken on whether to adopt or reject it. An individual's decision to adopt an innovation is not taken immediately, but the process consists of series of actions and choices by the individual over time (Rogers, 1983). The innovation decision process is the process through which an individual or other decision making unit passes from first knowledge of an innovation to forming an attitude towards the innovation, to a decision to adopt or reject an innovation.

Rogers (2003), explained the innovation decision process consists of five stages: (i) Knowledge stage: This is when the person becomes aware of the existence of an innovation through various communication channels, and gives it some attention. (ii) Persuasion stage: At this stage, a person develops a favourable or unfavourable attitude towards the innovation. Here, the person actively seeks information about the innovation. (iii) Decision stage: This is when a decision is taken whether to adopt or reject the innovation by the person. Adoption means the person has decided to make full use of the innovation while rejection means a decision has been taken not to adopt the innovation. (iv) Implementation stage: Here, the person applies the innovation, leading to behaviourial change. But at this stage, the person still keeps some amount of doubts about the expected consequences of the innovation. (v) Confirmation stage: At this stage, the person will seek to strengthen the decision to adopt or reject the innovation, avoiding all forms of conflict.

B) Communication Channels

A communication channel is the means by which message about an innovation or technology is shared among two or more individuals. According to Rogers, the two important types of communication channels that would help the communicator in diffusion of innovations are and mass media and interpersonal channels. (i) Mass media includes: radio, video and internet (computer) which enable messages to reach a larger, diverse audience simultaneously within a shorter duration. They are used mainly for awareness creation. (ii) Interpersonal channels includes: face-to-face communication between two or more individuals. These channels are the means for persuading individuals to accept a new idea. These channels include neighbors, extension agent and friends.

Rogers' (2003), noted media alone are limited in their effectiveness towards individual or social change. Rather the media's role in spreading new information works perfectly if they complement other means of communication, particularly interpersonal.

Mass media channels are necessary to spread information on awareness of innovation and practices, but, when it is time to decide whether to adopt or not, personal communication is far more effective (Servaes, 2002).

C) Time

Rogers' (2003), noted that, it takes time for an innovation to diffuse throughout the social system. When an agricultural innovation is introduced into a social system, not all farmers within the society adopt it instantly. Some will adopt it immediately, whiles others will adopt it later. Those who adopt the innovation early influence other members of the social system to adopt the innovation, and they in turn influence others and it goes on.

i) Innovators: According to Rogers (2003), innovators are the 'techies', the experimenters who have technology as a central interest in their lives and pursue new technology as soon as it appears, no matter what its function is. Usually, they are the youngest among the population, possessing the highest social class, are fairly well resourced financially, are very social, have close contact to scientific sources and those introducing the innovation.

ii) Early adopters are the 'visionaries' who blend an interest in technology with a concern for significant professional problems and tasks. Among this population, you will find the largest number of opinion leaders compared with the other four categories.

iii) Early majority: They only adopt the innovation after consulting with those who have adopted it earlier. They have above average social status, they are rarely opinion leaders, and tend to spend a lot more time considering when to adopt than innovators and early adopters.

iv) Late majority are the conservatives. They share the attitude of the early majority, though being less comfortable with technology. Those in this category will adopt the innovation, only after average society members have adopted it.

v) Laggards are the final category of people to adopt an innovation. These persons are characteristically always against change in the society, and usually the elderly in society. They are very traditional in their approach to things, most likely of the lowest social status, and are the least worthy persons.

D) Social System

A social system is a set of individuals, informal groups or organizations that are engaged in solving a common problem or in accomplishing a common goal. Diffusion of an innovation happens within a social system. Here, the spread of an innovation would obviously be affected by the social system. Two key factors affect the diffusion of innovation within a social system, according to Rogers (1995). First is the complexity of the technology, and secondly the nature of the social system. Diffusion of agricultural innovations at the village level depends upon the structural characteristics of the village or social system, which may be homogenous or heterogeneous. The homogenous village may have population similar in social characteristics like social grouping, religion and culture, whereas a heterogeneous village may have population varied in the characteristics.

2.2.0 Theory of Planned Behavior (TPB)

Despite the predictability of the TRA is strong across studies, it becomes problematic if the behavior under study is not under full volitional control. Sheppard, B. Hartwick, J. and Warshaw, P.R. (1988) noted two problems of the theory. First, one must differentiate the difference between behaviors from intention. This could be problematic because a variety of factors in addition to one's intentions determine how the behavior is performed. Second, there is no provision in the model for considering whether the possibility of failing to perform is due to one's behavior or due to one's intentions. To deal with these problems, Ajzen (1985), extended the Theory of Reasoned Action by including another construct called perceived behavioral control, which predicts behavioral intentions and behavior. The extended model is called the Theory of Planned Behavior (TPB).

Considering, TRA and TPB have many similarities. In both theories, Behavioral Intention is a main factor in the prediction of actual behavior. Both theories assume that human beings are basically rational and make systematic use of information available to them when making decisions.

By considering control-related factors, TRA assumes that the behavior being studied is under total volitional control of the performer (Madden, T.J. Ellen, P.S., and Ajzen, I. 1992). But, TPB expands the boundary conditions of TRA to more goal-directed actions. Attitude toward Behaviour is defined as "a person's general feeling of favorableness or unfavorableness for that behavior" (Ajzen and Fishbein, 1980).

Subjective Norm is defined as an individual's perception that most people who are important to a person think the individual should or should not perform the behavior in question, (Ajzen and Fishbein, 1980). Attitude toward behavior is a function of the product of one's salient beliefs that performing the behavior will lead to certain outcomes, and an evaluation of the outcomes, that is, ranking of the desirability of the outcome.

The main difference between these two theories is that the TPB has added Perceived Behavioral Control as the determinant of Behavioral Intention, as well as control beliefs that affect the perceived behavioral control. Though it may be difficult to assess actual control before behavior, TPB asserts that it is possible to measure Perceived Behavioral Control "people's perception of the ease or difficulty in performing the behavior of interest" (Ajzen, 1991). Perceived Behavioral Control is a function of control beliefs and perceived facilitation. Control belief is the perception of the presence or absence of necessary resources and opportunities desired to carry out the behavior. Perceived facilitation is one's assessment of the importance of the resources required to an achieved the outcomes (Ajzen and Madden, 1986). Perceived Behavioral Control is included as an external variable that has both a direct effect on actual behavior and an indirect effect on actual behavior through intentions. The indirect effect is based on the assumption that Perceived Behavioral Control has motivational implications for behavioral intentions.

When people believe that they have little control over performing the behavior because of a lack of required resources and opportunities, then their intentions to perform the behavior may be low even if they have favorable attitudes or the subjective norms concerning performance of the behaviour. Bandura (1977), has provided empirical evidence that people's behavior is strongly influenced by the confidence they have in their ability to perform the behavior.

The structural link from Perceived Behavioral Control to Behaviour Intention reflects the motivational influence of control on actual behavior through intentions. The direct path from Perceived Behavioral Control to actual behavior is assumed to reflect the actual control an individual has over performing the behavior. Ajzen (1985), offers the following rationale for this direct path. First, if intention is held constant, the effort needed to perform the behavior is likely to increase with Perceived Behavioral Control.

For example, if two people have equally strong intentions to learn how to apply rhizobium inoculant, and if both try to do so, the person who is confident that he or she can master this activity is more likely to apply than a person who doubts his or her ability. Second, Perceived Behavioral Control often serves as a substitute for actual control, and insofar as perceived control is a realistic estimate of actual control, Perceived Behavioral Control should help to predict actual behavior.

As with TRA, the relative importance of behavioral intention predictors varies with the behavioral domain. In some applications, it may be found that only Attitude toward performing the behavior has a significant impact on behavioral intention; in others, attitude toward performing the Behavior and Perceived Behavioral Control will be significant; in still others, Attitude toward performing the Behavior, Subjective Norm, and Perceived Behavioral Control will contribute to the prediction of behavioral Intention (Ajzen, 1985).

Equally, the ability of Perceived Behavioral Control and behavioral intention to predict actual behavior also will vary across behaviors and situations. Both behavioral intention and Perceived Behavioral Control can make significant contributions to the prediction of goal-directed actions. In any given application, however, one predictor may be more important than the other, and only one of the two may be important.

2.3.0 Background of Inoculant

According to Bashan (1998), the history of inoculation with beneficial bacteria can be traced back for centuries. By the end of the 19th century, the practice of mixing "naturally inoculated" soil with seeds became a recommended method of legume inoculation in the USA (Smith, 1992). For almost 100 years, *Rhizobium* inoculants have been produced around the world (Bashan, 1998). Some legumes, such as soybean *(Glycine max)* in Brazil, are not fertilized with nitrogen, but are only inoculated. Soybean inoculation has made a major agricultural impact in the USA, Brazil, and Argentina (Bashan, 1998). In countries such as Australia, North America, Eastern Europe, Egypt, Israel, South Africa, New Zealand, and, to a lesser extent, Southeast Asia have used inoculation on other legumes. However, the large majority of less developed countries in Asia, Africa, and Central and South America, inoculant technology has had little impact on crop productivity (Bala et al. 2011).

Fertilizers, especially nitrogen and phosphates, are one of the most important inputs used in the global agricultural industry. The FAOSTAT (2003), reported that between 1960 and 2000, the annual world use of nitrogen fertilizer increased from 13 to 89 million tons N, a seven-fold increase in 40 years. Even though the inoculant sector represents a relatively small industry, it is an important part of the increasingly competitive global agricultural production demands.

Inoculants used as either substitute or complement to the use of commercial or noncommercial fertilizers have the potential to increase productivity and profitability of legume crops, enhance food production, support social progress in many under-developed countries, and moderate environmental effects of use of commercial inorganic fertilizers in agriculture.

For almost 100 years, *Rhizobium* inoculants have been produced around the world, primarily by small companies. Some legumes, like the soybean *(Glycine max* (Merr.)L.) in Brazil, are not fertilized with nitrogen, but are only inoculated (Döbereiner, lecture in: VI *Azospirillum* conference, Sárvár. Two major breakthroughs in plant inoculation technology occurred in the late 1970s: (i) *Azospirillum* was found to enhance nonlegume plant growth (Döbereiner and Day, 1976), by directly affecting plant metabolism (Bashan & Holguin, 1997), and (ii) biocontrol agents, mainly of the *Pseudomonas fluorescens* and *P. putida* groups, began to be intensively investigated (Kloepper and Schroth, 1981; Glick and Bashan, 1997). For some time now, various other bacterial genera, such as *Bacillus, Flavobacterium, Acetobacter,* and several *Azospirillum*-related microorganisms have also been evaluated (Kloepper, 1994; Tang and Yang, 1997). A major role of inoculant formulation is to provide a more suitable microenvironment to prevent the rapid decline of introduced bacteria in the soil.

Inoculants have to be designed to provide a dependable source of beneficial bacteria that survive in the soil and become available to the plant. Developing countries practice mainly low-input agriculture in which fertilizers, pesticides, and agro-technical machinery are scarce. The financial resources of the individual farmer in a family' farm system are small and the availability of bank loans is extremely limited. Naturally, this type of farming does not have the resources to invest in improved agricultural techniques.

Artificial inoculation, in particular, requires an infrastructure to store and transport biological products in large quantities into rural areas, and this infrastructure is not available in most developing countries. In developing countries, even the wealthier growers lack sufficient knowledge of modern agricultural techniques. Governmental extension services (there are almost no private consultancies) and the growers' formal agricultural education are poor.

Most growers tend to practice traditional methods or copy methods from more developed countries without being aware of the deficiencies of such practices in their own particular region or without knowing the "cost" to the environment. In most cases, fertilizers are too expensive or the crop's value does not justify the expense In places where fertilizers are available, over fertilization is common (Bashan et al. 1992), and this practice may contaminate deep water reservoirs, produce significant health hazards to the nearby population, and disrupt the local environment (Turrent-Fernández, 1994).

2.3.1 Optimal Characteristic of a Carrier for Inoculants

The carrier is the delivery vehicle of live microorganisms from the factory to the field; however, no universal carrier or formulation is presently available for the release of microorganisms into soil (Trevors, J.T. Van Elsas, J.D. Lee, H. and Van Overbeek, L.S. 1992). The carrier is the major portion (by volume or weight) of the inoculant. The materials of which the carrier is composed and the type of formulation vary. The carrier can be slurry or a powder. A good carrier should have one essential characteristic: the capacity to deliver the right number of *viable* cells in good physiological condition at the right time (Bashan, 1986, 1991; Fages, 1990, 1992; Smith, 1992; Trevors et al. 1992). Additional desirable characteristics for a good inoculant should be as follows:

(i) Chemical and physical characteristics. The inoculants should be nearly sterile or easily sterilized, and as chemically and physically uniform as possible. They should also be of consistent quality, high water-holding capacity (for wet carriers) and suitable for as many bacterial species and strains as possible.

(ii) Manufacturing qualities. The inoculant should be easily manufactured and mixed by existing industry, it should allow for the addition of nutrients, have an easily adjustable pH, and be made of a reasonably priced raw material in adequate supply

(iii) Farm handling qualities. A good inoculant allows for ease of handling (a major concern for the farmer), provides rapid and controlled release of bacteria into the soil, and can be applied with standard agro technical machinery.

(iv) Environmental characteristics. The inoculant should be nontoxic, biodegradable and nonpolluting, and should minimize environmental risks such as the dispersal of cells to the atmosphere or to the ground water.

(v) Storage qualities. The inoculant should have sufficient shelf life (one or two years at room temperature is often necessary for successful integration into the agricultural distribution system in some countries).

Naturally, no single carrier can have all these qualities, but a good one should have as many as possible. A "super-inoculant" such as the one described above is theoretically possible.

2.3.2 Inoculants come in four basic dispersal forms:

(i) Powders. This form is used as a seed coating before planting. The smaller the particle size, the better the inoculant will adhere to the seeds. Standard sizes vary from 0.075 to 0.25 mm, and the amount of inoculant used is around 200 to 300 g/ha. These inoculants are the most common in developed (Smith, 1997) and developing countries (Tang and Yang, 1997).

(ii) Slurries. This inoculant is based on powder-type inoculants suspended in liquid (usually water). The suspension is directly applied to the furrow or alternatively, the seeds are dipped just prior to sowing.

(iii) Granulars. These inoculants are applied directly to the furrow together with the seeds. Size ranges are from 0.35 to 1.18 mm. Rhizobium inoculant is used at a rate of 5 to 30 Kg/ha. These inoculants are popular and have been successfully commercialized since 1975 (Tang, 1994; Tang and Yang, 1997). Bead-like forms are synthetic variations of granular forms. These can be in macro sizes (1 to 3 mm in diameter) used as granules form, or in micro size (100 to 200 ìm) used as a powder for seed coating. These inoculants are a new, as yet unproven, possibility in inoculation technology, and their features will be described later in detail.

(iv) Liquids. These inoculants use broth cultures or liquid formulations, mainly in water, but also in mineral or organic oils. The seeds are either dipped into the inoculant before sowing, or an applicator evenly sprays the liquid inoculant on the seeds. After drying, the seeds are sown. This method ensures even coverage of the seeds without interference with the seed monitoring system of the planters or inoculum loss when dried (Smith, 1995). These inoculants are currently popular in the USA, Canada, Argentina, and Brazil, mainly for soybeans, but also for lentils, peas, and peanuts (Smith, 1995,).

For bio control agents of leaf diseases, the inoculant can be diluted in water and sprayed for better coverage of the leaves (Daayf, F. Schmitt, A. and Bélanger, R. 1995). Alternatively, the suspension can be sprayed directly into the furrow or on the seeds before sowing. The in-furrow inoculant provides a larger amount of bacteria to the plant than seed inoculation. In rhizobium, this improves plant nodulation (Smith, 1995).

For bacteria with poor survival in the soil, like *Azospirillum* sp. (Bashan et al. 1995), these formulations are largely useless since they do not provide a protective environment for the bacteria. Furthermore, in some plant species, these formulations should be applied several days after sowing at seedling germination, causing extra work and cost for the farmer. The microbial inoculant is not merely a suitable carrier containing the bacteria. Other materials might be involved in the final formulation.

For example: an *Azospirillum lipoferum* inoculant for corn, developed in France, was based on 1% alginate containing the bacterial cells and 99% inert calcium carbonate "diluent", which allowed for the right bacterial concentration, because the alginate contained too many cells of *Azospirillum* for optimal inoculation (Anonymous, 1995).

Apparently this alginate formulation was never commercialized, perhaps due to its high cost, and *A. lipoferum* was commercialized in a sterile peat inoculant instead (Anonymous, 1996). The use of each type of inoculant depends upon market availability, cost, and the needs of a particular crop under specific environmental conditions. For example, the granular form is better than powder inoculants for rhizobium, under stressful planting conditions, but since more is required, it is costlier (Smith, 1992)

2.3.3 Types of Inoculation

According to Hegde (1992), there are two methods of inoculation; seed inoculation and soil inoculation. The latter is done by delivering the inoculant directly into the sowing furrow with the seeds (Gault, 1982). Seed inoculation is the most popular method worldwide, as long as the farmer is willing to take the extra step of mixing the inoculant with the seeds immediately before sowing.

The less common method, soil inoculation, is now being used successfully for rhizobium inoculation, but has several disadvantages which limit its future for the application of *Azospirillum*, which survives poorly in many soils (Bashan et al. 1995). For inoculation of soybeans, the major inoculated crop, changing management practices (conservation tillage and narrow rows) also limit the use of the granular form (Smith, 1995).

Microbial inoculants can be applied during three possible phases: (i) at the seed processing plant as a seed coating, months before the actual sowing, (ii) "on site", as a seed application just before sowing, or by inoculant delivery directly onto the seeds in the furrow, and (iii) after seedlings emerge (Bashan, 1986). The most popular method to date with peat based inoculants is the "on site" method, primarily because of lower costs.

However, Fages (1992), revealed, some main drawbacks for "on-site" seed inoculation: (i) additional work is required during sowing, which is time restricted, (ii) the seed germination rate may decrease if some seeds are damaged during the mixing step with the inoculant, (iii) since the bacteria in the inoculant are alive, they may be subjected to UV irradiation which can reduce their population during the field mixing operation, and (iv) the bacterial population may be reduced when the wet inoculant is attached to the chemically coated seeds. Soil inoculation is an alternative to seed inoculation.

It is more convenient for the farmer than seed inoculation, but is sometimes not as effective. It is also more expensive because more inoculant is required. Soil inoculation can be done either with peat-based granules or with micro-granulated forms of inert materials; sand, calcium carbonate or marble powder. These materials are mixed with the inoculum in the factory or can be mixed with the seeds by the farmer prior to sowing. The technique uses a specific granular applicator which makes use of insecticide applicators farmers already know.

2.4.0 Farmers Socio-Economic Characteristics

The factors related to the socio-economic characteristics of farmers includes: education level, experience in the activity, age, gender, level of wealth, farm size, labor availability, risk aversion (Feder, Just and Zilberman, 1985). Ebojoi et al. (2012) conclude that, five socio-economic variables of farmers are as follows; age, income, educational status, labour and extension visits influenced farmer's participation in hybrid maize in the study area. Ebojoi et al. (2012) suggested that, it is important to investigate the personal and social characteristics of farmers in order to understand their relative influence in the farmers' information use behaviours. According to Lavison (2013), farm size can affect and in turn be affected by the other factors influencing adoption.

Several authors, (Kasenge, 1998; Ahmed, 2004; Mignouna, Manyong, Rusike, Mutabazi and Senkondo. 2011), revealed positive relation between farm size and adoption of agricultural technology. Farmers with large farm size are likely to adopt a new technology as they can afford to apply part of their land to try new technology unlike those with less farm size (Uaiene, R. Arndt, C. Masters, W. 2009).

Farmers with small land may adopt land-saving technologies such as greenhouse technology, zero grazing among others as an alternative to increased agricultural production (Yaron et al. 1992).

Though, other authors Bonabana- Wabbi (2002) and Kariyasa and Dewi (2011), reveal insignificant or neutral relationship with adoption, with regards to farm size. Human capital of the farmer is assumed to have a significant influence on farmers' decision to adopt new technologies. Though, most adoption studies have attempted to measure human capital through the farmer's Education, age, Gender, and household size (Fernandez-Cornejo and Daberkow, 1994; Fernandez-Cornejo et al. 2007; Mignouna et al. 2011; Keelan, Thorne, Flanagan and Newman, 2014).

Education of the farmer has been noted to have a positive influence on farmers' decision to adopt new technology. Education level of a farmer increases his/her ability to obtain; process and use information relevant to adoption of a new technology (Mignouna et al. 2011 and Lavison 2013). Though, some authors have reported a negative effect of education on the rate of technology adoption, (Uematsu and Mishra, 2010) revealed a negative influence of formal education towards adopting genetically modified crops.

Age is seen as a determinant of adoption of innovation. Older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers (Mignouna et al. 2011; Kariyasa and Dewi 2011). Age is also observed to have a negative influence on adoption (Mauceri, Alwang, Norton and Barrera, 2005). Younger farmers are usually less risk-averse and are more willing to try an innovation. Bonabana and Wabbi (2002), observed gender as another determinant agricultural technology adoption. In examining the impact of gender on technology adoption, Morris and Doss (1999), had found no significant association between gender and probability to adopt improved maize in Ghana.

Sex affects technology adoption since the head of the household is the primary decision maker and men have more access to and control over important production resources than women because of socio-cultural values and norms (Omonona, Oni and Uwagboe, 2006; Mignouna et al. 2011). Obisesan (2014), revealed a positive influence on adoption with gender. For instance, Lavison (2013), indicated that male farmers were more likely to adopt organic fertilizer unlike their female counterparts. Also, unavailability of innovation and late delivery of the innovation serves as constraints to adoption (Makokha et al. 2001), as well as cost involved, unavailability (Wekesa et al. 2003). Off farm income has been shown to have a positive impact on technology adoption, (Yanggen, Kelly, Reardon and Naseem, 2007).

2.5.0 Communication Methods Used For Information Dissemination

In 2004, Kajogbola noted that, in most small scale farm environments, the most commonly used communication methods are television, radio and mobile phones which attests to significant improvement in information dissemination. A study by Ndaghu, Yohanna, and Simon, (2013) that sought to assess the utilisation of mass communication tools in disseminating agricultural information among farmers in the Adamawa State in Nigeria. He identified radio, a mass communication tool as the most popular source of information among 82 respondents surveyed. Majority of the farmers indicated that their information needs were satisfied through the radio channels. This was attributed to various factors including the high level of literacy among the farmers, availability and accessibility of the radio channels and easy language comprehension. The study showed the use of radio in spreading agricultural information among farmers is increasing at a faster rate than personal contacts by extension workers. An analysis of the Malawian government's agricultural policy launched in year 2000 revealed the policy made vast use of mass media particularly radio in communicating to farmers (Farm Radio International, 2010).

Radio was one of the key components under the policy to provide relevant and appropriate information to farmers in Malawi through a number of channels. The study by Farm Radio International revealed new techniques such as phone-in programmes, live community forums, and radio diaries are making radio a more interactive medium which is providing farmers with a real voice and information. Farmers' reliance on interpersonal media for agricultural information instead of mass media was evident in another study by Oto and Dauda (2011), in the Benue State in Nigeria which assessed farmers' use and preference of agricultural extension communication channels.

Majority (66.77%) of the respondents indicated use of radio in obtaining agricultural information but only 10.44% of them indicated they regularly apply what they hear in their work, while 56.33% indicated that they used it only some times. The study found that interpersonal communication channels of disseminating agricultural information were generally more available and accessible for use by farmers than the mass media. Specifically, the study found that relatives, friends and neighbours of farmers, as well as extension agents were the main sources of farmers' information, although a government run programme had been ongoing in the community to encourage the use of radio to educate farmers.

These findings corroborated those of Tologbonse, Mesini and Tsado (2006), that television and extension publications like bulletins, newsletters, posters and hand bills were not considered as important sources of agricultural information among the farmers in Nigeria mainly because of the low level of literacy there. In a study by Obidike (2011), observed a number of other factors that hindered the effectiveness of mass media in communicating agricultural extension information.

These challenges include poor radio and television signals, none availability of electricity supply in most villages, vast poverty which made it impossible for farmers to purchase newsletters and leaflets containing agricultural information. Additionally, the study indicated illiteracy and inability of radio and television stations in Enugu State to broadcast agricultural information programmes in the native Nsukka dialect hindered the use of mass media as a communication tool in reaching farmers. This study will find out if these factors equally inhibit the dissemination of rhizobium inoculant information among farmers in the Northern Region.

A study by Tadesse (2008), examined the participation of farmers themselves in the spread and utilisation of agricultural information in Ethiopia. The respondents were asked to explain their involvement in the dissemination of the agricultural information they had obtained to other farmers and neighbours. The result showed that, 87.5% of respondents participated in local information exchange during community meetings, social gathering time, religious sessions and when they met in places like markets. These results confirm that local information exchange network plays important role in the dissemination of simple and easily understandable agricultural information like the need to use government approved chemicals on one's farm. The results of a study by Ndilowe (2013), which investigated how ideas of new agricultural practices are communicated to farmers under the Malawian Agriculture Development Program Support Project showed both personal and non-personal means of communication, are necessary to properly impact farmers with agricultural information.

The research established that farmers receive messages through a variety of interpersonal communication means. These include communication through extension workers, using the lead farmer concept, communication through village meetings and communication through field days.

Farmers also receive messages through electronic media (radio), although it has not been so much utilized under the project. Print communication through the use of leaflets is also common under the project. The study thus recommended that agricultural communication methods including print, electronic and interpersonal need to be taken into great consideration if interventions for developing agriculture are to be successful. It recommended that the Ministry of Agriculture streamlines the management of all stakeholders involved in the communication process on the project so as to achieve harmony and consistency in message development and dissemination.

The review of the above literatures informed the researcher about the several available channels of communicating agricultural information both interpersonal and mass means. It also showed regular channels of agricultural information for farmers are usually influenced by a number of factors including literacy, availability of technological tool and among others. This informed the researcher about what to look out for in this study in relation to how information on rhizobium inoculant. This study will find out if in the Northern Region, rhizobium inoculant information dissemination is mainly through mass media platforms or interpersonal means of communication, what account for the usage of a particular media and it influence on their awareness creation and knowledge enhancement on rhizobium inoculant technology.

2.6.0 Communication Methods Used in Promoting the Use of Rhizobium Inoculant

Several communication methods have been adopted by research institutions in promoting and creating awareness of this innovation. In the contexts of rhizobium inoculant adoption, multi-media approach and farmer field school approach have been the communication approach in dissemination of agricultural information.

2.6.1 Use of Multi-Method Communication Method

The use of multi-method channels which include a combination of mass, group and interpersonal communication, if appropriately selected and utilized, is usually more effective in dissemination of agricultural information. An important aspect in employing a multi-method approach is the proper selection of available channels in order to avoid redundant or superfluous method usage and to optimize the level of multi-method support required. Thus, a multi-method approach does not mean that all available communication channels should be utilized.

The rationale behind the use of a multi-method approach is that a coherent, coordinated, and reinforcing system of communication should be able to address specific but varied information problems and needs of farmers. Another reason for employing a multimedia approach is the need to make the extension system more efficient given the various information, educational and communication objectives of a campaign. For example, presentation of radio programs is more effective in creation of awareness and increases the knowledge level of farmers on rhizobium inoculant, (FAO, 1994). Media interactions are initiated by promoting institutions for farmers on adoption of agricultural technologies.

For example, in Ghana local radio broadcasts are made resulting from collaboration between promoting institutions and Radio stations. Regular transmission of radio programs related to agriculture gives valuable information about new farming methods. Radio transmission is quick and reaches to a wider population. As the farmers receive useful information from the radio, gradually they bring change in farming method applying new techniques (Sharma, 2008), radio is the powerful and effective medium to project the information and knowledge related to agriculture. (Nakabugu, 2001).

2.6.2 Use of Radio Programmes

Radio has been used extensively as an educational medium in developing countries. Educational radio has been utilised in, India, for rural development (Long, 1984) Nigeria, for management courses for the agriculture sector (Shears, 1984). Radio has been employed within a wide variety of instructional design contexts. In some cases it is supported by the use of printed materials, by local discussion groups, and by regional study canters. It is sometimes designed to permit and encourage listener reaction and comment.

Indeed, in some cases, there is provision for the audience to raise questions and to receive feedback. One of the most dominant and widespread examples of the use of educational radio is known as "Farm Radio Forum." The use of forums, multi-media, printed materials, two-way communication and various production techniques (drama, interview, panel discussion) are method used in radio programme. The radio programs for rural forums have been concerned with the problems of agriculture, rural development, innovations, self-government, and literacy, (Nyirenda, 1981). A study conducted by Neurath (1959), on the effects of a Farm Radio Forum project at Poona, India. He compared 145 forum villages with non-forum villages.

The forum lasted for ten weeks with a total of twenty programs. Each forum had twenty members who came together twice a week to listen to a thirty-minute programme on subjects such as agriculture, health, and literacy. Forum members were interviewed before and after the project as were samples of twenty adults from each of the control villages. Each forum was visited and observed four times during the project. It was found that forum members learned much more about the topics under discussion than did adults in villages without forums. Radio farm forum as an agent for transmission of knowledge has proved to be a success beyond expectation.

Increase in knowledge in the forum villages between pre- and post-broadcasts was spectacular, whereas in the non-forum villages it was negligible. According to Abell (1968), group of farmers listening to rural radio forums in Ghana is more effective in acquiring agricultural knowledge. Abell selected the "Eastern Region of Ghana" for the study. Sixty experimental forums were organized in forty villages, while forty more villages were designated as controls.

Twenty programs were broadcast once a week from December, 1964 to April, 1965. Five programs dealt directly with agricultural problems while the rest took up the problems of family living, national policy, and relationships with government. Each forum met on the day of the broadcast and exchanged ideas on the topic, then listened to the broadcast and discussed it. After the last session, forum members as well as the control group (non-forum members) were interviewed on what they had learned from the broadcasts. The results revealed that forum members learned more than the non-forum members, (Abell, 1968). Also, Jain (1969), conducted a study on the effect of rural radio program. He selected a number of villages in one area of India and formed in each one a volunteer group of adult farmers.

All the groups listened to a twenty-five minute recorded broadcast on a topic of current rural interest; some followed it up with group discussion or decision making or both. Others were only expected to listen and take no further action. Tests were conducted after the broadcasts. The results showed that group listening followed by group discussion was more influential in changing beliefs and attitudes towards innovation than was group listening without discussion.

Group decision making was found to be an important factor as well. It enabled farmers to approach their problems in a more informed fashion and to work together towards the solutions. The potential of radio to motivate listeners to take action, modify behaviour, and undertake activities.

Radio has also been used to promote community development, innovation, and other programs in which self-help and community participation are essential (Cassirer, 1977). However, there is some evidence to suggest that radio alone can bring about results (Ray, 1978; Cooke and Romweber, 1977).

Other studies have examined the results of radio when used in combination with some form of interpersonal support such as group discussion, printed materials, or contact with extension workers (Bordenave, 1977) and found them to be very efficient and effective. While most communication and education experts agree that radio can play an important role in inducing change, the ability to bring about such change using radio alone remains controversial. Mohammad, Salleh and Hasbullah, (2010) are of the view that, radio can be useful medium to educate farmers on modern agricultural technologies. However, the literacy of farmers is important to understand such programs and apply them appropriately. Furthermore, as rural farmers themselves participate in the radio programs, they become more interesting and effective because of the feeling of the ownership, Nakabugu (2001).

Information on better farming methods, improved seeds, timely planting, agro-forestry, better harvesting methods, soil conservation, marketing, post-harvest handling and fertilizer application are easily transmitted through local radio programme. Nakabugu (2001), further stated that rural radio gives farmers an opportunity to interact with each other and other relevant authorities e.g. extension workers, crop and animal experts through format like live talk shows, phone in programmes and on location broadcasts. Another studies by Sharma (2001), suggested that agricultural programmes transmitted by Radio Nepal have been very much useful in the context of Nepal. Such programs have left positive impacts in both small and large scale farmers on adoption of agricultural innovation.

A study was conducted in Bhawalpur, district of Punjab Pakistan; it revealed that radio was the most effective source of information dissemination among famers about agroforestry. Furthermore, the study also noted that most of the farmers were interested in agro-business news and farmers were obtaining the information various aspects of agriculture and improving their skill and knowledge. Radio is multidimensional source of transferring the information in the rural areas of developing countries and the impact of radio was showed a positive among different communities of people such as farmers. In this context, there is no doubt that modern information about agriculture can be diffuse by using the radio. The findings of the study showed that radio was the best source of information about dissemination information about wheat, seed and soil (Fossard. 2005; Saadi et al. 2008).

Communication media are main element which disseminates effective technologies to growth agricultural production. By use of these technologies access to farmers and learn how to effectively utilize these technologies in farming systems and practices. The use of Radio among farmers in remote areas still popular most of farmers depend on traditional media such as radio and newspaper these media channels could transfer information among farmers in remote areas and can enhance the knowledge and skills for the development of agriculture (Ani and Baba, 2009).

So far radio has been one of the best medium of communication which has played a very vital role in socio, economic cultural and agricultural information. Radio is powerful communication tool in rural areas which provides agricultural and marketing information. The achievement of agricultural development programs in developing countries basically depends on the nature and level of use of mass media channels in mobilization of people for development in general.

Radio is one of the best sources of diffusing agricultural, technical and scientific information to the farmers (Murty and Albino, 2012). The use of radio has brought changes in different sectors of society such as radio broadcast agriculture programmes and latest information for farmers. Radio has provided new approaches and knowledge to millions of people in remote areas. Radio is an important tool of communication especially for illiterate farmers to gather information of various kinds on agriculture and other features to keep up to dates their knowledge and services. Radio technology has played an important role the information about agriculture, weather and use of pesticides among farmers (Weiss et al. 2000). The development about agriculture in developing countries mostly depends on the use of communication method which can connect the different communities of people. The radio and television have played a very important role in enhancing the capacity of farmers by broadcasting different agricultural related programs.

2.6.3 Use of Video Shows in Technology Communication

Video is a tool that enhances participation in communication as well creating a final product that can be watched by other people who understand the language of the video, Toyoma, (2011). The advantages of using participatory video have been felt for decades. The late Martha Stuart was one of the pioneer researchers in the areas of participatory video, with a special focus on how participatory video can be used as an instrument for social change and, in several other respects.

She recognized the development potential of small video formats because of its flexibility and portability compared to other traditional media (Singhal et al. 2008). With latest revolutions witnessed in video and computer technologies, different video formats have been developed that caters for the different technology platforms and output mediums being used. The recorded participatory videos can then be transported to other communities for watching.

Use of participatory video has been found to be relatively cheaper and effective in dissemination and communication of agricultural technologies compared to other conventional extension methods. The proponents of participatory video say that its overall costs is cheaper because; first, the costs of video cameras, computers and Television sets have significantly reduced, making it affordable and accessible to many people including farmers. In addition, video being portable makes it easily transferable from one location to another thus enhancing wide dissemination of the agricultural technologies (Toyoma, 2011). This method favors majority of the rural farmers who are either semiliterate or completely illiterate. When farmers express themselves through the media, in the case of participatory video, it makes the participants more critical and they realize that they have a place in the society, that they are citizens, and that they can be heard.

Participatory video has been used in different parts of the world for such varied purposes as community development, training and education, therapy, community organization and mobilisation, political and social activism, advocacy, cultural preservation, mediation and conflicts resolution, lending voice to the voiceless empowering women behind cameras and for use among illiterate communities, (White, 2003). In 1970s, Food and Agriculture Organization (FAO) begun using video to recover, preserve and produce farmers' knowledge in Peru and Mexico.

However, the organisation was criticized for using a sophisticated technology in a rural setting (Ramírez 1998). Nevertheless, Harding 1997 through his studies found out that video tool could be used as a cost-effective tool to enhance group development and therefore, participatory video has now been used for engaging stakeholders, facilitating development and sharing knowledge. Compared to other media, videos became very affordable and they have a comparative advantage because pictures stick better in the mind and they are available for a wide range of people (Omotayo, 2005).

Participatory video uses both visual and verbal communication methods thus appears to be an appropriate extension tool for less developed countries as this medium is suited for the transmission of skills, information and knowledge (Vidya and Chinnaiyan, 2010). Video has been used as tool to produce information with farmers and disseminate that knowledge to similar people. Knowledge and access to information are essential for people to respond successfully to the opportunities and challenges of social, economic and technological changes, including those that help to improve agricultural productivity, food security and rural livelihoods.

WARDA developed an approach called zooming-in zooming-out (ZIZO) which shows organizations how to produce low cost, high quality videos that are locally appropriate and regionally relevant (Van-Mele, 2006). In Ghana, participatory video was used as a medium to empower innovative farmers to share their innovations to others. From this study, an important characteristic of participatory video identified as a form of farmer to farmer diffusion is the presentation of technical messages from a another farmer encouraging innovation and trust, (Zossou et al. 2009) leading to increasing chances of uptake technology.

2.6.4 Use of Community Video Show

The role of community video show in agricultural research has been to educate farmers and helping to spread messages on agricultural innovation. Video show disseminates scientific and agricultural knowledge among farmers and provides latest information with the discussion of agriculture experts. In the context of India and Ethiopia video show has played a most vital role as a medium of diffusion information about agriculture. It indicated that farmers can get easily information by watching the agriculture related programs on video programme (Murty and Abhinov, 2012). Video show has provided a lot of information to all stakeholder of the society.

Video show creates awareness and knowledge among farmers about use of technologies in farming video show produce such kind of programmes which create interest among masses and mostly the masses depend on media for getting the information regarding education, health and agriculture (Age, 2012). The success of agriculture development depends on the use access and the mobilization of the community ability to use video programmes.

The experts of agriculture extension believe that mass media can bring the positive changes and growth of agriculture in developing countries by using the communication media in their countries (Salleh, 2010). Video show is one of the effective medium of communication for dissemination agriculture information among farmers quickly. In different countries such as India, Pakistan, Bangladesh and Srilanka the farmers' education is low therefore video show is one of the best method of communication where farmers are able watch and get the information about use of different techniques and pesticides in short time (Nazari and Hasbullah, 2008). A similar study conducted in Iran shows that 68% of the respondents believe that video programme which provided good benefit to farmers. Furthermore, it indicated that the programs should produce in their regional languages which can provide good benefit to farmers.

However, 87% of the respondents said that 6 to 8 pm is more suitable time for broadcasting the agriculture programs in this time most farmers were free to watch program easily and around 20 minutes duration is enough for agriculture program on video show. It was indicated that in various related issues of agriculture such as in bad weather situation video show is one of the most important source of disseminating agricultural related information among farmers (Nazaril and Hassan, 2011). Different communities use the information and communication media in different ways such as farmers prefer to watch the video pragrammes and get the information about weather and markets regularly.

However, farmers also use the other communication tools for information. It also showed that many developing countries have established different centers of communication media for providing the information about agriculture to farmers. Video show has given new choice the farmers for watching the different agriculture programmes on different channels. Farmers choose the best way for keeping up to date each other about different information of agriculture. It was also showed that video show is not only the sufficient source of agriculture information but there is need to provide other technologies for latest information to farmers. Video show is playing an important role in sharing attitude, creating interests and presenting factual information (Buren, 2000).Video show helps the different stakeholders for provide information about different issues while the farmers are also getting good benefit from this technology and obtaining the information about agriculture.

2.6.5 Use of Farmer Field School Approach

Farmer Field Schools (FFS) were developed in Asia to promote Integrated Pest Management (IPM), under situations of excessive and damaging pesticide use in wetland rice (Kenmore, 1996). Farmer field school is a participatory method of learning, technology development, and dissemination based on adult-learning principles such as experiential learning. Farmers meet regularly for the duration of an entire cropping season.

They learn by observing what is happening on the field, by discussing in groups what they have observed, and by hands on management of the field from pre-planting to harvest. Through group interactions, attendees sharpen their decision-making abilities and are empowered by learning leadership, communication and management skills.

The farmer field school addresses the problem of accountability in two ways: (i) The trainers who conduct the field school are bound by a strict timetable of sessions within a pre-specified curriculum, which can be easily verified by supervisors; and (ii) Continuous interaction with a cohesive group of trainees creates accountability to the group, which is enhanced by the participatory nature of the training methods.

Accountability is presumed to be even greater when farmer-trainers who are members of the same community administer the training. These features are thus expected to ensure the quality and relevance of the service (knowledge) provided to the farmers. FFS have also shown major potential as a starting point for building the capacity of rural people to address their farming challenges. This is a result of the empowering experience of solidarity, self-organisation and networking encouraged in the FFS process (Pontius, Dilts, and Bartlett, 2001; Chhay, 2002).

In Africa there has been much interest in transferring and adapting FFS approach (Simpson and Owens, 2002). Some adopters have sought more efficient ways to disseminate technologies developed at research stations. Some scholars emphasizing the empowerment and organisational elements of FFS, have been interested in FFS as a methodology for building an effective platform for the interaction of actors in a creative innovation process.

FFS training is lengthy, however, requiring a high level of facilitation and client focus by the implementing organisations. Such knowledge-intensive training and the usage of this is considered costly (Quizon, Feder and Murgai, 2000). Another, strategy adopted in the dissemination of rhizobium inoculant technology is demonstration method. This method is one of the most important group techniques used for extension purposes. The purpose of using demonstration method is to prove that new practice is superior to the one being used currently.

Demonstration, due to its practical nature, is a useful method to introduce a new technology and practice for a large group of interested people. According to Khan, Pervaiz, Maula, Ahmad and Shaheen, (2009) effects of demonstration, bring positive, indicate prospect of increased income and better livelihood for most farmers. The dissemination of inoculant technologies through demonstrations plots on farmer's fields and the provision of technology packages to farmers to test on their own fields.

For the demonstrations the best-improved varieties with high BNF potential, identified in agronomic trials and suitable for the prevailing agro-ecological conditions, are used. Demonstrations often consist of a control, a P-fertilizer application, and use of inoculants and combination of inoculants and P-fertilizer. Sometimes treatments include local versus improved varieties or the use of other types of inputs. Each demonstration uses best agronomic practice in terms of plant density and planting in line, and is supported by training in the use of inoculants and fertilizer. In the demonstration plots the farmer can observe the response to the use of the various inputs and decide which technology is best suited for him or her to use in their own fields, the farmers then decide whether to adopt or reject the technology, (N2Africa, 2013). Effective communicative takes place when farmers exchange views and share insights during group sessions such as field days or demonstration field and exchange visits, etc. (Hagmann et al. 1998).

A study by Khan et al. (2009), stated that demonstration plots and field days are some of the major weapons for introducing new innovations in agricultural practices to increase agricultural production among the rural masses. These methods are effective means of communication to transmit knowledge and skills, and the interested may easily see, hear, and learn the things conveyed by extension worker. Moreover, demonstration methods stimulate adult youth, both male and female, for action.

Demonstration is one of the best methods to improve yield and stimulates adoption. These methods are used as tools by the extension worker to effect desirable changes in the behavior of rural masses, arrange the best learning situations, and provide opportunities in which useful communication and interaction take place between extension workers and farmers. This studies is agreement with Mashavave, Gwandu, Nezomba, Chikowo, Siziba, Mtambanengwe and Mapfumo, (2011), that revealed about 72% of farmers participating in integrated soil fertility management (ISFM) field-based learning alliances established by Soil Fertility Consortium for Southern Africa (SOFECSA) in eastern Zimbabwe had adopted components or modified components of the ISFM packages through attendance of field day school, a demonstration plot established by Soil Fertility Consortium for Southern Africa (SOFECSA).

2.7.0 Determinants of Farmers' Intention to Use Agricultural Technologies

Studies on farmers' intention to use agricultural technology in developing countries focus on two factors: (i) the availability and affordability of technologies; and (ii) farmer expectations that adoption will remain profitable both which determine the extent to which farmers are risk averse (Carletto, Kirk and Winters. 2007: Foster and Rosenzweig, 2010).

A number of factors drive the above expectations, ranging from availability and size of land, family labour, prices and profitability of agricultural enterprises, and peer effects. Ownership of large tracts of land can facilitate experimentation with new agricultural technologies, and also determine the pace of intention as large land owners are more likely to be the early adopters (de Janvry et al. 2011). Moreover, the limited availability of land may shoot the use of organic fertilizers in a poor resource setting (Reardon, Stamoulis and Pingali, 1987).

Furthermore, the quality of land may be a major factor in deciding the use of key inputs such as chemical fertilizers, or using improved crop varieties due to expected higher returns (Carletto et al. 2007). In countries, with entrenched overlapping and relatively unsecure property land rights (Deininger and Ayalew Ali, 2008), availability of land alone may not spur agricultural technology adoption. A main determinant of continuous intention to adopt is the profitability of agricultural enterprises.

The changing prices for agricultural products are shown to be a key factor in agricultural technology adoption (Kijima, Otsuka and Sserunkuuma, 2011). Primarily attracted by higher product prices, farmers can abandon the technologies if the expected benefits from adoption are lower than the prevailing costs. The changing profitability of agricultural enterprises also introduces the time dimension as a driver of adoption households may adopt technologies for some but not all periods. Another reason, which drives agricultural technology adoption, is peer effects or learning from other farmers. According to Oster and Thorton (2009), in any technology adoption process, peer effects work in three major ways: (1) individuals profit from acting like friends/neighbours; (2) individuals gain knowledge of the benefits of the technology from their friends; and (3) individuals learn about how to use a new approach from peers.

With regard to agricultural technology adoption, peer effects can lead to economies of scale by lowering transportation costs but can also lead to increased competition and land prices, which can spur dis-adoption (Carletto et al. 2007). A study conducted by Muzari, Gatsi and Muvhunzi, (2012) in Sub-Saharan Africa on the impacts of technology adoption by smallholder farmers, found out that the factors affecting technology adoption were assets, income, institutions, vulnerability, awareness, labour, and innovativeness by smallholder farmers.

They also established that technologies that require few assets, have a lower risk premium, and are less expensive have a higher chance of being adopted by smallholder farmers. The socioeconomic characteristics are age, education level, marital status, farm size, farm income and off-farm income. Previous studies have shown that young farmers (Rogers, 2003; Akinola and Owombo, 2012) and married heads of households (Nkamleu and Coulibaly, 2000) are more likely to adopt agricultural innovations.

Similarly, household size, being an active laborer, education, access to agricultural services and agricultural and farm income favor the adoption of new agricultural techniques by farmers (Neupane, Sharma and Thapa, 2002; Asrat, Belay and Hamito, 2004; Muzari et al. 2012). According to Nkamleu and Coulibaly (2000), off-farm income did not. Farmers who receive high off-farm income compared to their income from agricultural activities invest less in agriculture, particularly in agricultural innovations. The cost of technology is a major constraint to technology adoption, the removal of subsidies on prices of seed and fertilizers since the 1990s due to the World Bank-sponsored structural adjustment programs in sub-Saharan Africa has worsened this constraint (Nkonya, Schroeder, and Norman, 1996). However, the relevance of input subsidies was seen by African leaders at the 2006 'Abuja Declaration on Fertilizer for the African green Revolution'.

In this African Ministers of Agriculture committed to substantially raise the very low rates of fertilizer use across the continent with measures to reduce costs of fertilizer acquisition and supply, improve smallholder access by scaling up private sector and other supply networks, provide targeted fertilizer subsidies and invest in infrastructure, supplier finance and complementary seed and soil services, and improve trade flows (Africa Fertilizer Summit, 2006).

Agricultural input subsidies are useful instrument for promoting greater equality by targeting subsidies specifically at the poorest smallholders. Conventional arguments for subsidies in agricultural development have focused on the promotion of increased agricultural productivity through the adoption of new technologies (Ellis, 1992). Morris, Kelly, Kopicki and Byerlee, (2007) describe ten features of smart subsidies: 'promoting fertilizer as part of a wider strategy', 'favoring market based solutions' in input supply, 'promoting competition' in input supply, 'paying attention to demand', 'insisting on economic efficiency', 'empowering farmers', 'involving an exit strategy', 'pursuing regional integration', 'ensuring sustainability', and 'promoting pro-poor economic growth'

Several studies have emphases on the importance of agricultural subsidies. Dorward et al. (2004) in a studies on green revolution experience in Asia argue that sustained input subsidies were a major part of successful Green Revolution packages, making a critical contribution to thickening and thus 'kick starting markets' first within staple food supply chains and then in the wider rural economy. Additionally, Djurfeldt et al. (2005) also argue that input subsidies were a critical element within green revolution policies, drawing on detailed policies studies across a range of Asian countries. Fan, Gulati and Thorat, (2007) further provided empirical evidence on the contribution of input subsidies to growth and poverty reduction in India in the early stages of the green revolution but not later.

A study by Kohli and Singh (1997), on analysis of the adoption of high yielding varieties (HYV) in India, revealed that inputs played a major role in the rapid adoption of HYVs in the Punjab. They claimed that the effort made by the Punjab government to make the technological innovations and their complementary inputs more easily and cheaply available through subsidies allowed the technology to diffuse faster than in the rest of India.

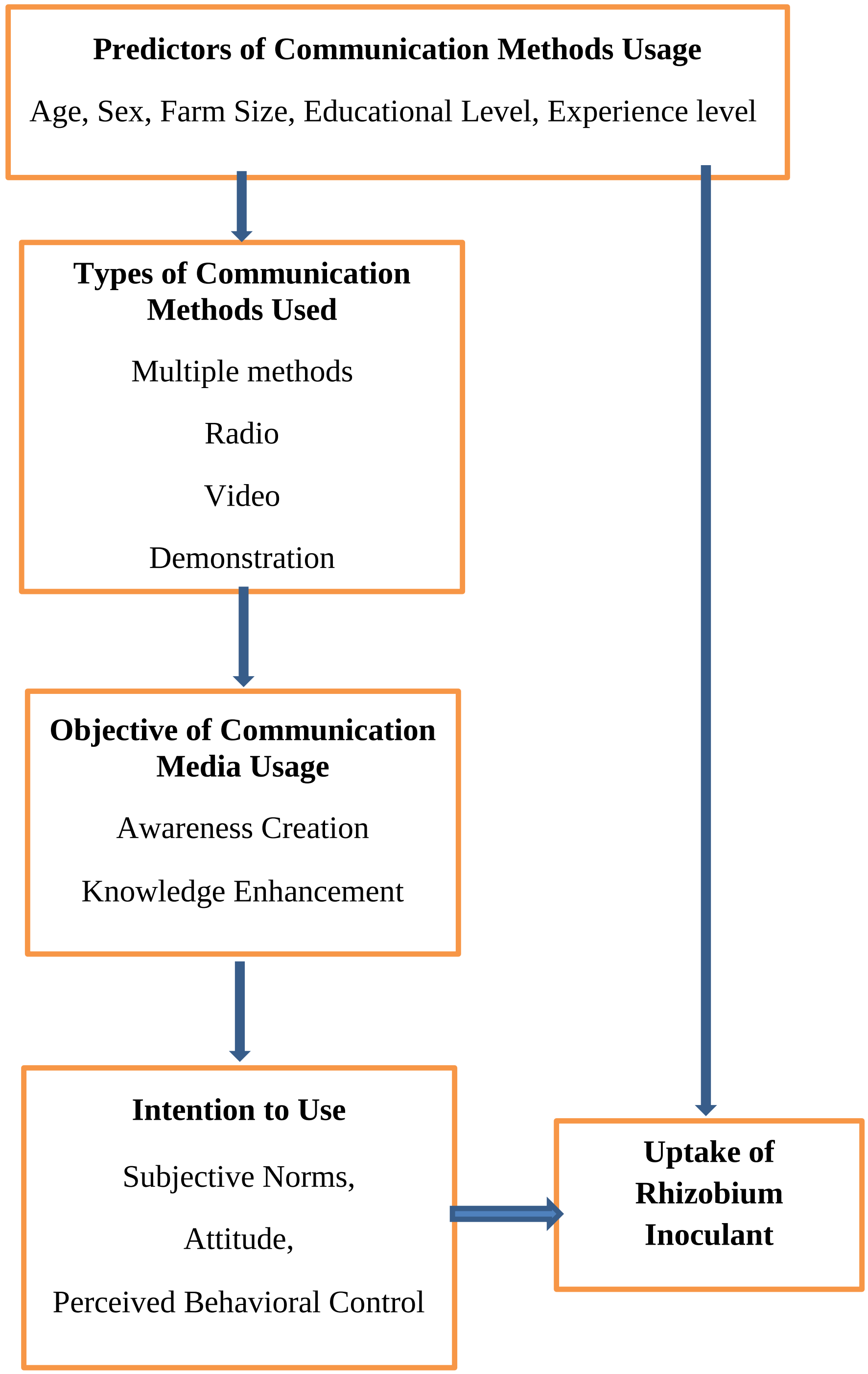
They establish that, since HYVs require higher levels of fertilizer and irrigation to realize their yield potential, their introduction corresponded with a large jump in the demand for fertilizer and irrigated land. Another study by McGuirk and Mundlak (1991) on the transformation of Punjab agriculture during the Green Revolution and find that the short period of transition from the use of traditional varieties to the adoption of HYVs was largely determined by the availability of irrigation facilities and fertilizer. This result partially stems from the fact that, as mentioned before, to fully utilize the yield potential of HYVs, it is necessary to apply considerably larger doses of fertilizer and water per unit of land.

2.8.0 Conceptual Framework

Conceptual framework abstracting the researcher view of linkages of concepts and variables explored in this study is illustrated in figure 2.0 below. The communication methods used by promoters are radio program, video show and demonstration as well as combination of all these methods. However, the use of these communication methods are influenced by certain predictors such as age, gender, farm size, educational level, availability of communication media. These communication methods are expected to perform two main functions, thus, increase farmers' awareness as well as enhance their knowledge on rhizobium inoculant, which ultimately leads to farmers' decision to adopt or reject the technology.

Farmers' awareness and knowledge of the technology informs their decision to use rhizobium inoculant. However, for a farmers to make a decision as to whether to use or not, he/she is influence by the attributes of the technology. Thus, Expected benefits, Easy to use, Affordability and Availability of rhizobium inoculant as depicted by Subjective Norms, Attitude and Perceived Behavioural Control. These factors finally lead to uptake of rhizobium inoculant among farmers.

Figure 2.0: Conceptual Framework for the Study



Source: Adapted from Theory of Planned Behaviour, (Ajzen, 1991).

CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

This chapter focuses on brief description of the study area, instrument used to collect needed information for this study, it also presents research design, sampling procedure, data collection, pre- testing of research instrument, reliability analysis and data analysis.

3.1 The Study Area

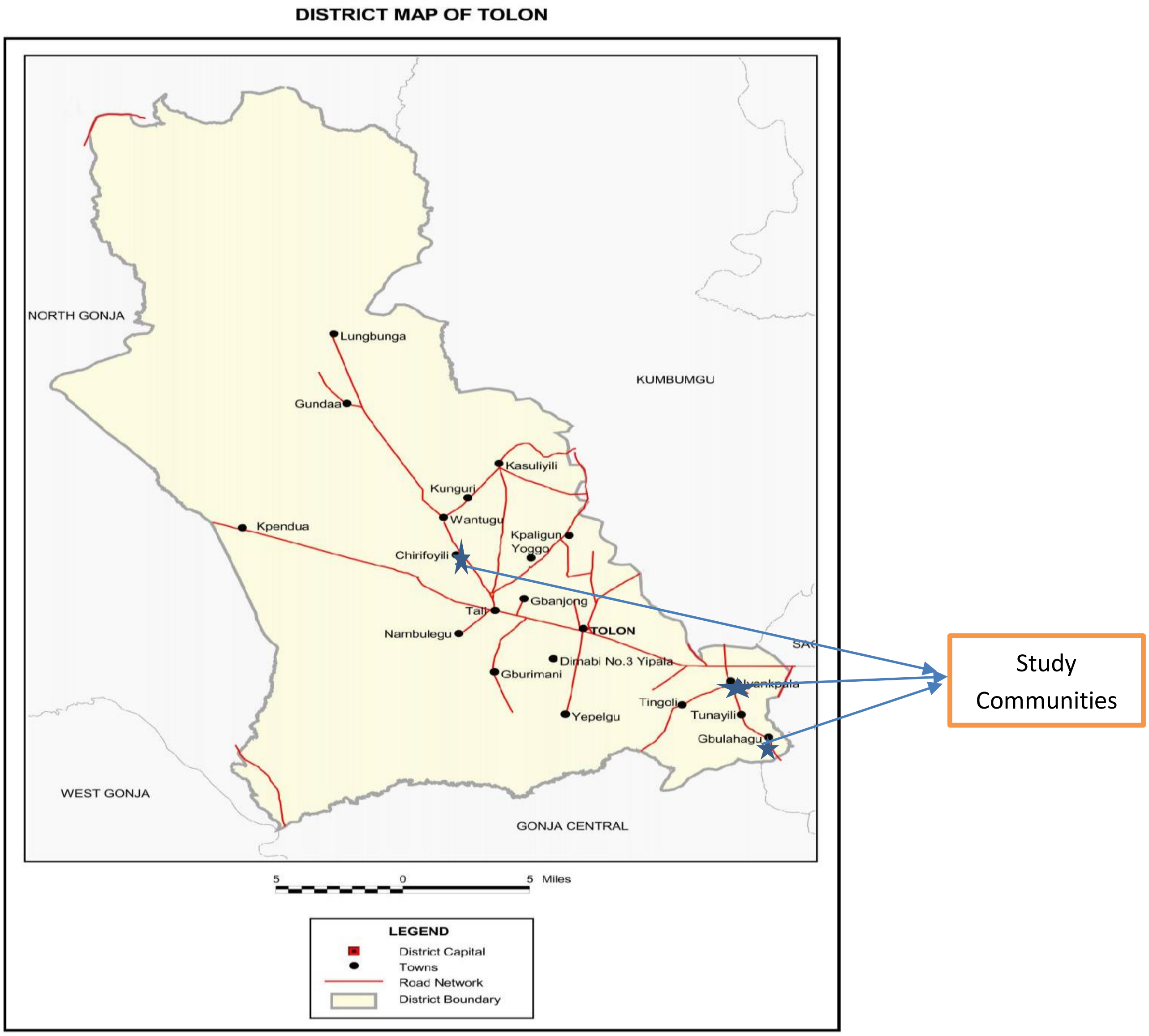
The research aimed at obtaining an understanding of communication media usage on uptake patterns and farmers intention to use rhizobium inoculant technology in Savelegu Municipal and Tolon District. In order to achieve this, Savelegu Municipal and Tolon District of the Northern Region were selected to due to the operation of Savannah Agricultural Research Institute (SARI) and International Institute of Tropical Agriculture (IITA) in these areas in promoting the use of rhizobium inoculant to farmers.

3.1.1 Profile of Tolon District

The Tolon District Assembly came into existence in 2011 by LI. 2142 with Tolon as the district capital. Hitherto, the district was part of the Tolon/Kumbungu District; one of the 45 districts created by the then Provisional National Defense Council (PNDC) Law 207 in 1988. In order to enhance participation and development especially at the grass-root, the District was among the 42 inaugurated districts in 2012. The District was carved out from the then Tolon/Kumbungu District. According to the 2010 Population and Housing Census, the district has about 72,990 people.

The District lies between latitudes 9° 15′` and 10°$^0$ 02` North and Longitudes 0° 53′and 1° 25′ West. It shares boundaries to the North with Kumbungu, North Gonja to the West, Central Gonja to the South, and Sagnarigu Districts to the East. The district is characterised by a single rainy season, which starts in late April with little rainfall, rising to its peak in July-August and declining sharply and coming to a complete halt in October-November. The dry season starts from November to March with day temperatures ranging from 33°C to 39°C, while mean night temperature range from 20°C to 26°C. The Mean annual rainfall ranges between 950mm - 1,200m (Ghana Statistical Service, 2010).

Figure 3.1: Map of Tolon District



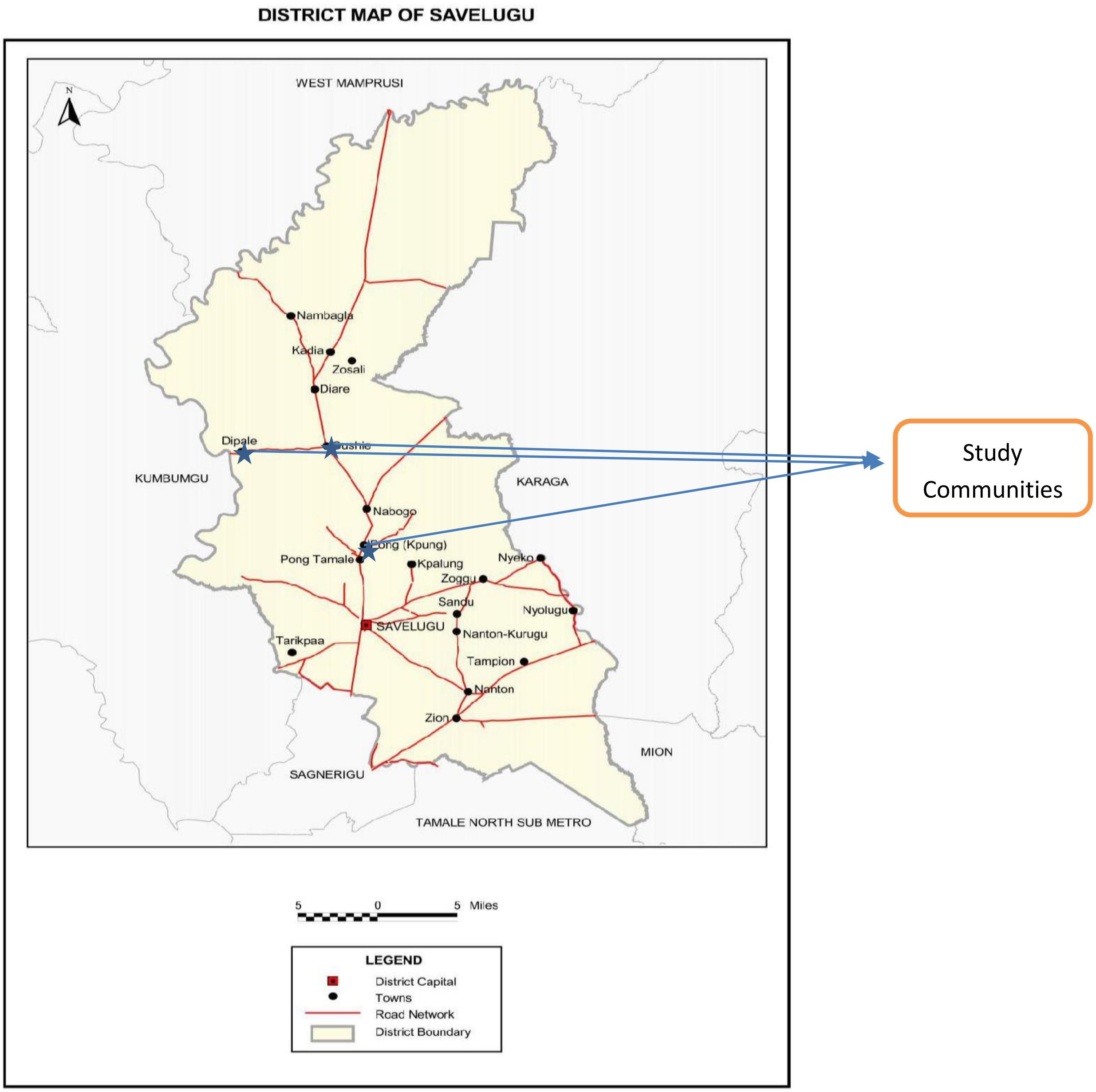
Source: Ghana Statistical Service, (2014)

3.1.2 Profile of Savelegu Municipal

Savelugu/Nanton Municipality is located at the northern part of Tamale, the capital of Tamale Metropolitan Assembly. It shares boundaries with West Mamprusi to the North, Karaga to the East, Kumbungu to the West and Sagnerigu District Assembly to the South. The Municipality has a total land area of 1790.70 sq. km. The population of Savelugu-Nanton District, according to the 2010 Population and Housing Census, is 139,283 representing 5.1 percent of the region's total population. Males constitute 48.5 percent and females represent 51.5 percent. Sixty percent of the population is rural. The district has a sex ratio of 94.1.

About 4 in 10 (43.5%) of the population of the district is youthful (0-14 years) depicting a broad base population pyramid which tapers off with a small number of elderly persons (6.5%). The total age dependency ratio for the District is 95.7, with the age dependency ratio for males (106.1) higher than that of females (87.0). (Savelegu/Naton District assemble annual report, 2014)

Figure 3.2: Map of Savelegu Municipal



Source: Ghana Statistical Service, (2014)

3.2 Research design

Research design serves as a blue print for conducting research work, by considering which questions to answer, which data is relevant, what data to collect and how to analyze the results (Babbie, 2005). The research design shows the procedure for conducting the study, such as when, from whom and under what conditions data were obtained. Its objective is to provide valid and accurate answers as possible to research questions (McMillan and Schumacher, 2006).

According to Patton (1990), surveys are used to derive qualitative estimations reflecting the research under consideration. It also enables the researcher to accept lower levels of precision because of resource limits availability and to make maximum use of prior knowledge with sampling. This design was used to investigate influence of communication media usage on uptake patterns of rhizobium inoculant technology after these projects are over in the Northern Region. Additionally, data collected could be used as a benchmark data to evaluate trends and makes the method repeatable with a high degree of confidence. With regard to qualitative and quantitative data such as descriptions and analysis of situations, people, interactions and observed behaviours, surveys are appropriate to make a decision when researching characteristics, social patterns, motivations and attitudes, (Minichiello et al. 1995)

A survey was used to gather qualitative and quantitative data such as demography characteristics of the legume farmers, communication media usage and factors that influence farmers' intention to use rhizobium inoculant technology in the Northern Region.

3.3 Population

Population is any precisely defined set of people or collection of items which are being studied (Babbie, 2005). In the context of this study, the target population for this study is farmers engaged in legume production in the Savelegu Municipal and Tolon District of the Northern Region. This project currently work with about 7000 farmers in the Savelegu Municipal and Tolon District of the Northern Region, thus, the sample frame was 7000 farmers.

3.4 Sampling Procedure and Sample Size

All legume farmers in these two districts constituted the population of the study. From reconnaissance survey conducted by the researcher prior to data collection, the two institutions, namely; Savannah Agricultural Research Institutes (SARI) in collaboration with International Institute of Tropical Agriculture (IITA) were found to be the dominant institutions promoting rhizobium inoculant usage among farmers in these districts. Accordingly, only beneficiaries from these institutions were sampled for this study because of unavailability of other institutions promoting rhizobium inoculant.

For the purpose of data collection and to ensure representativeness, two districts were targeted for sampling, namely, Savelegu Municipal and Tolon Districts. The selection is because of the operations of Savannah Agricultural Research Institutes (SARI) and International Institute of Tropical Agriculture (IITA) within these districts having major demonstrations fields and community outreach.

Six communities were randomly selected from Savelugu Municipal and Tolon District respectively. The sampled communities from Tolon district were Chirifoyili, Gbulahagu and Nyankpala. Whiles, from Savelugu Municipal were Kpung, Dipale and Gushie.

From the list of legume farmers from each community sampled, the lottery method of random sampling technique were used to sample 35 legume farmers from each of the six communities to form a sample size of 210.

From the sample frame of 7000 farmers benefiting from the promotion of rhizobium inoculant in the Savelegu Municipal and Tolon District of the Northern Region. The Fisher's method (Fisher, Laing and Stoeckel, 1983) of sample size determination and Theory Planed Behaviour were used to determine the sample size. Thus, the sample size formula is given 95% confidence level shown below

$$n = \frac{pqZ^2}{d2}$$

Where;

n = sample size for infinite population

Z = 1.96 (at 95% Confidence level)

p = estimated proportion of soybeans farmers (0.1)

q = 1-p d = precision of the estimate at 5% (0.05)

The sample size will be;

$$n = \frac{(1.96)^2 \quad 0.1 \times 0.9}{(0.05)^2}$$

n =138

The adjusted sample sizes for the finite population of 7000 farmers in the two district are:

$n^1 = 1/(1/n + 1/N)$

Where;

n^1 = adjusted sample size

n = estimated sample size for infinite population

N = Finite population size

$n^1 = 1/(1/138 + 1/7000)$

$n^1 = 135$

However, according to Cohen, (1988), using theory of planed behaviour model, requires sample size of more than 80 to 210 respondents with a response rates above 50 percent are appropriate for conducting social research. With a moderate effect size of around 0.3 is required for a multiple regression. This assumption helps in arriving at an appropriate sampling size of 210 respondents.

3. 5 Data Collection

Both primary and secondary data source were collected for this study. Personal interview with the aid of semi-structured questionnaires was used in collecting primary data.

3.6 Techniques for Collecting Primary Data

The primary data used in this research was collected from a field survey conducted by the researcher in the months of December, 2016 to March, 2017. Close and open-ended Questionnaire was the main method for collecting quantitative and qualitative data. Primary data was collected through observation and interviews by the use of semi-structured questionnaires.

The research questionnaire was titled 'Communication Media Usage and Uptake Patterns of Inoculant Technology' consisting of four parts was used to collect data for the study.

The first part seek to solicit information on personal data of respondents such as age, sex, marital status, educational background, farm size, farming experience and type of legume cultivated. The second part solicits information from respondents on the types of communication methods such as radio, video and demonstration as well combination of these methods.

The third part consists of questions designed to solicit information regarding effectiveness of communication methods on awareness creation and knowledge. Whiles, final part examines farmers' behavior, attitude and intention to use rhizobium inoculant on a 5-point linkert scale.

Secondary data was obtained by surfing the internet for relevant data, from thesis, books, articles, journals, the research organizations, the district assembly in the study area and other relevant publications and records was also accessed for this study

3.7 Secondary Data

Secondary data was also used in addition to the primary data in order to improve the quality of discussions, explanation of the study. The secondary data was collected from both published and unpublished sources including journals, articles, books, official reports and the internet sources. Secondary data from SARI and other relevant publications and records was also used for this study.

3.8 Pretesting of Questionnaires

It is widely assumed that no matter how much developmental and pre-pretesting work is done on a questionnaire, the instrument must still be tested under field conditions (Fowler 1993; Czaja and Blair 1996).

Field testing generally means administering a questionnaire to respondents selected from the target population using the procedures that are planned for the main study. Respondents can be selected by probability or convenience sampling and the number of completed interviews is usually between 20 and 70. For this study, 25 farmers were randomly selected within Tamale South constituency. A field questionnaire was administered to the farmers on communication media usage and uptake patterns of inoculant technology.

3.9 Reliability Analysis

The internal consistency of the research instrument was tested using Cronbach's coefficient as shown in the tabled below. According to Hair et al. (2006), for construct measures to be accepted as reliable, its Cronbach's Alpha must exceed 6. Hence, the research instrument is considered appropriate, since the Cronbach's Alpha exceed 6.

Table 3.1: Reliability Statistics

Cronbach's Alpha	N of Items
.648	145

Source: Field Survey Data, 2017

3.10 Validity of Instruments Used for Data Collection

The questionnaire was carefully design to make each item relate to the objectives and the research questions. Besides, content validity was checked by the research project supervisor and improvement of questions to have the content as in the conceptual framework.

Table: 3.2: Summary of Data Required and Method of Data Collection

Study constructs	Objective	Information required	Source of Information	Method of data collection
Demographic Characteristics	To examine legume farmers in the Northern Region by their socio-demographic characteristics	Sex Age Marital status Farm size Educational level Farming experience	Legume farmers	Personal interviews
Effectiveness of Communication Strategies	To examine the influences of communication media usage on uptake patterns of rhizobium inoculant among farmers	Awareness Creation Farmers knowledge Farm decision to use	Legume farmers	Personal interviews
Farmers' Intention to Use	To examine the factors that affect farmers' intention to use rhizobium inoculant in the Northern Region	Attitude Intention Perceived Behavoiur Constraints Subjective Norms	Legume farmers	Personal interviews

3.11 Data Analysis

Data processing involves the transformation of data into information by collating, sorting, classifying, retrieving, disseminating information manually or through the use of computer software (Bourque, 2006). The goal is to highlight useful information, suggest conclusions and support decision making. After primary data from the field had been checked for completeness and accuracy the responses were coded and entered into the Statistical Package for Social Sciences (SPSS) and analyzed, using the appropriate analytical tool. Descriptive statistics, linear multiple regression, chi-square test, Pearson correlation and pair t-test were used to analysed the data. The results were presented using percentages and frequencies and displayed as tables and charts

3.11.1 Analysis of Farmers intention to Use Rhizobium Inoculant

To confirm the proposition on the farmers' intentions to use rhizobium inoculant can be predicted from attitudes towards using rhizobium inoculant, subjective norms and perception of control on the technology. The most common appropriate approach is multiple regression analysis with a root from theory of planned behaviour, (Fishbein and Ajzen, 1975). To examined the Pearson correlations coefficients between the outcome variable (intention) and the independent variables on one hand, and between the independent variables themselves on the other hand. Multiple linear regression analysis was performed to identify which variables predict farmers' intention use to rhizobium inoculant. Given that a project seek to implement interventions that promote the use of an innovation, it is necessary to identify the beliefs that predict intention use to rhizobium inoculant, (Fishbein and Ajzen, 1975).

Therefore, it is appropriate to perform simple correlation analysis and multiple linear regression analysis to assess the relationship between the beliefs expressed by respondents and their intentions intention to use rhizobium inoculant.

Following the expectancy-value model (Fishbein and Ajzen, 1975) a belief based measure of the attitude (A) is obtained by multiplying belief strengths (bs) and outcome evaluation (oe) and summing the products according to:

$$A \propto \sum bsi \times oei \text{……………………………………………………..1}$$

Belief strength is explained as the subjective probability that a given behaviour will produce a certain outcome (Fishbein and Ajzen, 1975) and the outcome evaluation can be regarded as the utility received of that outcome occurring.

In the same way, measures for the other components are obtained. Subjective norm (SN) results from multiplying strength of normative belief (nb) with motivation to comply (mc) and summing the results following.

$$SN \propto \sum nbi \times mci \text{……………………………………………………..2}$$

Finally, perceived behavioural control (PBC) is obtained by multiplying control belief strength (cb) with power of control (pc) and summing the results by applying.

$$PBC \propto \sum cbi \times pci \text{……………………………………………………..3}$$

Thus, all components that measure behavioural intent consist of direct as well as belief based measures following the expectancy-value model.

To validate the model, the belief based measures should correlate well with the global measure of the specific component (Ajzen, 1991). This reveals salient beliefs, which are then used for further analysis.

Based on the three components of the TPB that are derived following the expectancy-value model, the model to explain the behavioural intention BI becomes:

$$BI = \beta 1A + \beta 2SN + \beta 3PBC + \epsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where β are empirically determined weights to estimate the importance of each component and ϵ is an error term.

Depending on the context and the farmers, the influence of attitude toward the behaviour, subjective norm and perceived behavioural control on behavioural intention to use inoculant can vary. In general, the more positive the attitude, subjective norm and perceived behavioural control the more likely the farmer is to use inoculant. However, due to social consequences and not having full control over the implementation, attempting to perform the behaviour may not necessarily lead to actual performance of the behaviour.

The analysis in this study will show how these components influence the intention of farmers to use rhizobium inoculant for their farm operations.

3.11.2 Prediction of Intention to Use Rhizobium Inoculant by the Constructs

Fishbein and Ajzen (1975), proposed a categorisation of correlation coefficients as drivers and barriers, with a correlation coefficient below 0.2 being a barrier, while above 0.2 being a driver for predicting intention to use a particular technology or perform a behaviour. Thus, this concept were used to establish whether individual perception statements influences farmers' intention to use rhizobium inoculant or not.

Table: 3.3: Summary of Method of Analysis

Study constructs	**Objective**	**Variables**	**Statistical Analysis/test**
Demographic Characteristics	To examine legume farmers in the study area by their socio-demographic characteristics	Sex Age Marital status Farm size Educational level Farming experience	Percentages Frequency Means Cross tabulation Chi-square test
Effectiveness of Communication Strategies	To examine the influences of communication media usage on uptake patterns of rhizobium inoculant among farmers	Awareness Creation Farmers knowledge Farmers decision to use	Chi-square test Cross tabulation Pair T-Test
Farmers' intention to Use	To examine the factors that affect farmers' intention to use rhizobium inoculant in the study area	Attitude Intention Perceived Behavoiur Constraints Subjective Norms	Multiple Linear regression analysis, Chi-square test, Mean and Standard deviation Pearson correlation

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 INTRODUCTION

This chapter presents and discusses the results of the study. Section 4.1 explains the breakdown of the various sections in this chapter. 4.2 present the descriptive statistics of socio-demographic characteristics of the respondents. 4.3 present the influences of communication media usage on uptake of rhizobium inoculant among farmers in the study area. Factors that affect farmers' intention to use rhizobium inoculant in the study area are presented in section 4.4.

4.1.0 Demographics Characteristics of Respondents

This section presents findings of selected demographics characteristics of the sampled population. The demographics characteristics selected are those deemed important to the purpose of this study as informed by available literature on the issues explored.

4.1.1 Sex of respondents

The survey results (table 4.1) show that majority of legume farmers (73.3 %) were males, with 26.7 percent of legume farmers being females. Although females form the least group in the survey, they play several roles such as planting, harvesting, shelling of legumes etc. However, much of what the women do on the farm is, mostly considered as family labour and this could accounts for the small number of female farmers (26.7%) in the study area. Also, the type of farming men does is often considered as commercial farming and this could accounts for the greater number of male farmers (73.3%) interviewed in the study area.

MoFA, (2015) reported that, farming in Ghana has always been male dominated since, independent and it is therefore not surprising that this study confirms this trend.

Table 4.1: Frequency distribution of Sex of respondents

Sex of Respondents	Frequency	Percentage (%)
Male	154	73.3
Female	56	26.7
Total	**210**	**100**

Source: Field Survey Data, 2017

4.1.2 Age of Respondents

From the survey, the results revealed that, 23.8 percent of the farmers were below the age 30 and above 60 years were 5.7 percent. However, (37.6%) majority of farmers were between 30 and 45 years, whiles 32.9 percent of the respondents were between the age 46 and 60 (table 4.2 below).

However, according to Johnson and Neumark, (1997) categorization, age were group into the following it as: (1) age less than 30 years, (2) age between 30 to 45 years (3) age between 46 to 60 years and (5) age above 60 years, with the productive age of a person normally ranges between age 15 and 49.

Table 4.2: Frequency distribution of Age of respondents

Age of respondents	Frequency	Percentage (%)
Below 30	50	23.8
30-45	79	37.6
46-60	69	32.9
Above 60	12	5.7
Total	**210**	**100**

Source: Field Survey Data, 2017

4.1.3 Marital Status of Respondents

Marital status of farmers was explored for the purpose of this study as shown in figure 4.1.1 below. The analysis shows that, majority of farmers (78.1%) interviewed are married, while very few (5.2%) are single (never married) and 10% and 6.7% divorcees and windows respectively. However, marriage is considered as one of the most important institution of Ghanaian societies in present time. Someone who is not married at a certain age is almost an abnormal, whiles every woman in African societies wants and hopes to be married, (Gyekye, 1998). In most of Ghanaian society authority is vested with male heads, which has an impact on decision to use or not a technology.

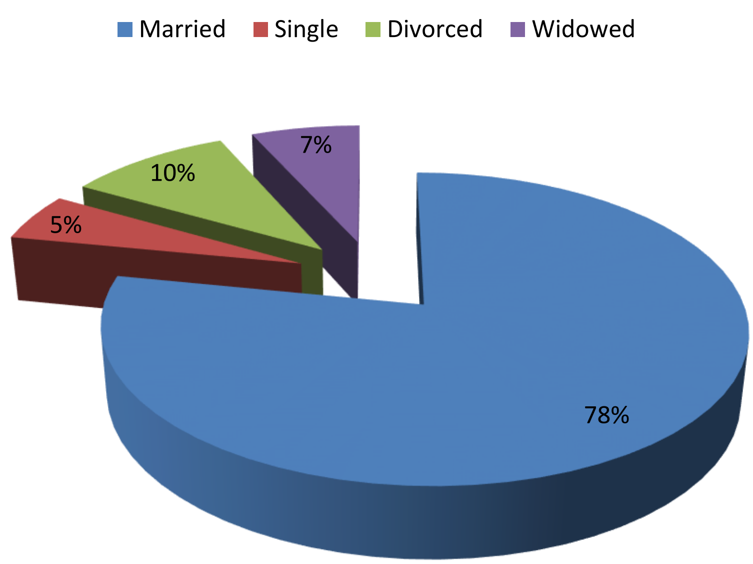


Figure 4.1: Marital Status of Respondents

Source: Field Survey Data, 2017

4.1.4 Educational Level of Respondents

On the educational status of respondents, 112 (53.3%) of farmers had no formal education. Few farmers had Junior High school education 19 (9.0%), Senior High school education 26 (12.4%), whiles the 53(25.2%) remaining had primary education. However, none of the respondents had tertiary education. The results indicate that majority of the farmers had no formal education, as shown in figure 4.2 below

Higher education status of farmers increases their ability to process and use information disseminated to them on agricultural innovation (Lavison 2013; Namara et al. 2013). In line with the findings, it might be difficult for illiterate farmers to properly understand information disseminated to them by promoters of rhizobium inoculant.

However, several studies, Bell (2004); Bonati and Gelb (2005) and Rogers (2003) have revealed that, higher educational levels of farmers place them in a more receptive position in adopting innovations. This also necessitates an effective and efficient way of communicating information on rhizobium inoculant to farmers. Hence, educational levels of farmers can be used as one of the predictors of their attitude towards the use of rhizobium inoculant in their farming activities. This is however, not the case in this study, since majority are illiterates with no formal education.

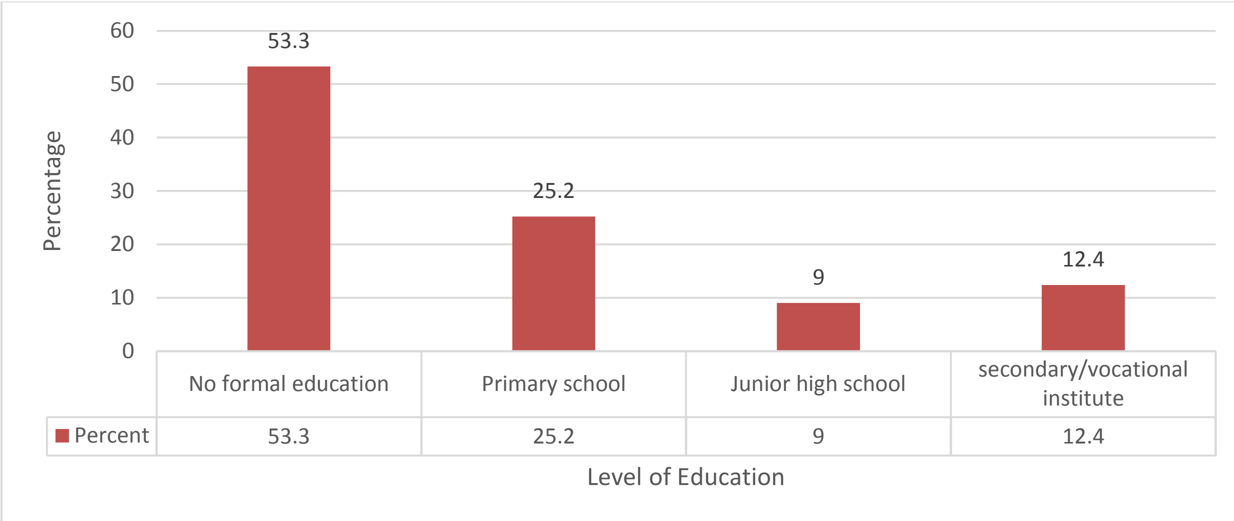


Figure 4.2: Bar Chart illustrating educational level of respondents

Source: Field Survey Data, 2017

4.1.5 Experience of Farmers in Legume Cultivation

Figure 4.3 below presents results of the period with which the respondents practiced legume farming. The results shows that, 19.5% of the respondents started growing legumes less than 5 years ago, 28.1% started between 5-10 years while 52.4% started more than 10 years ago.

Some researchers suggest that experience in a particular activity is relevant in achieving results over time, (Fiedler, 2007; McCall et. al. 2004). Further research supports this assumption that, the number years of work influences a work output, (McDaniel et al. 2007).

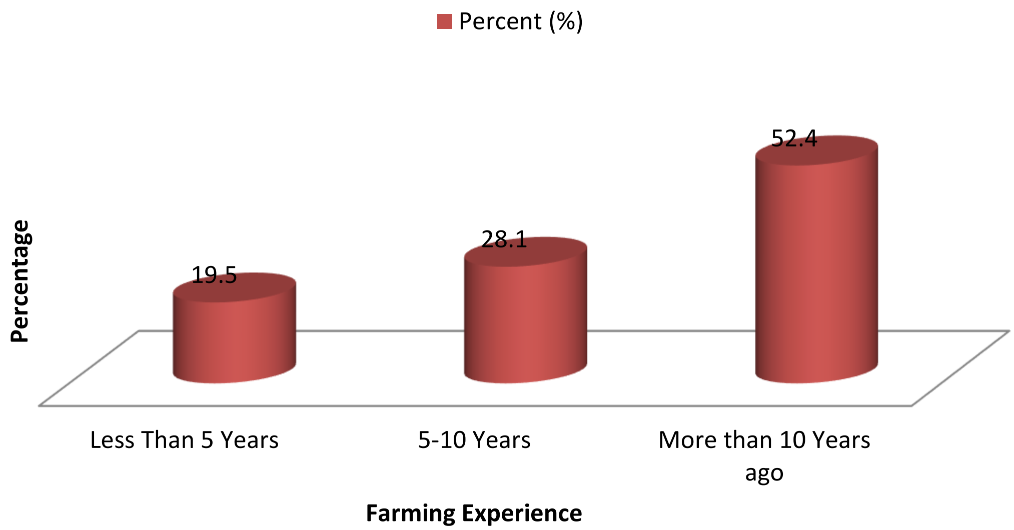


Figure 4.3: Experience of Farmers in Legume Cultivation

Source: Field Survey Data, 2017

4.2.0 Influences of Communication Methods Used on Uptake Patterns of Rhizobium Inoculant

This section of the chapter assesses the influences of communication methods used on uptake patterns of rhizobium inoculant among farmers in the Savelegu Municipal and Tolon District of the Northern Region.

4.2.1 Types of Communication Methods Used by Respondents to Access Information

Table 4.3 shows that majority, (54.8%) of the respondents had used radio as the communication method to access information. Respondents who had used video to access information were 19.5%. Though, field demonstration is noticed to provide practical and hand on knowledge to farmers, only 25.7% of the respondents' used this medium due to the cost involved in setting up demonstration. Thus, from the analysis, it is clear that more respondents use radio as against the rest of the methods in the in the Savelegu Municipal and Tolon District of the Northern Region.

Table 4.3: Types of Communication Methods Used by Respondents to Access Information

Communication Methods	Frequency	Percent (%)
Radio	115	54.8
Video	41	19.5
Demonstration	54	25.7
Total	210	100

Source: Field Survey Data, 2017

4.2.2 Combination of Communication Methods Used by Respondents to Access Information

The results of the survey in table 4.4 below show that majority 132 (62.9%) of the respondents had used a combination of all the three communication methods to access information on rhizobium inoculant. However, respondents who used only one method were 45 respondents. The rest 33 (15.7%) of respondents had used combination of two methods to access information on rhizobium inoculant. The above discussion implies that majority of farmers used combination of all the three communication methods to access information on rhizobium inoculant. This finding suggests that promoters of rhizobium inoculant can use combination of all the three methods to easily disseminate information to farmers since, most farmers used combination of all the three methods for accessing information in the in the Savelegu Municipal and Tolon District of the Northern Region.

Table 4.4: Combination of Communication Methods Used by Respondents

Use of Communication	Frequency	Percentage
Only one method	45	21.4
Combination of two method	33	15.7
Combination of three methods	132	62.9
Total	**210**	**100.0**

Source: Field Survey Data, 2017

4.2.4 Type of Message Communicated to Farmers by Promoters of Rhizobium Inoculant

Figure 4.4 shows that most of the respondents 164 (78.2%) received information regarding how to apply inoculant. Moreover, only 2 (1.0%) of the respondents had received information on how to store inoculant. About 21 percent of the respondents had received information on where to access inoculant for their farming operation as shown in the figure 4.4 below. These Findings suggests that promoters of rhizobium inoculant have not dealt well with farmers, since the major concern has to do with handling and storage of rhizobium inoculant. Rather, promoters of rhizobium inoculant have being able to enhance farmers knowledge on application of the technology, with only knowing how to handling and storage of rhizobium inoculant. Mishandling and storage of the technology will result to loss of viability of rhizobium inoculant. Thus, giving farmers a misconception about rhizobium inoculant, ultimately leading low uptake of the technology.

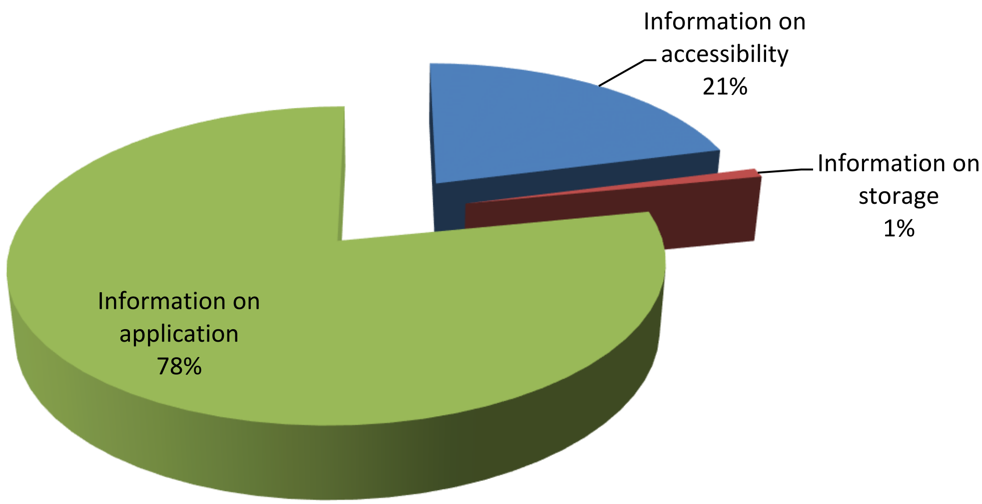


Figure: 4.4: Type of Information Communicated to Farmers by Promoters of Rhizobium Inoculant

Source: Field Survey Data, 2017

4.2.3 Relationship between Communication methods and Level of Effectiveness of Messages Disseminated

Table 4.5 shows the relationship between communication methods used and level of effectiveness of each method. From the results, majority of respondents (62) perceived combination of all the three methods had high effectiveness on their awareness and knowledge on rhizobium inoculant as compare to only (24) respondents who perceived that only method had high effectiveness on their awareness and knowledge on rhizobium inoculant. When subjected to the chi square test, the chi square (X^2 =10.794 p=0. 029) at 5% confidence level shows that the relationship between communication methods used and level of effectiveness is significant. It therefore means that, the level of effectiveness of each method is dependent on the number of methods used.

Table 4.5: Relationship between Communication methods and Level of Effectiveness of Messages Disseminated

Communication Methods Used	Level of Effectiveness			Total
	Moderate effectiveness	High effectiveness	Very high effectiveness	
Only one method Frequency	5	24	16	45
% within Column	9.6%	24.0%	27.6%	21.4%
Combination of two methods Frequency	6	14	13	33
% within Column	11.5%	14.0%	22.4%	15.7%
Combination of three methods Frequency	41	62	29	132
% within Column	78.8%	62.0%	50.0%	62.9%
Total	100%	100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =10.794 p=0. 029) Significant**

4.2.4 Relationship between Communication methods and Level of Knowledge Enhancement

Table 4.6 shows the relationship between communication methods used and level of knowledge enhancement. From the results, majority of respondents (92) perceived radio discussion had higher knowledge enhancement on rhizobium inoculant as compare to only (23) respondents who perceived that radio discussion had lower knowledge enhancement on rhizobium inoculant. Additionally, respondents (48) perceived demonstration had higher knowledge enhancement on rhizobium inoculant as compare to only (6) respondents who perceived that demonstration had lower knowledge enhancement on rhizobium inoculant

When subjected to the chi square test, the chi square (X^2 =2.739 p=0.254) at 5% confidence level shows that the relationship between communication methods used and level of knowledge enhancement is not significant. It therefore means that, respondents' level of knowledge enhancement is not dependent on the type of methods used.

Table 4.6: Relationship between Communication methods and Level of Knowledge Enhancement

Communication Methods Used		Level of Knowledge		Total
		Lower knowledge on rhizobium inoculant	**Higher knowledge on rhizobium inoculant**	
Radio discussion	Frequency	23	92	115
	% within Column	67.6%	27.6%	54.8%
Video show	Frequency	5	36	41
	% within Column	14.7%	20.5%	19.5%
Demonstration	Frequency	6	48	54
	% within Column	17.6%	27.3%	25.7%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =2.739 p=0.254) Not Significant**

4.2.5 Relationship between Communication methods and Level of Awareness Creation

Table 4.7 shows the relationship between communication methods used and level of awareness creation. From the results, majority of respondents (108) perceived radio discussion had higher awareness creation on rhizobium inoculant as compare to only (7) respondents who perceived that radio discussion had lower awareness creation on rhizobium inoculant. Additionally, respondents (48) perceived demonstration had higher awareness creation on rhizobium inoculant as compare to only (6) respondents who perceived that demonstration had lower awareness creation on rhizobium inoculant

When subjected to the chi square test, the chi square (X^2 =13.132 p=0. .001) at 5% confidence level shows that the relationship between communication methods used and level of awareness creation is not significant. It therefore means that, respondents' level of awareness creation is dependent on the type of methods used.

Table 4.7: Relationship between Communication methods and Level of Awareness Creation

Communication Methods Used		Level of Awareness		Total
		Lower awareness on rhizobium inoculant	Higher awareness on rhizobium inoculant	
Radio discussion	Frequency	7	108	115
	% within Column	25.0%	59.3%	54.8%
Video show	Frequency	7	34	41
	% within Column	25.0%	18.7%	19.5%
Demonstration	Frequency	6	48	54
	% within Column	50.0%	22.0%	25.7%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =13.132 p=0. .001) Significant**

4.2.6 Relationship between Intention to Use Rhizobium Inoculant and Farmers Awareness and Knowledge Level

A two-way between-groups analysis of variance was conducted to explore the effect of knowledge enhancement and awareness creation on intention to use rhizobium inoculant. Respondents were divided into two groups according to their knowledge and awareness level (Lower and higher). The interaction effect between knowledge enhancement and awareness creation was not statistically significant, F (1, 206) = 2.672, p = .104.

This corresponds to small effect size of η2 = .013, which means that about 1.3% of the variance in the knowledge enhancement and awareness creation scores was predictable from intention to use rhizobium inoculant when all of the other variables are held constant.

There was no statistically significant main effect for knowledge enhancement, *F* (1, 206) = .886, *p* = .348; however, the effect size was small (partial eta squared = .004). The main effect for awareness creation, *F* (1, 206) = .209, *p* = .648, did not reach statistical significance. As shown in table 4.8 below.

Table 4.8: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11.268	3	3.756	2.699	.047	.038
Intercept	336.344	1	336.344	241.659	.000	.540
Knowledge Enhancement	1.233	1	1.233	.886	.348	.004
Awareness Creation	.291	1	.291	.209	.648	.001
Knowledge * Awareness	3.719	1	3.719	2.672	.104	.013
Error	286.713	206	1.392			
Total	1856.000	210				
Corrected Total	297.981	209				

a. R Squared = .038 (Adjusted R Squared = .024)
b. Dependent Variable: Intention to Use

Source: Field Survey Data, 2017

4.3.0 Relationship between Demographic Factors and Farmers Uptake of Rhizobium Inoculant

This section of the analysis examining the influence of age, sex, educational level, marital status and farming experience on uptake of rhizobium inoculant among farmers in the study area.

4.3.1 Relationship between Age and Farmers Uptake of Rhizobium Inoculant

Table 4.9 shows the relationship between the age of respondents and their using of rhizobium inoculant. Majority of respondents (69) between the ages of 30-45 years are using rhizobium inoculant, 54 respondents between the ages of 46-60 years are using rhizobium inoculant, 45 respondent below 30 years are using rhizobium inoculant as compared to (10) respondent above 60 years are using rhizobium inoculant.

When subjected to the chi square test, the chi square (X^2 =3.746 p=0.290) at 5% confidence level shows that the relationship between age of respondents and using of rhizobium inoculant is not significant. It therefore means that usage of rhizobium inoculant is not dependent on age of respondents

Table 4.9: Relationship between Age and Farmers Uptake of Rhizobium Inoculant

Age of Respondents		**Usage of Inoculant**		**Total**
		Using	**Not Using**	
Below 30	Frequency	45	5	50
	% within Column	25.3%	15.6%	23.8%
30-45	Frequency	69	10	79
	% within Column	38.8%	31.2%	37.9%
46-60	Frequency	54	15	69
	% within Column	30.3%	46.9%	32.9%
Above 60	Frequency	10	2	12
	% within Column	5.6%	6.2%	5.7%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =3.746 p=0.290) Not significant**

4.3.2 Relationship between Sex and Farmers Uptake of Rhizobium Inoculant

From table 4.10, majority of respondents (130) who are males are using rhizobium inoculant as compared to (48) of respondents representing females are using rhizobium inoculant.

When subjected to the chi square test, the chi square (X^2 =.054 p=0.817) at 5% confidence level shows that the relationship between sex of respondents and usage of rhizobium inoculant is not significant. It therefore means that usage of rhizobium inoculant is not dependent on sex of respondents.

Table 4.10: Relationship between Sex and Farmers Uptake of Rhizobium Inoculant

Sex of Respondents		**Usage of Inoculant**		**Total**
		Using	**Not Using**	
Male	Frequency	130	24	154
	% within Column	73.0%	75.0%	73.3%
Female	Frequency	48	8	56
	% within Column	27.0%	25.0%	26.7%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =.054 p=0.817) Not significant**

4.3.3 Relationship between Educational Level and Farmers Uptake of Rhizobium Inoculant

Table 4.11 shows the relationship between the educational level of respondents and their usage of rhizobium inoculant. Majority of respondents (95) who had no formal education are using rhizobium inoculant, 24 respondents with secondary education are using rhizobium inoculant, 43 respondent with primary education are using rhizobium inoculant while 16 respondent with junior high education are using rhizobium inoculant.

When subjected to the chi square test, the chi square (X^2 =1.692 p=0.639) at 5% confidence level shows that the relationship between educational level of respondents and usage of rhizobium inoculant is not significant. It therefore means that usage of rhizobium inoculant is not dependent on educational level of respondents.

Table 4.11: Relationship between Educational Level and Farmers Uptake of Rhizobium Inoculant

Educational Level		Usage of Inoculant		Total
		Using	Not Using	
No formal education	Frequency	95	17	112
	% within Column	53.4%	53.1%	53.3%
Primary school	Frequency	43	10	53
	% within Column	24.2%	31.2%	25.2%
Junior high school	Frequency	16	3	19
	% within Column	9.0%	9.4%	9.0%
Secondary/vocational institute	Frequency	24	2	26
	% within Column	13.5%	6.2%	12.4%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =1.692 p=0.639) Not significant**

4.3.4 Relationship between Marital Status and Farmers Uptake of Rhizobium Inoculant

Table 4.12 shows the relationship between the marital status of respondents and their usage of rhizobium inoculant. Majority of respondents (140) who are married are using rhizobium inoculant, 18 respondents who are divorced are using rhizobium inoculant, 9 respondent who are single are using rhizobium inoculant while 11 respondent who are widowed are using rhizobium inoculant.

When subjected to the chi square test, the chi square (X^2 =.550 p=0.908) at 5% confidence level shows that the relationship between marital status of respondents and usage of rhizobium inoculant is not significant. It therefore means that usage of rhizobium inoculant is not dependent on marital status of respondents.

Table 4.12: Relationship between Marital Status and Farmers Uptake of Rhizobium Inoculant

Marital Status		**Usage of Inoculant**		**Total**
		Using	**Not Using**	
Married	Frequency	140	24	164
	% within Column	78.7%	75.0%	78.1%
Single	Frequency	9	2	11
	% within Column	5.1%	6.2%	5.2%
Divorced	Frequency	18	3	21
	% within Column	10.1%	9.4%	10.0%
Widowed	Frequency	11	3	14
	% within Column	6.2%	9.4%	6.7%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =.550 p=0.908) Not significant**

4.3.5 Relationship between Farming Experience and Farmers Uptake of Rhizobium Inoculant

Table 4.13 shows the relationship between the farming experience of respondents and their using of rhizobium inoculant. Majority of respondents (89) who had more than 10 years of farming experience are using rhizobium inoculant, 52 respondents who had between 5-10 years' of farming experience are using rhizobium inoculant and 37 respondent who had less than 5 years' of farming experience are using rhizobium inoculant.

When subjected to the chi square test, the chi square (X^2 =2.738 p=0.254) at 5% confidence level shows that the relationship between farming experience of respondents and usage of rhizobium inoculant is not significant. It therefore means that usage of rhizobium inoculant is not dependent on farming experience of respondents.

Table 4.13: Relationship between Farming Experience and Farmers Uptake of Rhizobium Inoculant

Farming Experience		**Usage of Inoculant**		**Total**
		Using	**Not Using**	
Less than 5 years ago	Frequency	37	4	41
	% within Column	20.8%	12.5%	19.5%
5-10 years ago	Frequency	52	7	59
	% within Column	29.2%	21.9%	28.1%
More than 10 years ago	Frequency	89	21	110
	% within Column	50.0%	65.6%	52.4%
Total		100%	100%	100%

Source: Field Survey Data, 2017 **(X^2 =2.738 p=0.254) Not significant**

4.4.0 Frequency of Uptake of Rhizobium Inoculant among Farmers

Table 4.14 presents results on uptake of rhizobium inoculant by respondents in the study area. The results revealed that, few farmers 46 (21.9%) out of the total sample size were already aware and using rhizobium inoculant for their farming activities before these institutions started promoting the technology within their communities. However, since these institutions are now promoting the technology, majority 178 (84.8%) of respondents out of the total sample size are currently using rhizobium inoculant.

Furthermore, farmers currently exposed this technology are intends to use rhizobium inoculant in the near future for their farming activities, this was revealed by the great number of respondents 156 intending to use the technology. This finding gives a firm indication that majority of the respondents are now using and hope to continue to using rhizobium inoculant in the future for their farming operation.

Table 4.14: Frequency of Uptake of Rhizobium Inoculant among Farmers

Uptake of Rhizobium Inoculant	Frequency		Percentage	
	Yes	No	Yes	No
Number of farmers using inoculant before	46	164	21.9	78.1
Number of farmers using inoculant now	178	32	84.8	15.2
Number of farmers intending to use inoculant in future	156	54	74.3	25.7

Source: Field Survey Data, 2017

4.4.1 Usage of Rhizobium Inoculant before and Now among Respondents

A paired sample T-test was conducted to examine whether a statistically significant relationship could be established in the mean scores before and current usage of rhizobium inoculant in the study area.

The Paired Sample T-test table is presented below and shows the following:

i. There is a significant difference between the scores before and during the promotion rhizobium inoculant. Thus, this shows an overall significant difference in the number of farmers now using rhizobium inoculant for their farming activities. The probability value in table (4.15b) is .000, which is less than .0005. This value is substantially lower than the specified alpha value of .05 and indicates a significant difference in the number of farmers now using rhizobium inoculant for their farming activities.

ii. The next statistic reveals, in terms of the scores, which score is lower than the other before and during the promotion rhizobium inoculant. The mean scores, before the promotion rhizobium inoculant was 1.78; and that of during the of promotion rhizobium inoculant was 1.15. Therefore I can conclude that there was a significant difference in the number of farmers now using rhizobium inoculant for their farming activities.

iii. The results presented show that the difference obtained in the two sets of scores was unlikely to occur by chance; and does reveal the magnitude of the information dissemination effect. Using the eta squared statistic, an effect size of 0.55 was obtained. Based on the guidelines provided by Cohen (1998), where an effect size of 0.5 and above is interpreted as a large effect; this impact represents a large effect of the information dissemination to farmers on uptake of rhizobium inoculant.

A paired sample T-test was conducted to evaluate the effect of the information dissemination to farmers on uptake of rhizobium inoculant. There was a statistically significant difference in the number of farmers now using rhizobium inoculant for their farming activities (M=1.78, SD=.415) to after [M=1.15, SD=.360, t(210)= 16.084, p<.0000]. The eta squared statistic (0.55) indicated a large effect size.

Table 4.15a: Paired Samples Statistics of the Usage of Rhizobium Inoculant before and Now

Trend of Usage	Mean	Std. Deviation
Farmers using of rhizobium inoculant before	1.78	.415
Farmers currently using of rhizobium inoculant	1.15	.360

Source: Field Survey Data, 2017

Table 4.15b: Test of Usage of Rhizobium Inoculant before and Now

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Farmers using of rhizobium inoculant before*Farmers currently using rhizobium inoculant	.629	.566	.039	.552	.706	16.084	209	.000

Source: Field Survey Data, 2017

4.4.2 Characteristics of Users of Rhizobium Inoculant before the Promotion of the Technology

Table 4.16 below, it shows clearly that most 19 (41.3%) of respondents who were using rhizobium inoculant were between the ages of 30-45 and only one respondent being above 60 year. However, on educational level, majority 31 (67.4%) of respondents who had no formal education were using the technology before the promotion.

Additionally, with regard to farming experience, as much as 27 respondents had more than 10 years of farming experience were using rhizobium inoculant before the promotion. Male farmers dominated the use of rhizobium inoculant before the promotion started with a frequency of 30 respondents.

Table 4.16: Characteristics of Users of Rhizobium Inoculant before the Promotion of the Technology (N=46)

Socio-economics Factors	Frequency	Percentage
Age:		
Below 30	9	19.6
30-45	19	41.3
46-60	17	37.0
Above 60	1	2.2
Educational level:		
No education	31	67.4
Primary school	10	21.7
Junior high school	3	6.5
Secondary/vocational institute	2	4.3
Farming Experience:		
Less than 5 years ago	8	17.4
5-10 years ago	11	23.9
More than 10 years ago	27	58.7
Sex:		
Male	30	65.2
Female	16	34.8

Source: Field Survey Data, 2017

4.4.3 Characteristics of Users of Rhizobium Inoculant during the Promotion of the Technology

Table 4.17 below, it shows clearly that majority 69 (38.8%) of respondents who are currently using rhizobium inoculant were between the ages of 30-45. However, on educational level, majority 95 (53.4%) of respondents who had no formal education are now using the technology. Additionally, with regard to farming experience, as many as 89 respondents had more than 10 years of farming experience are currently using rhizobium inoculant before the promotion. Male farmers dominated the use of rhizobium inoculant during promotion stage, with a frequency of 130 respondents. Finally, on the number of communication methods respondent were exposed to, majority 114 (64.0%) who have access to all the three communication methods.

Table 4.17: Characteristics of Users of Rhizobium Inoculant during the Promotion of the Technology (N=178)

Socio-economics Factors	Frequency	Percentage
Age:		
Below 30	45	25.3
30-45	69	38.8
46-60	54	30.3
Above 60	10	5.6
Sex:		
Male	130	73.0
Female	48	27.0
Educational level:		
No education	95	53.4
Primary school	43	24.2
Junior high school	16	9.0
Secondary/vocational institute	24	13.5
Farming Experience:		
Less than 5 years ago	37	20.8
5-10 years ago	52	29.2
More than 10 years ago	89	50.0
Number of Communication Methods Used:		
Only one method	35	19.7
Combination of two method	29	16.3
Combination of three methods	114	64.0

Source: Field Survey Data, 2017

4.4.4 Characteristics of Respondents Intending to Use Rhizobium Inoculant in Future

Table 4.18 below, it shows that majority 57 (36.5%) of respondents who intend to use rhizobium inoculant in the future are between the ages of 30-45. Furthermore, on educational level, majority 83 (53.3%) of respondents who had no formal education intend to use rhizobium inoculant in the future. Additionally, as many as 82 respondents who had more than 10 years of farming experience intend to use rhizobium inoculant in the future. Male farmers dominated those who intend to use rhizobium inoculant in the future, with a frequency of 115 respondents. Finally, on the number of communication methods respondent were exposed to, majority 93(59.6%) who have access to all the three communication methods intend to use rhizobium inoculant in the future.

Table 4.18: Characteristics of Users of Rhizobium Inoculant during the Promotion of the Technology (N=156)

Socio-economics Factors	Frequency	Percentage
Age:		
Below 30	37	23.7
30-45	57	36.5
46-60	51	32.7
Above 60	11	7.1
Sex:		
Male	115	73.7
Female	41	26.3
Educational level:		
No education	83	53.3
Primary school	39	25.0
Junior high school	14	9.0
Secondary/vocational institute	20	12.8
Farming Experience:		
Less than 5 years ago	32	20.5
5-10 years ago	42	26.9
More than 10 years ago	82	52.6
Number of Communication		
Methods Used:	35	22.4
Only one method	28	17.9
Combination of two method	93	59.6
Combination of three methods		

Source: Field Survey Data, 2017

4.5.0 Factors That Affect Farmers' Intention to Use Rhizobium Inoculant

4.5.1 Farmers' Behavior, attitude and Intention to Use Rhizobium Inoculant

The average values of the Theory of Planed Behaviour components were calculated. Table 4.19 below presents the means, and standard deviations for these variables. As shown in the table 4.19, farmers' attitude towards the use of use rhizobium inoculant was below average of the items. A mean score of 2.20 (Mean = 2.20, Standard Deviation= .704) was reported for this variable.

As indicated by subjective norms, it is clear that farmers perceived a moderate social pressure to use rhizobium inoculant in their farming operation (Mean= 2.42, Standard Deviation = .640). However, results revealed that farmers' perception on power of control beliefs was almost moderate.

In other words, farmers' perception of their control over money and farmland and evaluations of the extent to which these resources constrain their use of rhizobium inoculant, was strong suggesting that farmers perceived use of rhizobium inoculant as being under their control. This perception was supported by a relatively higher mean score for perceived behavioural control (Mean= 3.48, Standard Deviation = .650).

Table 4.19: Descriptive Analysis of the Theoretical Variables of the Model

Variables	Mean	Std. Deviation	N
Intention	3.44	.500	210
Attitudes	2.20	.704	210
Subjective Norms	2.42	.640	210
Perceived Behavioural Control	3.48	.650	210

Source: Field Survey Data, 2017

4.5.2 Attitudes Statements on Rhizobium Inoculant

Table 4.20 below presents the individual attitudes statements used in analysing the regression analysis. From the results, farmers perceived that inoculant easily losses it viability if not use on time score the least mean of 0.25. However, farmers perception on inoculant as is a cheap alternative to the use of inorganic fertilizer score the highest mean of 1.75

Table 4.20 Descriptive Statistics of Attitudes Statements

Attitudes Statements	N	Mean	Std. Deviation
Inoculant is a cheap alternative to the use of inorganic fertilizer	210	1.75	.435
Inoculant is easily available in the open market	210	.58	1.329
It is very easy to apply inoculant on the farm	210	1.50	.556
The use of inoculant on the farm increase crop yield	210	1.21	1.028
Inoculant easily losses it viability if not use on time	210	.25	1.256
It very easy to store inoculant	210	.81	1.324
Use of inoculant require less labour	210	1.30	.885
The use of inoculant on the farm produces high quality crop	210	1.70	.459

Source: Field Survey Data, 2017

4.5.3 Subjective Norms Statements on Rhizobium Inoculant

Table 4.21 below presents the individual subjective norms statements used in running the regression analysis. The least mean score on subjective norms is fellow farmer think that I should use used inoculant on my farm to improve crop yield. However, the highest mean score is promoters of inoculant think that I should use used inoculant on my farm to improve crop yield.

Table 4.21 Descriptive Statistics of Subjective Norms Statements

Subjective Norms Statements	N	Mean	Std. Deviation
Promoters of inoculant think that I should use used inoculant on my farm to improve crop yield	210	1.66	.550
For me to use inoculant on farm, as recommended by promoters is likely or unlikely	210	1.66	.514
Fellow farmer think that I should use used inoculant on my farm to improve crop yield	210	1.56	.578
For me to use inoculant on farm, as recommended by fellow farmer is likely or unlikely	210	1.70	.556
Extension agent thinks that I should use used inoculant on my farm to improve crop yield	210	1.58	.514
For me to use inoculant on farm, as recommended by extension agent is likely or unlikely	210	1.51	.589

4.5.4 Perceived Behavioural Control Statements on Rhizobium Inoculant

Table 4.22 below presents the individual perceived behavioural control statements used in running the regression analysis. From the results, lack of inoculant in the open market is serious constraint to the use of inoculant score the highest mean of 1.60. While, high loss of viability of inoculant is serious constraint to the use of inoculant score the least mean of 1.30.

Table 4.22 Descriptive Statistics of Perceived Behavioural Control Statements

Perceived Behavioural Control Statements	N	Mean	Std. Deviation
Lack of inoculant in the open market is serious constraint to the use of inoculant	210	1.60	.491
Lack of storage material for inoculant by farmers is serious constraint to the use of inoculant	210	1.63	.512
High loss of viability of inoculant is serious constraint to the use of inoculant	210	1.30	.499
Farmers inadequate knowledge on the application of inoculant is serious constraint to the use of inoculant	210	1.45	.875
Delays in the delivery of inoculant by suppliers to farmers are serious constraint to the use of inoculant	210	1.54	.528
High cost of inoculant is serious constraint to the use of inoculant	210	1.47	.784
Difficulties in handling inoculant is serious constraint to the use of inoculant	210	1.56	.535

Source: Field Survey Data, 2017

4.5.5 Behavioural Intention to Use Rhizobium Inoculant and Attitude, Subjective Norm and Perceived Behavioral Control

Table 4.23 present the correlations between the dependent and independent variables, in the multiple regression shows that intention was positive and significantly correlated with Attitudes at 5.0% significant level. This implies that farmers' intention to use rhizobium inoculant is positively affected by their attitude. This finding is in line with Ajzen (2006), Theory of Planed Behaviour, that a positive attitude towards an act will influence ones intention to use rhizobium inoculant.

On the other hand, farmers' attitude was negative and significantly correlated with PBC at 5.0% significant level.

Thus, the attitudes of farmers towards rhizobium inoculant are likely to be affected by the challenges they encounter with rhizobium inoculant used. Moreover, Subjective Norms was positive and significantly correlated with PBC at 5.0% significant level.

Finally, PBC was negative and significantly correlated with attitude and Subjective Norms at 10.0% significant level and 1% significant level respectively. Although some of the independent variables were significantly correlated with each other for instance.

PBC was significantly correlated to both attitude and Subjective Norms, the assumption of multicollinarity was not violated and all independent variables displayed tolerance levels greater than 0.1 and variance inflation factors less than 10 (Tabachnick and Fidell, 2007).

Table 4.23: Correlations between theoretical constructs

Variables	Intention	Attitude	PBC	SN
Intention	1.000	.591	.329	-.089
Attitude	.591	1.000	.038	-.245
PBC	.329	.038	1.000	-.127
SN	-.089	-.245	-.127	1.000
Intention	.	.000	. .000	.099
Attitude	.000	.	.290	.000
PBC	.000	.290	.	.033
SN	.099	.000	.033	.

Source: Field Survey Data, 2017

4.5.6 Relationship between Behavioral Intention to Use Rhizobium Inoculant and Attitude, Subjective Norm and Perceived Behavioral Control

Table 4.24b demonstrates that Adjusted R Square for this model is 0.444 which indicates 44.4% of the variation on intention to use rhizobium inoculant (dependent variable), can be explained by Subjective Norms, Perceived Behavioral Control and Attitude (independent variables).

Table 4.24a revealed that, the F-value of 56.622 is highly significant at 5%. This indicates that the overall regression model with these three independent variables (Subjective Norms, Perceived Behavioral Control and Attitude) can well explain the variation of the dependent variable (intention to use rhizobium inoculant)

A linear multiple regression model was fitted to estimate the factors that are perceived to influence or predicts farmers' intention to use rhizobium inoculant. The adjusted coefficient of determination (R^2) of 0.444 suggests that, 44.4% of the variation of farmers' intention to use rhizobium inoculant can be explained by the model. The result from the linear regression model revealed all the variables had significantly influence on farmers' intention to use rhizobium inoculant in the study area, which are attitude and subjective norms at 5.0% significant level whiles, perceived behavioral control at 10.0% significant level

The results revealed that attitude (β=0.603) has the greatest impact on farmers intention to use rhizobium inoculant. This means that every unit increase in attitude will result in 0.603 unit increase of farmers' intention to use rhizobium inoculant, with an assumption that all other variables are held constant. Next to attitude is subjective norms (β =0.318), which has the second strongest impact on farmers' intention to use rhizobium inoculant. For every unit increase in subjective norms, results in 0.318 unit increase in farmers' intention to use rhizobium inoculant.

However, perceived behavioral control (β=0.099) has the weakest impact on farmers' intention to use rhizobium inoculant as any unit increase in perceived behavioral control will result in 0.099 increase in farmers' intention to use rhizobium inoculant. From the analysis above, all the variables namely; attitude subjective norms and perceived behavioral control had a joint influence on the dependent variable.

Table 4.24a: Anova Analysis

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	23.589	3	7.863	56.622	.000
Residual	28.607	206	.139		
Total	52.195	209			

a. Predictors: (Constant), Subjective Norms, Perceived Behavioral Control and Attitude

b. Dependent Variable: Intention

Source: Field Survey Data, 2017

Table 4.24b: Relationship between Behavioral Intention to Use Rhizobium Inoculant and Attitude, Subjective Norm and Perceived Behavioral Control

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.631	.216		7.537	.000
Attitude	.428	.038	.603	11.332	.000
SN	.248	.041	.318	6.117	.000
PBC	.076	.041	.099	1.847	.066

a. Dependent Variable: Intention

Number of observation = 210 Prob. > .000 R – Squared = .452 Adj. R – Squared = .444

Source: Field Survey Data, 2017

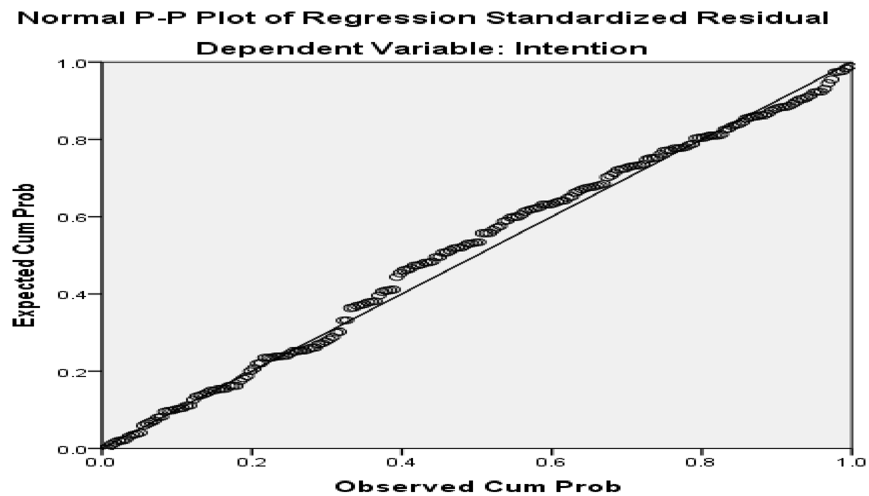


Figure 4.5: Normal Probability Plot of Regression Standardized Residual

Source: Field Survey Data, 2017

Figure 4.5 above shows that, the estimated Intention to use rhizobium inoculant had a linear relationship. It therefore suffices to say that all the three independent variables namely; attitude, subjective norms and perceived behavioral control had a positive significant relationship with the dependent variable intention. However, to check whether this strange case is having any undue influence on the results for our model as a whole as shown in the below 1.12, we can check the value for Cook's Distance given towards the bottom of the Residuals Statistics table. According to Tabachnick and Fidell (2007), cases with values larger than 1 are a potential problem. However, in our word, the Maximum value for Cook's Distance is 0.21999, suggesting no major problems.

Table 4.26 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Mahalanobis Distance	210	.05609	18.85173	2.9857143	3.02854097
Cook's Distance	210	.00000	.21999	.0064066	.01768068
Centered Leverage Value	210	.00027	.09020	.0142857	.01449063

Source: Field Survey Data, 2017

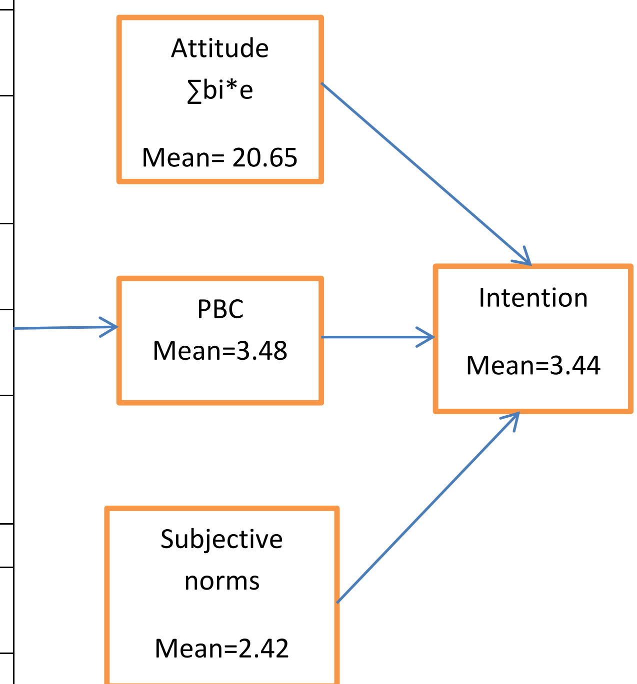
4.5.7: Rank Influential Attitude (A*I) correlation with Intention

When attitude measure (∑bi*e) was correlated with the intention to use rhizobium inoculant. The results of the correlation analysis revealed that two attitude items out of eight items were important contributors to influencing farmers' intention to rhizobium inoculant. The attitude statements farmers perceived were, rhizobium inoculant being a cheap alternative to the use of inorganic fertilizer with a correlation coefficient of .200** indicating a driver and the ease of applying inoculant on their farms with a negative correlation coefficient of -.203** indicating a driver.

Table 4.27: Rank Influential Attitude (A*I) correlation with Intention

Statements	Correlation Coefficient	Indicators (Barriers/ Drivers)
Inoculant easily losses it viability if not use on time	-.018	Barrier
Inoculant is hardly available in the open market	.190**	Barrier
It is easy to apply inoculant	-.203**	Driver
The use of inoculant do not increase crop yield	-.113	Barrier
Rhizobium inoculant are a cheap alternative to the use of inorganic fertilizer	.200**	Driver
It easy to store inoculant	.195**	Barrier
Use of inoculant require a lot of labour	-.142	Barrier
The use of inoculant do not produces high quality crop	.051	Barrier

Source: Field Survey Data, 2017



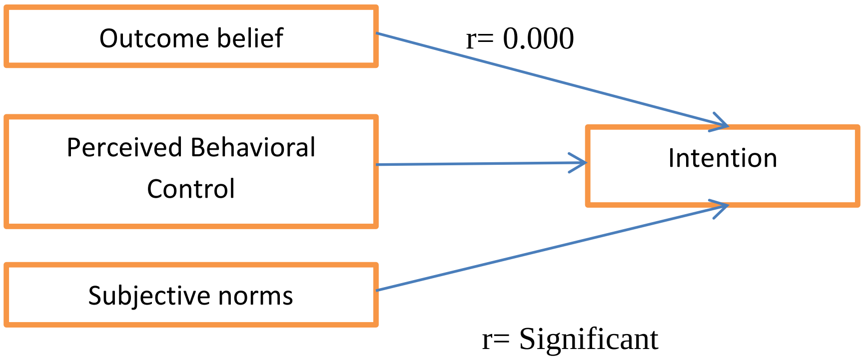


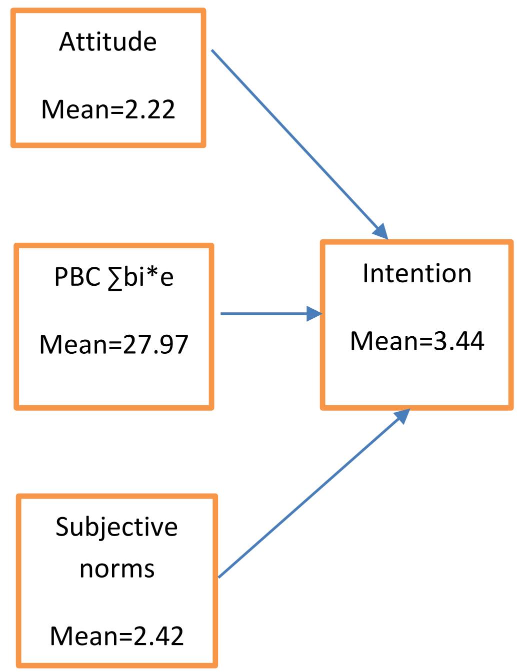
Figure 4.6: Rank Influential Attitude (A*I) correlation with Intention

4.5.8: Rank Influential Perceived Behavioral Control (PBC*I) correlation with Intention

When Perceived Behavioural Control measure (∑bi*e) was correlated with the intention to use rhizobium inoculant The results of the correlation analysis revealed that, none of perceived behavioral control items contributed to farmers' intention to rhizobium inoculant. In other words, Perceived Behavioral Control (PBC) would not influence farmers' intention to rhizobium inoculant. Since, farmers had no control over the use of rhizobium inoculant. Rhizobium inoculant presented farmers with some kind of challenges such as difficulties in storage and handling as well as it unavailability of the technology in the open market.

Table 4.28: Rank Influential Perceived Behavioral Control (PBC*I) correlation with Intention

Statements	Correlation Coefficient	Indicators (Barriers/ Drivers)
Lack of inoculant in the open market is serious constraint to the use of inoculant	-.099	Barrier
Lack of storage material for inoculant by farmers is serious constraint to the use of inoculant	.157*	Barrier
High loss of viability of inoculant is serious constraint to the use of inoculant	-.039	Barrier
Inadequate of knowledge on the application of inoculant is serious constraint to the use of inoculant	-.171*	Barrier
Delays in the delivery of inoculant by suppliers to farmers are serious constraint to the use of inoculant	.079	Barrier
High cost of inoculant is serious constraint to the use of inoculant	.179**	Barrier
Difficulties in handling inoculant is serious constraint to the use of inoculant	.172*	Barrier



Source: Field Survey Data, 2017

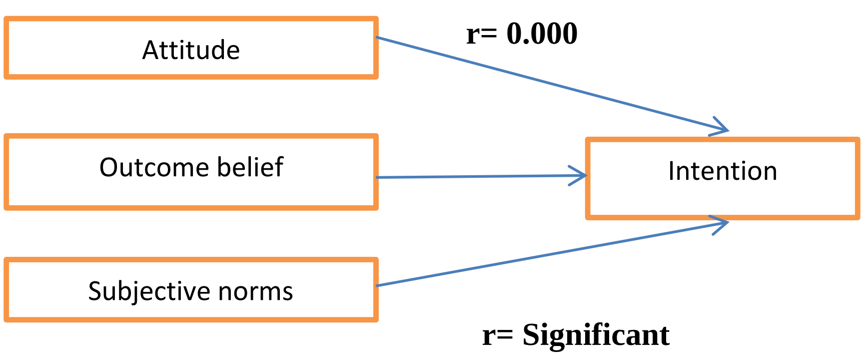


Figure 4.7: Rank Influential Perceived Behavioral Control (PBC*I) correlation with Intention

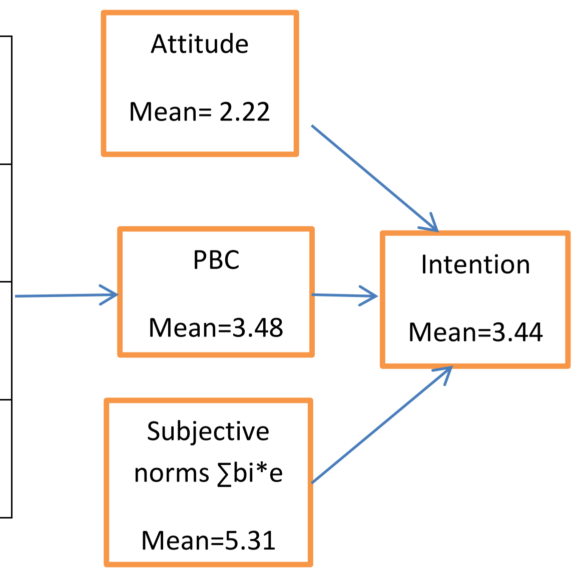
4.5.9: Rank Influential Subjective Norms (SN*I) correlation with Intention

Table 4.28 below, the analysis revealed that respondents considered social pressure as a necessity to the use of rhizobium inoculant. In other words, farmers overall subjective norms would influence farmers intention to rhizobium inoculant. Since, farmers perceived promoters of rhizobium inoculant as an in important contributor to the use of the rhizobium inoculant technology. Extension agents also played a significant role in influencing farmers' intention to use rhizobium inoculant.

Table 4.28: Influence of Subjective Norms on Intention

Statements	Correlation Coefficient	Indicators (Barriers/ Drivers)
Promoters of inoculant think that I should use inoculant on my farm to improve crop yield	-.243**	Driver
Fellow farmer think that I should use inoculant on my farm to improve crop yield	-.032	Barrier
Extension agent thinks that I should use inoculant on my farm to improve crop yield	.234**	Driver

Source: Field Survey Data, 2017



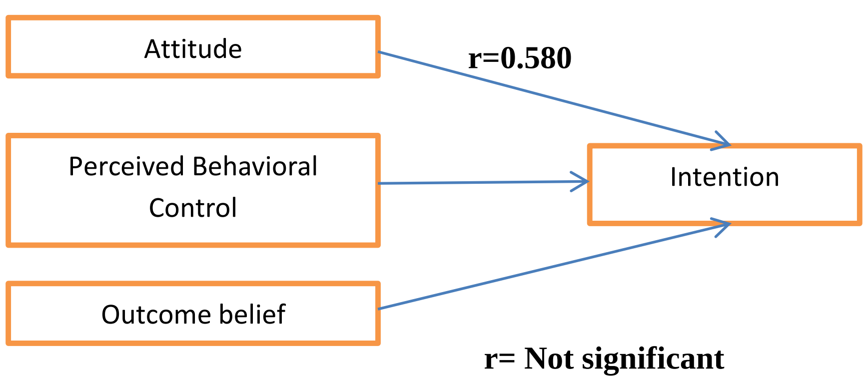


Figure 4.8: Rank Influential Subjective Norms (SN*I) correlation with Intention

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1.0 Introduction

This chapter presents the summary of the findings of the present study, conclusions and recommendations which when implemented could enhance the use of rhizobium inoculant among farmers. The summary and conclusions are presented in section 5.2.0 and 5.3.0 respectively. Section 5.4.0 presents the policy recommendations based on the findings of the study. Suggestions for future research are also presented in section 5.5.0.

5.2.0 Summary of Findings

The study examined the influences of communication media usage on uptake patterns of rhizobium inoculant among farmers in the Savelegu Municipal and Tolon District of the Northern Region. The study also examined the factors that affect farmers' intention to use rhizobium inoculant in the Northern Region.

5.2.1 Socio-demographic Characteristics of Legume Farmers

Legume farmers interviewed for this study shows that, males farmers (73.3%) were more than their female (26.7%) counterparts. On the educational status of respondents, (53.3%) of farmers had no formal education. Few farmers had Junior High education 19(9.0%), Senior High education 26(12.4%), whiles the 53(25.2%) remaining had primary education. Majority of farmers (37.6%) were between 30 and 45 years, with most (52.4%) having more than 10 years of farming experience.

5.2.2 Influences of Communication Media Usage on Uptake of Rhizobium Inoculant

The survey revealed that, the most frequently used communication methods among farmers were combination of radio, video and demonstration. Thus, recording as many as sixty-two percent of the respondents used combination of all three methods mention above. This implies that, the combinations of all the three methods can be used by promoters to effective and efficient disseminate information to farmers on rhizobium inoculant and its expected benefits.

The study revealed that most of the respondents 164(78.2%) had received information on how to apply inoculant. However, only two of the respondents reported to have received information on how to store inoculant, which is a necessary condition of rhizobium inoculant. Furthermore, as many as forty-four respondents had received information on where to access inoculant for their farming operation. This finding gives a firm indication that majority of the respondents know how to apply the technology on their farmers but lacks adequate knowledge on handling and storage of rhizobium inoculant. However, poor handling and storage of rhizobium inoculant would result to loss of viability of the technology.

The types of communication method used to promote and disseminate information on agricultural innovation to farmers had a strong influence on awareness creation among farmers in the study area. However, the types of communication method used to disseminate innovation to farmers did not influence respondents' knowledge on rhizobium inoculant in the study area.

The study revealed that, before the promotion of rhizobium inoculant technology started in the study area, only few farmers 46(21.9%) out of the total sample size were using rhizobium inoculant. However, since these institutions are now promoting the technology, majority 178(84.8%) out of the total sample size are now using rhizobium inoculant.

Moreover, great number 156 of respondents are intending to continue using rhizobium inoculant in the near future. This finding gives a firm indication that majority of the respondents are now using and hope to continue to using rhizobium inoculant in the future for their farming operation.

5.2.3 Factors that Affect Farmers' Intention to Use Rhizobium Inoculant

Farmers' attitude towards their use of rhizobium inoculant was below average of the items. A mean score of 2.20 (Mean = 2.20, Standard Deviation= .704) was reported for this variable. With subjective norms, farmers perceived a moderate social pressure to use rhizobium inoculant in their farming operation (Mean= 2.42, Standard Deviation = .640). In other words, farmers' perception of their control over money and farmland and evaluations of the extent to which these resources constrain their use of rhizobium inoculant, was strong suggesting that farmers perceived use of rhizobium inoculant as being under their control. This perception was supported by a relatively higher mean score for perceived behavioural control (Mean= 3.48, Standard Deviation = .650). Farmers' intention to use rhizobium inoculant is positively affected by their attitude at 5.0% significant level. On the other hand, farmers' attitude was negative and significantly correlated with PBC at 5.0% significant level. Moreover, subjective norms were positive and significantly correlated with PBC at 5.0% significant level. Finally, PBC was significantly correlated with attitude and Subjective Norms at 10.0% significant level and 1% significant level respectively.

The linear multiple regression model used to estimate the factors that are perceived to influence farmers intention to use rhizobium inoculant shows that, the adjusted coefficient of determination R^2 = .444 indicating that 44.4% of the variation of farmers intention to use rhizobium inoculant. However, in order to determine the strength of the relationship among variable, the regression was significant (F=476.710; p = 0.000) and the model explained 87.2% of the variance in behavioral intention.

Based on the results, three psychological items were tested against intention to use. The first test included the attitude as a predictor of intention to use. The second and the third test comprised, respectively, the subjective norms and perceived behavioral control. From attitude, two attitude items were important contributors to farmers' intention to rhizobium inoculant. The attitude statements farmers perceived were, rhizobium inoculant being a cheap alternative to the use of inorganic fertilizer with a correlation coefficient of $.200^{**}$ indicating a driver and the ease of applying inoculant on their farms with a negative correlation coefficient of $-.203^{**}$ indicating a driver.

However, with perceived behavioral control, none of constructs contributed to farmers' intention to rhizobium inoculant. Farmers had no control over the use of rhizobium inoculant. Rhizobium inoculant presented farmers with some kind of challenges such as difficulties in storage and handling as well as it unavailability of the technology in the open market. Additionally, farmers perceived social pressure as a necessity to the use of rhizobium inoculant. As the results revealed promoters of rhizobium inoculant as an in important contributor to the use of the technology as well as extension agents also influencing their intention to use rhizobium inoculant on their farms.

5.3.0 Conclusion

In evaluating the influence of radio, video and demonstration usage on uptake of rhizobium inoculant technology in the Savelegu Municipal and Tolon District of the Northern Region among farmers. The study results revealed that, communication methods used by promoters of rhizobium inoculant in the dissemination of information on rhizobium inoculant are radio, demonstration and video as well as combination of these methods. However, most of the respondents 132 used combination of all the three communication methods to access information on rhizobium inoculant on one way or other. Notwithstanding, efforts being made by promoters of rhizobium inoculant technology, the method of information dissemination do not necessary affect farmers knowledge on the technology, especially when it comes to handling and storage of the technology. Giving farmers some misconception about the use of rhizobium inoculant, thus, ultimately leading to low uptake of the technology.

In assessing the factors which affect farmers' intention to use rhizobium inoculant for their farming operation using theory of plan behavior. Overall, over 74.3% of farmers are intending to use rhizobium inoculant for their farming operation in the Savelegu Municipal and Tolon District of the Northern Region. This suggest that farmers would buy rhizobium inoculant if made available to them at the community level. Furthermore, considering the variables in theory of planed behaviour, which influences farmers' intention to use rhizobium inoculant, promoters of the technology as well as extension officer had a significant influence on farmers' intention to use rhizobium inoculant. Though, farmer themselves could not influence their colleague since, there equally lack adequate knowledge on the technology. Farmers' attitude towards the technology as well social pressure had an influence on farmers' intention to use the rhizobium inoculant.

5.4.0 Recommendations

With reference to the study results and conclusions presented above, the researcher recommends that promoting institutions of rhizobium inoculant should liaise with existing radio stations for slots to have officers broadcast agricultural innovations in various local languages to farmers. Also these institutions should identify and train community volunteers on radio broadcasting to assist officers reach out to farmers living in the rural area with information using the local language.

This can be realized through creation of incentives to promoting institution by governments and donor agency to enable them increase investments in information dissemination to enable farmers receive information through these communication media on timely.

Additionally, farmers should be encouraged to pay for the cost of information disseminated to them. Much emphasis should place on educating farmers on the handling and storage of rhizobium inoculant locally before using of the technology. Since, the viability of the technology lays on proper storage of rhizobium inoculant which has the ability to misinform farmers about the benefits of the rhizobium inoculant usage. Institutions that are mandated with provision of agricultural information to farmers should embrace a holistic approach when introducing an innovation to farmers. This would result in a deeper understanding of farmers' circumstances and the appropriate technologies packaged and disseminated in the right form using the communication methods available to the farmers.

The result of the study also showed that, majority of farmers interviewed for this study in the region are willing to use rhizobium inoculant for their farming operation. This calls for investors to take advantage of this existing opportunity. Through supporting research institutions to develop rhizobium inoculant that can last for several weeks without losing it viability.

5.5.0 Suggestions for Future Research

Future research on the of the use of rhizobium inoculant in farming operation among legume farmers should concentrate on the profit margin as compare to inorganic fertilizer.

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APPENDIX

Questionnaire on Communication Media Usage and Uptake Patterns of Inoculant Technology in the Savelegu Municipal and Tolon District of the Northern Region, Ghana

A. Demographic data

1. Sex of respondent

   1 = Male [ ]   2 = Female [ ]

2. Age of respondent

   1 = Below 30[ ] 2 = 30-45 [ ] 3 = 46-60 [ ] 4 = Above 60 [ ]

3. Marital status.

   1= Married [ ] 2 = Single [ ] 3= Divorced [ ] 4= Widowed [ ]

4. Educational level?

   1= No education [ ] 2= Primary school [ ] 3= Junior high school [ ]

   4 = secondary/vocational institute [ ] 5 = tertiary [ ]

5. For how long have you been cultivating legume?

   1 = Less than 5 years ago [ ] 2 = 5-10 years ago [ ] 3 = More than 10 years ago [ ]

6. What legume do you cultivate and total size of farm your farm devoted to it?

Legume	Groundnut	Soybeans	Common beans	Cowpea
Farm size(acres)				

B: Use of Communication Methods

7. Which of the following information domains are important to you in your decision to use inoculant? (Tick all that applies)

   [ ] Information on the cost of inoculant
   [ ] Information on how to store inoculant
   [ ] Information on where to access inoculant for my farm
   [ ] Information on how to identify quality inoculant in the market for my farm use
   [ ] Information on how to properly apply inoculant on my farm

8 Which of the following communication media/methods do you use to access information on inoculant?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

9. How often do you rely on these communication methods to access information on inoculant?

A: Radio discussion: 1= Daily [ ] 2= Weekly [ ] 3= Monthly [ ]

B: Video/ drama: 1= Daily [ ] 2= Weekly [ ] 3= Monthly [ ]

C: Demonstration plot: 1= Daily [ ] 2= Weekly [ ] 3= Monthly [ ]

10. What specific information do you require on the use of inoculant in your farm operation?

A: …………………………………………………………………

B: …………………………………………………………………

C: …………………………………………………………………

D: …………………..……………………………………………..

11. For how long have you been introduced to inoculant? (In years………………)

12. For how long have you been using inoculant in the past 7 years? :………………

13. How often have you inoculated your seed using inoculant?

1= Every year [ ] 2= Not every year [ ] 3= Others………

14. What benefits does inoculant provide in your farm operation?

A: ………………………………………………………………

B: …..…………………………………………………………...

C: ………………………………………………………………

D: ………………………………………………………………..

C: Effectiveness of Communication Methods on Awareness Creation and Knowledge

15. Which communication method helped in raising your awareness on how to use/apply inoculant on your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

16. Which communication method helped in raising your awareness on how to access inoculant for your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

17. Which communication method helped in raising your awareness on how to store inoculant on your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

18. Which communication method helped in raising your awareness on how to identify quality inoculant for your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

19. Which communication method helped in raising your knowledge on how to use/apply inoculant on your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

20. Which communication method helped in raising your knowledge on how to access inoculant for your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

21. Which communication method helped in raising your knowledge on how to store inoculant on your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

22. Which communication method helped in raising your knowledge on how to identify quality inoculant for your farm?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

23. How many communication methods were used to introduce you to inoculant?

A: Only one method (specify): 1…………………………………………..
B: Two methods (specify):1…………………, 2………………………….
C: Three methods (specify): 1……………., 2…………, 3………………

24. In your view, which of the following communication method helped in raising your awareness on inoculant?

A: Only one method (specify): 1………………………..………………..
B: Two methods (specify):1………………, 2……..…………………….
C: Three methods (specify): 1…………, 2…………, 3………..………..

25. In your view, which of the following communication method helped in raising your knowledge on inoculant?

A: Only one method (specify): 1…………………………………..……..
B: Two methods (specify):1………………, 2……………..…………….
C: Three methods (specify): 1………………, 2…………, 3……………

26. Which of the communication methods influenced your decision to use inoculant for your farm operation?

1= Radio discussion [ ] 2= Video/ drama [ ] 3= Demonstration plot [ ] 4=Others

(Specify)……………………

27. How many communication methods influenced your decision to use inoculant for your farm operation?

A: Only one method (specify): 1………….……………………………..
B: Two methods (specify):1……………, 2……………..……………….
C: Three methods (specify): 1……………, 2……………, 3…………....

28. Were you using rhizobium inoculant before this promotion started?

1= Yes [ ] 2= No [ ]

29. Are you currently using rhizobim inoculant?

1= Yes [ ] 2= No [ ]

30. Will you continue to use rhizobium inoculant in future for your farming operation?

1= Yes [ ] 2= No [ ]

D. Farmers Behavior, Attitude and Intention to Use Rhizobium Inoculant

31. Are you willing to use rhizobium inoculant based on your knowledge of it benefits?

1= Yes [ ] 2= No [ ]

Attitude:

32. What is your attitude on the use of inoculant? (2=strongly agree, 1=agree, 0=indifferent, -1=disagree, -2=strongly disagree and 2=extremely likely, 1=likely, 0=indifferent, - 1=unlikely, -2=extremely unlikely)

Statement	**Response**				
	S.A	**A**	**I**	**D**	**S.D**
Inoculant are a cheap alternative to the use of inorganic fertilizer					
Inoculant are easily available in the open market					
It is very easy to apply inoculant on my farm					
The use of inoculant on my farm increase crop yield					
Inoculant easily losses it viability if not use on time					
It very easy to store inoculant					
Use of inoculant require a lot of labour					
The use of inoculant on my farm produces high quality crop					
Statement	**E.L**	**L**	**I**	**U**	**E.U**
The cheaper cost would influence my decision to use inoculant					

The availability of inoculant would influence my decision to use inoculant					
The easy of inoculant application would influence my decision to use inoculant					
The increase in crop yield resulting from the use of inoculant would influence my decision to use inoculant					
The loss of viability of inoculant if not used on time would influence my decision to use inoculant					
The ease of storing inoculant would influence my decision to use inoculant					
The high labour involved in application would discourage me to use inoculant					
Getting a good yield as a result of the use of inoculant would influence my decision to use inoculant					

Intention to Use Inoculant

33. I intend to use inoculant on my farm in the coming season

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

34. For me, to use inoculant on my farm in the coming season is ……..

2=extremely likely		1=likely		0=indifferent		-1=unlikely,		-2=extremely unlikely	

Perceived Constraints of Inoculant

35. Lack of inoculant in the open market is serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

36. Lack of storage material for inoculant by farmers is serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

37. High loss of viability of inoculant is serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

38. Lack of knowledge on the application of inoculant is serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

39. Delays in the delivery of inoculant by suppliers to farmers are serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

40. High cost of inoculant is serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

41. Difficulties in handling inoculant are serious constraint to the use of inoculant?

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

Past behavior and normative referents:

42. Promoters of inoculant think that I should use used inoculant on my farm to improve crop yield

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

43. For me to use inoculant on farm, as recommended by promoters is ……

2=extremely likely		1=likely		0=indifferent		-1=unlikely,		-2=extremely unlikely	

44. Fellow farmer think that I should use used inoculant on my farm to improve crop yield

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

45. For me to use inoculant on farm, as recommended by fellow farmer is ……

2=extremely likely		1=likely		0=indifferent		-1=unlikely,		-2=extremely unlikely	

46. Extension agent thinks that I should use used inoculant on my farm to improve crop yield

2=strongly agree,		1=agree		0=indifferent		-1=disagree,		-2=strongly disagree	

47. For me to use inoculant on farm, as recommended by extension agent is ………

2=extremely likely		1=likely		0=indifferent		-1=unlikely,		-2=extremely unlikely	

Control Factors

48. I plan to use inoculant every year to inoculant my legume crop

2=extremely likely		1=likely		0=indifferent		-1=unlikely,		-2=extremely unlikely	

49. I am confident that if wanted to, I would use inoculant on a regular basis

2=extremely likely		1=likely		0=indifferent		-1=unlikely,		-2=extremely unlikely	

50. For me to use inoculant on a regular basis

2=extremely undesirable		1=undesirable		0=indifferent		-1=desirable		-2=extremely desirable	

51. How often do you face/encounter problems with the use of inoculant?

2= Very often		1=Often		0=Not at all		-1=Rarely		-2=Very rarely	

52. How often do you have problem in applying inoculant on time?

2= Very often		1=Often		0=Not at all		-1=Rarely		-2=Very rarely	

53. How often do you have problem in getting the required labour to assist you on your farm?

2= Very often		1=Often		0=Not at all		-1=Rarely		-2=Very rarely	

54. How often do you have problem with availability of inoculant on the market?

2= Very often		1=Often		0=Not at all		-1=Rarely		-2=Very rarely	

THANK YOU