

**FACTORS ASSOCIATED WITH THE ADOPTION OF AGRICULTURAL  
TECHNOLOGIES: A CASE OF SASAKAWA GLOBAL 2000 PROJECT IN  
DODOMA RURAL DISTRICT, TANZANIA**

**By**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE  
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**ABSTRACT**

The Sasakawa Global 2000 (SG2000) projects' strategy was successful during implementation as revealed by its ability to enable farmers to increase sorghum yields through training and demonstration as compared to the conventional methods. However, the lack of empirical evidence to the reasons why farmers in that project fail to continue adopting the SG2000 technologies prompted the need to study in detail the factors associated with the adoption and non-adoption of the advocated technologies.

The study was conducted in 12 villages in Dodoma Rural District in Dodoma Region. It involved 120 farmers and 20 village extension workers selected randomly from 50 villages which have been phased out of the SG2000 project.

Interview schedules and field observations were used as instruments for data collection. They were supplemented by documents and records from Regional and District offices. Personal computer Sub-programmes "FREQUENCIES" and "CROSSTABS" were used to analyse the data and was conducted at Sokoine University of Agriculture.

Findings show that about four out of the six technologies in the package introduced by SG2000 have been adopted (representing 67% of the adoption

rate). The adopted technologies were those which demand minimum or non-monetary investment while the non-adopted technologies were those which demand monetary investment.

Adoption was found to be influenced by cost of inputs, labour requirements, supply of inputs, inferior tools and equipment, credit, time of phasing out, teaching methods and markets. Out of these factors cost of input influenced strongly the non-adoption and/or failure to continue using the technologies while credit availability was strong for adoption of the technologies.

In order to increase adoption and continued use of introduced technologies, the following were recommended: a) Creation of sorghum market, b) improvement of ox-training programme, c) motivation of private sector to become stockists, d) improvement of credit provision and recovery, and e) use of actual bottom-up extension approach.

**DECLARATION**

I, FINEHAS BARAKA NDARO MACHUMU do hereby declare to the Senate of Sokoine University of Agriculture that the work presented here is my own creation, and has not been submitted for a degree award in any other Universities.

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Lastly but not least, the author's heartfelt thanks are due to his wife Mary and his children Frank and Fred for their moral support and for accepting to miss him while pursuing studies.

**DEDICATION**

This dissertation is dedicated to my mother Nyafuru Ndaro Machumu.

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**LIST OF ACRONYMS**

SG2000	Sasakawa Global 2000
MTP	Management Training Plot
NGO	Non-Governmental Organization
FAO	Food and Agricultural Organization
Kilimo	Ministry of Agriculture and Livestock Development
MVRTC	Makutupora Viticultural Research and Training Centre
SAFE	Sasakawa African Fellowship
TFA	Tanganyika Farmer's Association
ZZK	Zana Za Kilimo
CIMMYT	International Maize and Wheat Improvement Centre
TBL	Tanzania Breweries Limited
KIBUKU	Dar es Salaam Brewers

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 BACKGROUND TO THE STUDY**

The concern on the adoption of agricultural innovations stems from the fact that many developing countries have been relentlessly struggling to improve the standards of living of the people especially in rural areas through the transformation of the traditional systems to modern and improved way of agricultural production. Despite numerous painstaking research endeavors in developing technologies to improve the quantity and quality of food, fibre and livestock production, the adoption of some of these innovations has been low and at times non-existent. It is not surprising to note that the lack of adoption has caused most developing countries to suffer continuously from hunger, poverty and misery (Mattee, 1994).

It is also important to note that although most extension services are actively engaged in promoting new technologies to farmers, only infrequently are resources reserved for monitoring the outcome of these extension efforts and using the analysis to understand why some recommendations or extension techniques are more successful than others. Furthermore, governments in sub-Saharan Africa have

contributed considerable resources in agricultural research, but most of the generated technologies have been adopted by farmers. Indeed, the question often asked is why has the green revolution that took place in most parts of Asia almost 30 years not occurred in Africa (Mattee, 1994).

Tanzania possesses vast, and still undeveloped land and water resources to support future food production. Of the country's approximately 41 million hectares of potentially arable land, only 5.4 million hectares have been brought into agricultural production (FAO, 1989). In general, the adoption of improved germplasm has been limited, and crop yields remain quite low.

Many government's and donor agencies' projects such as Teaching and Visit (T&V) and SG2000 have been sponsoring rural development activities including the introduction of new agricultural technologies. Although these activities may represent a large investment of funds, the capacity to monitor the progress has rarely been a focus of many project. For instance, a development project may operate under certain assumptions about the possibility of improving the tillage operations, and the effects this will have on yields and income but may lack the

mechanism to assess the extent of adoption of the technologies. CIMMYT, (1993) observed that it is important to follow the degree to which project participants are actually changing their tillage practices and identifying any problems that have occurred. In short, most developing countries rarely assess the level of adoption of several rural development programmes. In Tanzania, this inefficiency is nationwide. In places like Dodoma region where climatic conditions are unpredictable, it poses an additional problem to the success of many agricultural programmes. For example, the rainfall pattern in Dodoma Region is essentially unimodal with annual rainfall ranging between 300 mm and 700 mm. The region has no traditional cash crop. Food crop production is very poor partly due to the traditional technologies (Ministry of Agriculture, 1989).

#### **1.1.1 Factors influencing the adoption process**

Agriculture and rural development depend upon the functional interaction of related systems. That is the interaction of the system of agricultural producers, suppliers, marketers, researchers, those who govern and those involved in education and extension is very crucial for improved agricultural productivity (Axinn and Thorat, 1972).

However, the fact remains that the low adoption rate is not due to the exclusive failure of the technology, but may be due to a number of many other factors which may influence farmers' decisions to adopt or reject a particular innovation. From the perspective of this study these factors are classified into five categories:

1. Farmers' characteristics which include (a) demographic factors such as age, educational background, economic status, size of the farm (b) socio-psychological factors such as motivation, perception and needs and; (c) cultural factors such as household norms and beliefs.
2. Innovation characteristics such as cost of inputs, complexity, compatibility and profitability of the technology.
3. Institutional characteristics such as quality, quantity and accessibility of research and extension services, availability of credit and inputs.
4. Environmental characteristics such as soil type, rainfall pattern and topography.
5. Infrastructural characteristics such as access to markets, transportation and so on.

There is not more a distinctive feature of agriculture than its dynamism because farming practices change continually. From these changes, farmers build on their own experiences and those of their neighbours to refine the way they manage their farm operations. Changes in natural conditions, resource availability and market development also present challenges and opportunities to which farmers respond. In addition, farmers learn about new technologies from various organisations, programmes and projects research recommendations, extension services, and so on. It is, therefore, essential that those organizations follow-up the results of their efforts and understand how the technologies they promote fit into the complex pattern of agricultural change in which all farmers participate (CIMMYT, 1993).

There are several reasons to invest in studying the adoption of agricultural technology. They include: improving the efficiency of technology generation, assessing the effectiveness of technology transfer, understanding the role of policy in the adoption of new technology and demonstrating the impact of investing in technology generation (CIMMYT, 1993).

## 1.2 THE ADOPTION OF TECHNOLOGIES IN DODOMA REGION

The adoption of technologies in Dodoma region has a long and frustrating history. Vivid examples include low adoption and non-adoption of technologies from three rural development agricultural projects that were implemented since early 1960's.

The first project was the introduction of grapevine production as a cash crop whose objective was to integrate native subsistence farmers into the market economy. The idea came from field observation of the performance of missionaries who grew vineyards on a small scale for wine production for church use. To establish this crop, one requires a simple technological package of farm yard manure, deep trenches, local stakes and cultivars. All these inputs are abundantly available in Dodoma region and within the reach of farmers. The vineyards were distributed to farmers surrounding missionary centres. In early 1970s, Makutupora Viticultural Research and Training Center (MVRTC) was established to provide training and extension services for both extension staff and farmers (Ministry of Agriculture, 1989). However, personal experience and (Director, MVRTC Personal communication 1994) reveal that it was only immigrants from other parts of the country who adopted and grew the crop despite its potential high return to resources invested.

Although the crop flourished in mid 1970s, only a few plants from more than thousands of hectares established remain in the region (Ministry of Agriculture, 1990).

Secondly, it was during this period (1960's) that the first improved cattle breeding multiplication unit in East Africa was introduced in Mpwapwa district in Dodoma region. The objective of this project was to produce and distribute to smallholder farmers dual purpose improved cattle for both meat and milk production. This was from the results of scientific observation which showed that local cattle kept in the region were for meat only. Again, (Director of Mpwapwa Veterinary Centre, Personal communication 1994) indicates that up to now the adoption of Mpwapwa breed in the region is quite low.

The third example of low or non-adoption of technologies by farmers is the use of the draught power technology. Although the region has one of the highest cattle populations in the country, it ranks the lowest in the use of draught power. Many farmers do not purchase ox-drawn implements and this has discouraged the suppliers (Ministry of Agriculture, 1992). Sales of Tanganyika Farmers Association (TFA), and 'Zana za Kilimo' (ZZK) who are the sole suppliers of ploughs put these

items as slow moving in Dodoma region. In spite of the government efforts to provide draught animals with ploughs free of charge to almost all villages in the region in 1970's, observations in the field show that the hand-hoe technology is still widely used by the majority of farmers. However, a few farmers adopted the technology.

### **1.1.3 An overview of the Sasakawa Global 2000 (SG2000) project**

The Sasakawa Global 2000 project (SG2000) was introduced in Dodoma Region in 1989 to assist farmers in increasing production of staple food crops especially sorghum through testing and demonstrating improved food crop production techniques. The project operates through the Ministry of Agriculture. All the agricultural extension staff in the project are employed by the Ministry of Agriculture and they serve as link persons between farmers and the project. The strategy of the project is to strengthen the linkage between farmers and agricultural research, education, production and credit organization (Quinones and Sicilima, 1992).

The extension method involves both group and individual contacts. The commonly used group techniques are the method and result demonstrations, field days and field visits and informal contacts.

Nationally, the project is providing services to 453 villages distributed in 27 in seven regions. About 32000 smallholder farmers are benefiting from the project (Foster, 1993).

#### **1.1.3.1 Selection of farmers**

From each village, 10 farmers are selected by village government under the supervision of village extension workers. The selected farmers form a cluster and elect the cluster leader among themselves. The characteristics of farmers selected to join the project include (a) hard working (b) readiness to work in the field (c) agree to repay the loan (d) readiness to adhere to village extension workers advises (e) being a farmer.

The project village forms the SG2000 farmers committee that is supposed to be representative of the farming community which is expected to be heterogeneous in terms of farming operations, resources and social status.

However, most of these farmers' committees are male dominated and consists of high social status villagers. Mascarenhas and Mbilinyi (1983), asserted that this phenomenon destroys the

representation of the poor and less powerful farmers. They contend that without the participation of the poor and low status members in the decision making of the farmers committee, their representation will remain a myth.

Experiences in the field with SG2000 show that, in most cases the selection of target farmers was not democratic and was being influenced by extension staff, and in some cases by village governments. The selection of the so called "progressive farmers" was done erroneously, ostensibly for the purpose of easing loan repayments. Extension workers who were also involved in loan recovery found it easy to select farmers who could repay the loan even when yields were not very good.

#### **1.1.3.2 The project strategy**

The project's main strategy for technology transfer has been through the use of the Management Training Plot (MTP) where the cooperating farmer agrees to follow the recommended crop management practices and to involve at least 10 neighbouring farmers in MTP operations during the growing season. The project mission is based on the assumption that a plot of one acre

per farmer under MTP is about the minimum for testing the improved technology on a realistic scale and for providing the participating farmer with immediate economic benefits.

The project supplies inputs on credit to each MTP cooperating farmer with inputs, mainly fertilizers and improved seeds. Village extension workers deliver the inputs to farmers who are expected to re-pay in cash or in kind after harvesting. Farmers can participate in the project for a maximum period of three years after which they are phased out from the project and have to look for inputs on their own.

The recommended technology package for growing sorghum which is advocated by SG2000 in Dodoma Region consists of the following:

1. An improved sorghum variety - Tegemeo;
2. Tillage before planting;
3. Fertilizer application of 57 kg N/ha and 29 kg P<sub>2</sub>O<sub>5</sub>/ha or one half a bag of TSP and one half a bag of Urea per acre at planting plus one half bag of Urea as top dressing (4 weeks after first weeding);

4. Optimum plant density in rows - a spacing of 80 cm between rows and 25 cm between plants in a row with two seeds per hole. This gives a plant population density of 100000 plants per hectare or 40000 plants per acre;
5. Timely first weeding at 3-5 weeks after seed germination;
6. Control of pests and diseases by chemicals.

The project started in the 1989/90 growing season with two districts in the region, namely Dodoma Rural and Kondoa. A total of nine villages with 90 farmers were involved. In the 1990/91 season, Mpwapwa district was included in the project. During this time a total of 22 villages accounting for 445 farmers were being served by the project in the entire region. In the 1991/92 growing season, a total of 1200 farmers were involved in 62 villages in the whole region. The project plan was to make each cooperating farmer a cluster leader of 10 new farmers. In the 1993/94 growing season, the project started training and demonstrations on storage structures and ox-training programmes. However, it appears that the development of the package, selection and evaluation did not involve farmers right from the beginning. The package was developed outside farmers' knowledge and introduced for implementation.

### **1:1:3:3 Implications to the adoption process**

The project success is measured by increased yield in the MTPs when compared to yields in other plots. In 1990, for example, the regional average of sorghum yield tripled from the traditional level 0.5 t/ha to 1.9 t/ha in SG2000 MTPs (Quinones and Sicilima, 1992). Another measure of success is the loan recovery rate which may indicate the economic benefits farmers are accruing from the package. For example, at the beginning of the project, the loan recovery rate was 98%. But as the project expanded to many farmers in following years, there was a marked decline in loan recovery rate to below 40% (Quinones and Sicilima, 1992 ).

The lessons learnt during the seven years of SG2000 project in the country have implications for its continuity. In his annual report, the Project's Country Director had the following to say:

"... Clearly the MTP approach is an effective extension tool. However, if it is to be used in a sustainable way, it will need to function within the natural framework of an extension management system. We therefore need to do some adjustments in the MTP approach. Extensionist should not deal with credit and input distribution operations directly" (Foster, 1993, p.10).

Foster (1993), further asserted that SG2000 project has been flexible to accommodate field experience according to the above observation. We anticipate that future MTP programmes will reflect greater diversification of farm enterprises. Although the MTP was previously mono-cropping, it should in future introduce inter-cropping of cereal crops with companion crops and use of crop rotations where appropriate (Foster, 1993).

It could be implied from the above remarks, that the project keeps in mind the importance of farmers' feed-back which is very crucial in their training. This is a credit to the SG2000 project for keeping in mind such crucial component in the programme. This SG2000 strategy is consonant to Fowler (1990) who asserted that non-governmental organizations (NGOs) have comparative advantages over governments as agents of development for the poor in the third world. His argument was based on the belief that NGOs possess features which better enable them to act as catalysts of community based and people centered development.

## **1.2 PROBLEM STATEMENT**

The SG2000 strategy appears successful during implementation as revealed by increased yields and high rates of loan recovery but it suffers a drop out syndrome after farmers have been phased out. Observations in the villages that have consecutively phased out after being under the project for a minimum of three years, show an insignificant adoption of the introduced package. Only in a few villages have farmers partially adopted the package. The lack of empirical evidence as to why there is such a low rate of continued adoption of the SG2000 introduced technologies prompted an investigation to ascertain factors which associated with adoption of technologies and approaches under SG2000 project.

## **1.3 SIGNIFICANCE OF THE STUDY**

Since its inception in Dodoma region, the SG2000 project has been strongly commended for enabling farmers to increase sorghum yields through training and demonstrations as compared to the traditional or conventional methods. Also, the high rates of loan recovery when the project started gave an indication that farmers were benefitting from the technology (Quinones and Sicilima, 1992). Considering this commendable project performance in demonstration, the need to study

in detail the factors influencing the adoption of advocated technology cannot be overemphasized if the ultimate goal of food sufficiency is to be reached. The result of this study will be of assistance not only in determining the extent of adoption of innovations but also in making modifications in the approach to facilitate continued adoption of technologies.

#### **1.4 OBJECTIVES OF THE STUDY**

The purpose of this study was to determine the influence of the factors associated with the adoption and non-adoption of agricultural technologies introduced by SG2000 project. The specific objectives were:

1. To determine the extent of adoption and continued use of the technologies promoted by the SG2000 project over time.
2. To identify and analyze factors associated with adoption of the introduced technologies.
3. To determine farmers perception of the SG2000 innovations and approach.

## **1.5 HYPOTHESES OF THE STUDY**

The hypotheses of the study were that:

1. The adoption of the promoted technologies was independent of the factors identified in objective number two of the study.
2. Continued use of the promoted technologies was independent of the time a farmer has stayed out of the project.

## CHAPTER TWO

### LITERATURE REVIEW

Van den Ban and Hawkins (1988), defined adoption of innovation as:

...decisions to apply an innovation and to continue to use it; (and), the adoption process as... changes that take place within an individual with regard to an innovation from the moment that he first becomes aware of the innovation to the final decision to use it or not (p.308).

They identified five stages that resemble the normative decision making model which is used to analyze the diffusion process as: 1) awareness (first hear about the innovation), 2) interest (seek further information about it) 3) evaluation (weigh up the advantages and disadvantages of using it), 4) trial (test the innovation on small scale for yourself) and 5) adoption (apply the innovation on a large scale in preference to old methods).

CIMMYT (1993), contended that it is useful to distinguish between adoption, which is measured at one time, and diffusion which is the spread of a new technology across a given  $\mu$  population over time. However, in most cases literature on diffusion assume that cumulative proportion of adoption follows an S-shaped curve in which there is a

slow initial growth in the use of the new technology, followed by a more rapid increase and then a slowing down as the cumulative proportion of adoption approaches its maximum (CIMMYT, 1993). On the same issue, Lionberger and Gwin (1991), asserted that the curve has three parts, meaning that the adoption starts slowly by a majority of people wanting to see the innovation tried locally by someone else first. This is followed by an increased adoption rate as a result of interpersonal communications on an innovation and finally the adoption rate declines at the third part.

The aforementioned adoption stages rely mostly on estimates which in many cases have some problems. CIMMYT, (1993) observed that these estimates assume cumulative adoption, that is, once, a farmer begins using the technology will continue using it. However, in some cases this is not true as many farmers may have one or more years of experience with the technology and subsequently abandoned it. Also t times, a significant proportion of farmers may have experience with the technology but very few of them could be using it. Furthermore, CIMMYT (1993), contended that in such a situation, it is worth trying to get information on why farmers stop using the technology.

Lionberger and Gwin (1991), asserted further that often the time from first knowledge to first adoption is considerable. For some farmers, the time of adoption may be longer and for others shorter. For example, the average time for the adoption of hybrid seed corn in Iowa (USA), was five years for the individual farmer and 12-14 years before all farmers had adopted (Van den Ban and Hawkins, 1988). However, they found that hybrid sorghum was adopted much faster in Iowa because farmers were familiar with the success of hybrid corn that hybrid vigour made a difference in production.

Farmers in Dodoma view the sorghum variety Tegemeo as an innovation in their area. In some villages other millet varieties namely Serere-17 and Serena have been introduced. Therefore, the adoption or non-adoption of the Tegemeo will have a bearing to the failure or success of the other varieties introduced earlier in the area (that is, Serena and Serere-17 varieties).

Field observations in Dodoma region show a spectrum of events from non-adoption to adoption of technologies in the villages that have been phased out from the project. However, the SG2000 interventions appear to leave most farmers at the stage between trial and evaluation. all

farmers in the project were introduced to the innovations and evaluated whether to adopt or not by seeing the advantages or disadvantages. However, it is surprising to see that even some of those who adopted the technologies fail to continue adopting them when they left the project. It tempts to speculate that the SG2000 project duration of a maximum of three years may appear to be very short to some farmers for a complete adoption.

On the same issue of the adoption process theory, Fliegel (1984), categorized farmers characteristics on the basis of differences in an underlying psychological trait called innovativeness as follows:

....Based on observations of farmers' behaviours (earliness or ateness of adoption), those few who are first to try out a new idea are called innovators. If the new idea survives for an appreciable length of time, the early adopters come in being more (in number) than the innovators. If the idea continues to spread, the bulk of farmers who are ultimately early and late majority come in. Finally some minority of farmers accept the idea very late, these are conventionally called "laggards" (p.83).

Using Fliegel's (1984) schema, the three years' period under which farmers stay with SG2000 project may be enough for innovators and early adopters to have gone through the stages of the adoption process. This implies that even at the phasing out of the project in the fourth year, some farmers may be at the adoption stage, where according to

the adoption process should be able to adopt and continue adopting those technologies. However, it is also possible that due to a number of other factors, the time may be too short for other groups of farmers to have gone through this adoption process.

Fliegel (1984), contended that the decision for or against adopting a technology involves the adopter's mental process which consists of several stages. Therefore, the objectives of extension communication should be to provide knowledge on which action can be based, to persuade the farmer to make decisions to try the new technology, to provide the information necessary for actual implementation and to provide farmers with the information to assess and confirm the results of the decision made.

There are a number of factors that may influence the farmers' decision to adopt or reject a particular innovation. While it is not an intention to list all of them, it has been generalized into five categories of (1) farmers' characteristics (2) innovation characteristics (3) institutional characteristics (4) environmental characteristics and (5) infrastructural characteristics.

However, it is important to understand that agricultural technology development and utilization continuum is basically composed of three sub-systems namely (1) knowledge generation (2) knowledge dissemination and (3) knowledge utilization (Rutatora and Rutachokoziwa, 1993). Each of these sub-systems has a significant role to play in the knowledge potential producer and potential user continuum.

Other researchers in Tanzania focused on the communication variables in technology development and adoption with a special emphasis on the performance of the extension service (Rutatora and Rutachokoziwa, 1993; Wambura, 1988). Generally, these studies suggest that by and large, the extension methods which have been used have been inappropriate or ineffective for one reason or another, although it is not clear whether the lack of effectiveness is due to the methods or due to inappropriate innovations. It has been consistently revealed that the agricultural technology dissemination sub-system lacks impact because perhaps, there are no new technologies to transfer to smallholder farmers or where there have been new technologies to disseminate they have not been disseminated and where the innovations have been disseminated they have been found to be inappropriate to the users (Rutatora and Rutachokoziwa, 1993).

On the success or failure of the project, Rogers (1988), contended that a successful project must be seen as one in which the role of the development agency becomes invisible - in which local people are convinced that the achievements are their own.

## 2.1 Farmers' characteristics

Many farmers' characteristics such as their attitudes and personalities are used to analyze adoption. In other cases, socio-economic characteristics such as wealth, land holding, or education are used to explain the differences between those who adopt and those who do not (CIMMYT, 1993). In general, these factors or characteristics include education, age, gender, ethnic, religion and other community factors. In addition to these, farm resources and land tenure make additional factors for farmers to be receptive to adopt new technologies (CIMMYT, 1993).

The subject of adoption of innovations has often been researched and discussed with a view of finding appropriate strategies for bringing about a more rapid modernization of the agricultural sector (Benad, 1988, Mvena and Mattee, 1988). However in reality, farmers all over the world, rarely adopt complete packages and rarely comply exactly to

the recommendations made when it comes to their specific situations. Benad (1988), argued that if some parts of a package are accepted and others are rejected, then the reasons for rejection have to be traced in the characteristics of the innovation rather than in a general "change resistant" attitude of farmers.

On the same issue of readiness to adopt early or late, Ashby (1982), observed a remarkable behaviour that farmers who adopt a technology first are not always the ones who find it most useful. His Nepal example showed that although larger scale farmers were the first to adopt high yielding rice varieties, it is the smaller farmers who had the highest rate of continued adoption of the variety.

This shows that farmers may have access to resources that enables them to adopt a given technology but in the long run they may drop it when they find that it was not useful to them. However, smallholder farmers may have less access to resources, a factor that may limit them from adopting a certain technology. There comes a time when they have access to the resources and become the major users of the technology which is appropriate to them.

Concerning farmers' characteristics such as age, education and income differences, Ponjee (1975), observed that the extension system tended to favour certain categories of farmers. Thus richer, younger and better educated farmers were found to have higher level of extension contact than others. However, under the SG2000 all farmers are treated equally. Therefore, this factor could not influence the adoption or non-adoption of introduced technologies.

Commenting on the place of literacy and poverty in village development in Bangladesh, Alam (1989), observed that illiteracy and poverty were closely linked. Through literacy, learners increase their economic self-reliance and also become more critically aware of the need and scope for social change. On the other hand Jahangir (1989), observed that most programmes of groups facilitated by Mauchack ( a group oriented rural programme in Bangladesh ) were determined by group members, and literacy was not associated with raising awareness.

The relationship of education and adoption was also explained by CIMMYT (1993). Education was seen to make a farmer more receptive to advice from an extension worker or more able to deal with technical recommendations that require a certain level of numeracy or literacy.

These skills, are not necessarily perfectly correlated with years of schooling although some adoption studies show some relationship between technology and education level of the farmer. These studies indicate that the more complex the technology is, the more likely it is that education will play a role (CIMMYT, 1993).

CIMMYT (1993), argued further that older farmers may have more experience, resources or authority that would give them more possibilities for trying a new technology. On the other hand, it may be that younger farmers are more likely to adopt a new technology because they have had more schooling than the older generation or perhaps have been exposed to new ideas through events like, migrant labour movements.

On the gender issue, CIMMYT (1993), contended that because women play a key role in most agricultural systems, it is important that adoption studies consider the degree to which a new technology reaches women farmers.

Commenting on the same issue of reaching women, Swanson *et al* (1984), wrote that although women make a major contribution to world

food production, they seldom benefit from agricultural extension services. He asserted further that the apparent and unconscious ignorance of treating women as a special case, make extension meetings and demonstrations, to be scheduled for the convenience of men at times and places that are inconvenience to women. However, Lionberger and Gwin (1991), observed that because of personal and life style characteristics, women seem to prefer communication strategies that provide for group participation.

On farmers' farm economics, Sharland (1991), asserted that production that is primarily for sale has very different priority values and methods from that for subsistence production. He argued further that although the differences between commercial and subsistence production are manifold, the central issue of subsistence production that affects most traditional practices is the importance of risk aversion which seeks to ensure a minimum level of production in worst years; and that this strategy leads to many varied practices that are seen as irrational or wrong to the scientist and the commercial sector.

People will accept information from one source and reject the same information from another source. We also know that people actively

seek advice from sources of high credibility. The cause seems to have its basis in the components of expertise and practicability (Lionberger and Gwin, 1991). Judgement of expertise is based upon what the source supposedly knows. Practicability is based on the reputation of the sources ability to evaluate new ideas in the light of their local usefulness. They further argued that advice from young advisors with college degrees (with expertise at plenty) is sometimes ignored because they are thought to be lacking practical experiences. Similarity in the characteristics between the message sender and the receiver also has an important influence on credibility. People who are very much alike can understand each other better, and are more at ease in each other's presence (Lionberger and Gwin, 1991).

## **2.2 Innovation characteristics**

Innovations have properties that affect their rates of adoption (Rogers, 1983). By using a standard classification skill for describing the perceived attribute of innovations in universal terms, Rogers (1983) came up with five attributes that are mutually exclusive. They are (1) relative advantage (2) compatibility (3) complexity (4) trialability (5) observability.

According to Rogers (1983), relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes and it is always expressed in economic profitability in a status of giving or otherwise. He commented that when the price of an innovation decreases dramatically during its diffusion process, a rapid rate of adoption is facilitated.

Compatibility is a degree to which an innovation is perceived as consistent with existing values, past experiences and, needs of potential adopters. An idea that is more compatible is less uncertain to the potential adopter. Roger (1988), contended further that an innovation can be compatible or incompatible with socio-cultural values and beliefs, with previously introduced ideas or with client needs for innovation.

Complexity is the degree to which an innovation is perceived relatively difficult to understand and use. Some innovations are clear in their meaning to potential adopters while others are not. On this issue, Rogers (1988), generalized by saying that the complexity of an innovation as perceived by members of social system, is negatively related to its rate of adoption.

Trialability is the degree to which an innovation may be experimented on a limited basis. New ideas that can be tried on the instalment plan will generally be adopted more rapidly than innovation that are not divisible.

Observability is the degree to which the results of an innovation are visible to others. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to explain to others.

It is asserted in IITA (1994), that a technology that is clearly profitable, reliable and compatible with farmers' farming systems will be highly adopted and diffused; and that farmers are likely to adopt technologies that are more visible and have positive attributes.

It is also learnt from Monu (1993), that if technologies developed are to be relevant, useful and acceptable to the intended users, a new model of technology development and dissemination is needed. In this new model, farmers need to be seen as the starting point and not the scientists of the development of agricultural technology. The unilinear model of knowledge creation, diffusion and utilization need to be discarded.

The need to involve farmers in technology development and dissemination is shared by Wallace (1994), who argued that for more complicated technologies such as alley cropping, farmers' participation improves clearly their adoption if they are in need of such technology for a pressing problem of their own. Also, Njoku (1991), contended that if improved technologies are to be adopted, they must be affordable by farmers and the inputs needed both in quantity and quality must be available at the time of the year when they are needed. In this particular aspect, SG2000 is commended for its effort to ensure timely availability of inputs .

In case of technologies that depend on purchased inputs the first farmers to adopt a new technology may be large-scale farmers or those with more resources or capacity to experiment with new practices( Rogers, 1983).

Since most of the farming practices in Tanzania are on a smallholder basis, Kauzeni (1988), challenged the Tanzanian research centres to include socio-economic considerations in the packages in order to create an impact. Similarly, it is learnt from Sharland (1991), that Indigenous Technical Knowledge (ITK) is particularly significant to farming systems

which are largely subsistence based. Conventional research and development has not only neglected subsistence production in favour of cash and export-oriented systems but it has also not been able to apply itself to the problem of subsistence systems because of the failure to recognize what the desirable qualities of innovations within such systems would be.

It is also true that although the available traditional technologies have evolved for a long time, very few studies have attempted to determine the rationale on which improved technologies could be built. Zeremiam (1991), gave a striking example of choices made by pastoralist in Eritrea that the declining physical and environmental security has led the Beni-Amer cattle herders to breed long-legged aggressive but less productive animals. Similarly, it was found that although farm families on Rusinga Island in Lake Victoria preferred the taste of maize to that of sorghum, they nevertheless grew sizeable amounts of sorghum simply because it is less relished and therefore consumed at a lower rate than maize such that sorghum food stocks last longer (Bonitatibus, 1991). These examples indicate that scientists should understand the indigenous knowledge and appreciate what and why farmers behave the way they do.

### 2.3 Institutional Characteristics

Institutional characteristics are derived from those publicly operated systems for providing research and extension services to farmers. For countries in which the private sector is not developed, these systems also include credit, input supply and markets. Lionberger and Gwin (1991), contended that public operated systems providing research and extension of new technology sometimes get out of touch with the needs of the farmers they serve. The researcher in this case plays a central role by directing what technology to be developed without firstly identifying the farmers' needs. They further argued that as farmers begin to produce for the market beyond their family needs, they find themselves in situations where they must depend on off-farm services and supplies over which they have no control.

Several researchers identified agricultural institutions such as research, extension, credit and marketing to be critical to agricultural development. For example Kauzeni, (1988) argued that the slow rate of adoption is frequently an indictment of project methodology rather than unwillingness of farmers to adopt the technology. He commented further that many projects have tended to perform poorly often because the people who are supposed to benefit were not consulted. This calls in,

the participation of farmers which Acherya and Vermal (1994), contended that is widely regarded as a desirable and necessary element for the successful design and implementation of rural development programmes. This is so because it enables people to be involved in making the decisions, suggestions and requests that could be integrated into the development programme.

SG2000 project can not escape this challenge since it literally introduced the technology without a prior assessment of the needs and problems of the beneficiaries. Its approach could be categorized as top-down approach where the scientists assume the central role in technology selection and transfer. Peter (1993), found further that skepticism and worries about the success of the project were among the reasons identified for low participation among farmers because they had seen in the past similar projects implemented by governments fail. This is also true for Dodoma farmers who had seen a number of projects poorly adopted such as grapevines production project, oxenization project and Mpwapwa breed multiplication project.

On the extension methodology, Mlozi and Mvena (1990), observed that the present process of transmitting technology is done bureaucratically,

hierarchically and is communicated downward hence hampering upward feedback and clarification of issues and insights from farmers. The SG2000 project involves farmers in field days, demonstrations, tours and it takes into consideration farmers' views during implementation. Again this is a credit to SG2000 project.

The selection of contact farmers by SG2000 project is closely related to the group extension approach. This approach makes use of village level social groups. The social groups are composed of people who are more closely associated with each other than with outsiders and who have developed special feelings of belonging together (Lionberger and Gwin, 1991). They further observed that members associated with each other in a casual yet meaningful face to face manner, have strong mutual concern for each other's welfare. It is from this observation that these authors argued that social groups are in excellent position to influence information communication and the adoption of new ideas and practices. They go further contending that social groups provide opportunities for farmers to talk matters over with those whom they intimately know and trust. This enables them to get information that they can not otherwise get and which is needed for deciding whether to accept or reject innovations.

In cases where farmers selection was keeping in mind the existence of social groups, communication was easy for SG2000, hence high adoption of the introduced technology.

Minde (1991) writing on credit commented that the perpetual low marginal returns and the inability to qualify for credit provided by lending institutions lead to a cyclic problem of lack of capital for farm investment. SG2000 project is commended for this as it provides inputs on credit to all farmers in the project without interest.

The process of giving credit to farmers by SG2000 involves the village extension staff in its delivery and recovery. The credit is given in terms of inputs and without interest. The project secures and delivers the credited inputs through the extension staff in each of the participating village. Although this is a better way of integrating the extension staff with farmers, Axinn and Thorat (1972), argued that the involvement of extension staff in regulatory activities reduces their time to concentrate on their basic role of the dissemination of knowledge and training of farmers on which they are employed. This makes extension workers to be more government oriented than farmer oriented. Nevertheless, it appears to facilitate the adoption process because access to credit is an important catalyst to adoption.

## 2.4 Environmental Characteristics

Environmental characteristics are derived from the influence of nature. They include biological conditions such as intensity of weeds, diseases and pests infestation, and climatic factors that includes rainfall pattern, temperature changes, drought and flooding, and soil factors such as slope, moisture content and texture. It further includes risk factors such as price changes and environmental changes. Kauzeni (1988), observed that environmental factors including climatic, edaphic or soil factors and prevailing pests and diseases differ from one geographical area to another even within short distances. This suggests that the "blanket" recommendations do not always apply for the entire country and must be adapted to suit local conditions if they are to be effective.

For example, the adoption of technology may be affected by weeds, diseases and insect pests prevalent in the area or in specific fields CIMMYT (1993). Therefore weed control techniques will be more or less appropriate depending on the weed population or the presence of a particular problem weeds in the field. Similarly, land quality and soil type may be important factors influencing the acceptance of a new technology. Not only many management practices differ by the type of soil, but other conditions such as slope or moisture retention capacity,

are often important as well. On the other hand, climatic factors play an obvious role in the management of farming systems. The possibility of drought or flooding makes farmers worry about investing in some technologies, (CIMMYT, 1993).

For Dodoma Region, environmental factors have a crucial importance in the adoption of technologies. The regional annual average rainfall ranges from 300 mm to 700 mm. Experience shows that soils are unworkable during the dry season. Some areas are water-logged and even flooded in rainy seasons. All these risky conditions of weather gives challenge to farmers, especially smallholder farmers who rarely afford risky technologies. The SG2000 project success is that it complies with the above observations because it allows flexibility and modifications to suit local conditions despite having developed a single package for the entire country.

## **2.5 Infrastructural Characteristics**

Agricultural development requires a "mix" of conditions such as good infrastructure, access to credit, water, land markets, relevant technologies and attractive prices of farm products (Kauzeni, 1988). So far, there is no developed market for the sorghum products. Reports in

the region show that farmers have no cash crop and hence depend on sales of surplus sorghum to meet family requirements. This lack of a cash crop results in low prices immediately after harvesting as everybody releases the output to the market. This is seen as a disincentive to production. Kauzeni (1988), lamented that lack of incentives to farmers or producers indirectly affects the performance of extension services. The agricultural productivity of farmers must be considerably increased to provide the marginal surplus for the economic and social development of the people. This will encourage farmers to adopt recommended farming practices in order to produce more. Unfortunately, SG2000 project have not assisted farmers on this issue.

It is further contended in CIMMYT (1993), that if an adoption study examines a number of different practices, in some cases different elements may be adopted independently, while in others there may be a sequential adoption pattern. Sometimes, certain elements will be adopted together, either because of biological complementarities between them or because farmers are provided with incentives such as credit.

Under SG2000 project, some technologies such as fertilizers were adopted because they were provided on credit. Withdrawal of credit when farmers phases out of the project may result in dropping the technology of fertilizer use as they may not afford, it may not be available or profitable to them .

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Location of the Study**

The study was conducted in Dodoma Rural district in Dodoma region. The district was selected based on the criteria developed which were wide distribution of sorghum production and the stage of development of the SG2000 project in areas concentrating on sorghum production. The selected district was among the first two to join the project where farmers adopted the sorghum variety, Tegemeo.

#### **3.2 Research Design**

The design of this study involved triangulation of sample survey and observations. A survey was used because survey studies are among the primary means of conducting descriptive research. Observations were also used to supplement the collected survey information. This is from the fact that, a triangulation of method has an advantage of establishing a strong case of relationships and correct information among variables by comparing the data of two or more methods (Bell, 1987).

### **3.3 Sampling Procedures**

#### **3.3.1 The Population**

The population of this study consisted of farmers who had been phased out of the SG2000 project and the respective village extension workers in Dodoma Rural district. The criteria for selecting villages were:

- (a) Villages in which farmers grow more sorghum than others and had similar ecological factors.
- (b) The number of years a village had stayed out of the project after being in the project for three continuous years. In this case three categories of villages (strata) were studied:
  - (a) Villages that had been phased out for three years
  - (b) Villages that had been phased out for two years, and
  - (c) Villages that had been phased out for one year

A preliminary survey (reconnaissance) was done in the district to establish the three strata suggested in the sampling procedures.

#### **3.3.2 The Sample**

Twelve villages were selected randomly from the list of 50 villages which met the criteria specified above. Four villages were picked from each of the three strata established. The sample was obtained by a

random sampling technique of 10 farmers from each of the 12 villages making a total of 120 farmers. The respective extension workers from the 12 selected villages were studied, but the study included other eight village extension workers from other villages in the project to make a total of 20 village extension workers. The eight extension workers were selected from a list of those extension workers who have worked with the SG2000 project for more than three years.

### **3.4 Instrumentation**

The following instruments were used to collect data for this study.

#### **3.4.1 Questionnaire**

##### **3.4.1.1 Questionnaire development**

Two structured questionnaires were developed and used as the instruments for data collection. These were the farmers' and extension workers' questionnaires respectively. The instruments were structured with closed and open-ended questions.

Farmers perceptions of the SG2000 innovations and approach were determined or measured by getting their opinions on the six package components of the project. An opinion scale on the

components was developed to study their compatibility, labour requirements, profitability, inputs costs, availability of inputs and appropriateness of technology. Furthermore, the extent of the use of participatory methods, for example involvement of farmers in technology development and giving feedbacks through dialogue was studied to give an indication of the farmers perception of the approach.

The Likert scales was used to determine the extent of adoption of the SG2000 package technologies which was obtained by scoring farmers practices on each of the package components. Total adoption ranged from a score of "4 to 6", while "0" indicated non-adoption and "1 to 3" indicated low adoption. Field observations supplemented the questionnaires on some of the adopted activities. To determine the effect of time on adoption, the extent of adoption was related to the time period of one, two, or three years strata under which a farmer has stayed out of the project.

The factors associated with adoption were obtained from the respondents by using questionnaire items. The questions were designed in a way that will facilitate the data by computer.

#### **3.4.1.2 Establishing Validity and reliability**

The first draft of the questionnaires was pre-tested at Buigiri village, one of the villages under the project. Ten farmers and two extension workers participated in the pretest. After pre-testing, the instruments were submitted to University experts, whose views were used to make necessary changes and produce the final draft of the questionnaires after establishing that the instrument gives a reliable and valid information for the research.

#### **3.4.2 Observations**

Observations concerning the use of SG2000 project packages, use of tools, draught power and farm yard manure were done. Since the interview was conducted at individual farmers homesteads, observations were also done at the same time. For example, whether a farmer had a plough, draught animals, and also the quantity of farm yard manure present in the animal shed. These were recorded in the researchers notebook indicating whether farmer interviewed had or hadn't used the technologies.

### **3.4.3 Documents and records**

Another source of data for this study was the official documents on the project, village and district records and regional reports which were made available to the researcher by the village, district and regional Agricultural and Livestock Development Offices. Also the SG2000 head office provided important documents. Information such as number of villages under SG2000, level of yields per acre under the project, modifications made in the packages, supply of inputs, and the number and distribution of stockist in the region were obtained from the aforementioned offices.

### **3.5 Data Collection Procedures**

Data collection was done by the researcher assisted by one local and experienced Ward Extension officer. This was done purposely to enable translation from the local language to Kiswahili (in case a farmer was not conversant in Kiswahili).

Observation were made in the farmers fields and households to see how field activities were performed, and whether the sorghum variety Tegemeo was grown. Credit forms, the farmers loan repayment lists were also observed at district and regional offices.

Informal interviews were also conducted with village leaders, district and regional agricultural development officers, district and regional coordinators of SG2000 project regarding the performance of SG2000 project in the project area verbally without using any interview schedule. The researcher was eager to how the project was perceived by other parties related to the project. The researcher also visited the project head office for more information regarding new developments in the programme and their experiences in the project implementation. A note book was used to record the discussions.

### **3.6 Data Analysis**

Data collected were verified, summarized and condensed from questionnaires and were entered into the personal computer for processing. Both analysis of single and multiple variables were done. A sub-programme "FREQUENCIES" was used for univariate analysis to obtain the variabilities and central tendencies of variables. A sub-program "CROSS-TABS" was used for bivariate analysis to determine the independence of time and other identified variables on adoption. All data were analyzed by PC-Computer SPSS programme at Sokoine University of Agriculture.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

This chapter discusses the results under four categories as follows: 1) respondents characteristics 2) the extent of adoption of technologies introduced by SG2000 project 3) factors associated with adoption of the introduced technologies; and the 4) farmers' perception of the SG2000 innovations and approach.

#### **4.1 Respondent's characteristics**

The preliminary step was to identify and describe farmers' characteristics. The characteristics studied were: farmers age, education level, gender, farm size and time after phasing out from the project.

##### **4.1.1 Age**

Farmers' age is among farmers characteristics that is often examined in adoption studies. The age of a farmer may influence adoption in many ways. It should be noted that under SG2000 project all farmers had equal chances of participation therefore, no age group had special treatment.

Table 1: Age distribution of respondents ( N=120 )

Age (Year)	Number	Percent
20 - 30	20	16.7
31 - 40	28	23.3
41 - 50	46	38.3
Above 50	26	21.7
<b>Total</b>	<b>120</b>	<b>100.0</b>

The results in Table 1 shows that 16.7% of the respondents were young, (20-30 years) while 61.6% (i.e 23.3 + 38.3%) were middle aged (31-50 years) and about 21.7% were old aged. Currently, the global emphasis is to include youths who account for large proportion of third world country's population in development projects. They are claimed to be educated, young and energetic but only that they don not have access to production resources. The involvement of only 17% of youths in the project is not a surprise because the traditional customs and values do not give chance to youths to have land. In addition very few youths are interested in farming.

#### 4.1.2 Education level

Many adoption studies examine the relation between a farmers' formal education and adoption behaviour. Education may make a farmer more receptive to advice from an extension worker or more able to deal with technical recommendations that require a certain level of literacy. Informal education may be important as well, and in some cases the attendance at training sessions organised by extension services such as demonstrations may also be crucial.

Table 2: Farmers distribution by education level ( N=120 )

Education level	Number	Percent
Primary school	85	70.8
Adult education	23	19.2
No education	12	10.0
<b>Total</b>	<b>120</b>	<b>100.0</b>

Observations from Table 2 indicate that the majority of respondents had the highest education level of primary school (70.8%) and the rest were below that education level. Although this education level could enable them to read and

write, it may not be very helpful in the adoption of technologies that require computations and comprehension of reading materials that demands skilful training. However, as documented earlier, SG2000 project strategy was to use a simple technology package which did not demand sophisticated computations.

#### 4.1.3 Gender

Women farmers are often forgotten in official agricultural statistics. Because women play a key role in agricultural systems, it is important that adoption studies consider the degree to which a new technology reaches women farmers (CIMMYT 1993). However, the selection of farmers under SG2000 project gave equal chances to both men and women to participate.

Table 3: Respondents' distribution by gender ( N=120 )

Gender	Number	Percent
Male	79	65.8
Female	41	34.2
Total	120	100.0

Table 3 shows that the sample comprised of women who stands at 34.2% and the rest were men (65.8%). Men show a greater representation than women in this case.

#### 4.1.4 Farm size

It is asserted by CIMMYT (1993), that sometimes a certain threshold of farm size is necessary before the investment in a technology is worthwhile. Sometimes, it is assumed that larger farmers conduct different management practices such as mechanization, prompting making specific recommendations which are more appropriate for them. On the other hand, certain technologies are more appropriate for labour intensive management characteristics of smallholder farms.

Table 4: The distribution of respondents' farm size ( N=115)

Farm size (acre)	Number.	Percent
4 - 6	48	88.0
Above 6	12	12.0
Total	115	100.0

The distribution of the respondents' farm sizes are given in Table 4. The table indicates that most farmers (88%) had farm sizes of less than six acres. Observations in the fields indicate that the majority of farmers practice mixed farming mainly for food crops.

When asked whether they have experienced food shortages before the project, 94.2% of farmers agreed; hence suggesting the existence of hunger among farmers before the project.

#### **4.1.5 Duration after the project**

Results in Table 5 show that most farmers has stayed out of the project for two and three years. Although the selected villages were grouped as four which had stayed out of the project for one year, another four villages for two years and another four for three years, the number of years after individual farmers had phased out is different. In this case, one can assume that some farmers had their villages phased out while they themselves had not completed the three year duration as required by the project.

Table 5: Distribution of respondents duration after the project (N=120)

No. of years	Number	Percent
1	30	25.2
2	50	42.0
3	40	32.8
Total	120	100.0

#### 4.2 The extent of adoption of technologies introduced by the project

During the project cycle, all farmers participated in demonstrations whereby all the six components of the package were tested at farmers' field known as MTP (Management Training Plot). This training took three years per village in which the project began with 10 farmers for the first year. In the second year more new farmers joined the project depending on the performance of the previous farmers. In the third year, the number of farmers increased but also depended on the performance in the second year. In this case, a village may begin with 10 farmers in the first year, 100 farmers in the second year and 200 in the third year if the performance in each year is good in terms of increased yields and rate of loan recovery.

It is important to note that when a village had been phased out, there were still farmers who had been in the project for one, two or three years depending on when the farmer joined the project.

In order to explore the extent of adoption of the introduced technologies farmers were asked to indicate whether they still use the six components of the package introduced by SG2000 project. The package comprised of 1) Tegemeo variety 2) tillage, 3) proper spacing 4) timely weeding 5) fertilizer use and 6) insecticide use.

#### **4.2.1 Adoption of introduced technologies**

Respondents were asked to indicate whether they adopted or not adopted each technology in the package. Their responses are presented in Table 6.

It is observed from Table 6 that Tegemeo variety was the most adopted technology followed by timely weeding, proper spacing and tillage. The table further shows that the remaining two technologies, that is, use of fertilizers and insecticides were the least adopted. Over 95% of the respondents indicated that they had not adopted the technologies.

Table 6: Percent of adoption of technologies introduced by SG2000 (N = 120)

Technology	Level of adoption			
	Adopted		Not Adopted	
	No.	PCT	No	PCT
1. Tegemeo variety	111	93.3	9	6.7
2. Timely weeding	101	87.1	19	12.9
3. Proper spacing	100	3.3	20	16.7
4. Tillage	96	80.7	24	19.3
5. Fertilizer use	5	4.2	115	95.8
6. Insecticide use	5	4.2	115	95.8
*7. Farm yard manure	62	52.1	58	47.9

\* Not part of package.

These results indicate that four technologies out of the six in the package were highly adopted after a three year training by SG2000 intervention in villages. This represents a 66.7% adoption rate. An interesting observation is that farmers were found to use farm yard manure although it was not part of SG2000 technology. This implies that farmers find cheaper alternative means of soil fertility than the introduced artificial fertilizers. Again this illuminates the importance of involving technology user in its development.

#### 4.2.2 The effect of time after phasing out on adoption

The purpose of the study in this section was to determine whether there was continued adoption after farmers in the project villages were phased out.

The proposed hypothesis that the continued use of the promoted technologies was independent of the time a farmer has stayed out of the project was tested by the chi-square statistic. Results presented in Table 7 indicate that there is enough evidence to reject the hypothesis and establish that a relationship exists between the time a farmer has stayed out and the adoption of Tegemeo (Chi-square = 11.28, df = 2,  $p < .01$ ) and non-adoption of fertilizers and insecticides (Chi-square = 15.4, df = 2,  $p < .01$ ). The relationship is positive with Tegemeo since it is high yielding and drought tolerant, while it is negative to fertilizers since they are costly and often unavailable.

Table 7: Relationship between years a village has phased out to adoption percentage for each of the six packages N=119 (%)

Adoption	Years after phasing out				X <sup>2</sup> value	X <sup>2</sup> prob.
	1	2	3	Total		
<b>Tegemeo variety</b>						
Adopted	24 (20.2)	38 (31.9)	49 (41.1)	111 (93.3)	11.82	0.0053 <sup>***</sup>
Not adopted	6 (5.0)	1 (0.8)	1 (0.8)	8 (6.6)		
<b>Tillage</b>						
Adopted	23 (19.3)	40 (33.6)	33 (27.7)	96 (80.6)	0.13	0.93
Not adopted	6 (5.0)	10 (8.4)	7 (5.9)	23 (19.4)		
<b>Spacing</b>						
Adopted	23 (19.3)	43 (36.1)	34 (28.6)	100 (84.0)	1.29	0.5
Not adopted	7 (6.0)	6 (5.0)	6 (5.0)	19 (16.0)		
<b>Weeding</b>						
Adopted	28 (23.6)	39 (32.8)	37 (31.1)	104 (87.5)	1.6	0.44
Not adopted	5 (4.2)	7 (5.9)	3 (2.4)	15 (12.5)		
<b>Fertilizer</b>						
Adopted	5 (4.2)	0 (0.0)	0 (0.0)	5 (4.2)	15.4	0.04 <sup>*</sup>
Not adopted	25 (21.0)	39 (32.8)	50 (42.0)	114 (95.8)		
<b>Insecticides</b>						
Adopted	1 (0.8)	0 (0.0)	4 (3.4)	5 (4.2)	5.8	0.05 <sup>*</sup>
Not adopted	29 (24.5)	35 (29.4)	50 (42.0)	114 (95.8)		

The results in Table 7 shows a variation of statistical significance among the six technologies in relation to the hypothesis. They further indicate that generally, farmers who had stayed out of the project longer had the highest adoption percentage of Tegemeo variety than the newly phased out farmers. The data indicate that farmers who had stayed out for one year had an adoption percentage of 20.2% while for those who had stayed out for longer time two and three years have adoption percentages of 31.9% and 41.1 respectively. The results show an interesting phenomenon that with time, farmers continued to use the technology and new farmers evaluate the packages and eventually adopted. This phenomenon resembles the aforementioned logistic adoption s-shaped curve in which there is slow initial growth in the use of a new technology, followed by a rapid increase, and then slowing down as the cumulative proportion of adoption approaches its maximum(CIMMYT 1993).

The table shows further that fertilizers and insecticides had consistently not been adopted by farmers as evidenced by the very low percentages of adoption. In actual fact fertilizers were completely abandoned after year one.

Table 8: Reasons for the non-adoption of fertilizers and insecticides (N = 119)

Reason	Fertilizers		Insecticides	
	No.	%	No.	%
Insecticides are not available	-	-	104	89.7
Expensive	101	88.6	97	84.3
Lack of credit	79	69.9	-	-
Difficult to apply	39	48.1	-	-
Fertilizer not needed	49	43.4	-	-
Side effects	-	-	36	30.8

The reasons for the non-adoption and/or continued use of fertilizers and insecticides are given in Table 8. For both technologies the cost element, unavailability and lack of credit emerged as strong reasons preventing farmers from adoption and/or continued use. However, a good proportion of farmers were found to use farm yard manure as an alternative to fertilizers.

These results are in line with Benad (1988), and Mvena and Mattee (1988) who commented that not all farmers in the world adopt complete package. Benad (1988) argued further that if some parts of a technology are accepted and others rejected, then the reasons for rejection have to be traced in the characteristics of the innovation rather than farmers' attitudes.

By considering the aforementioned trend that farmers adoption increase with time a farmer has stayed out of the project, one can predict the future of the advocated technologies since farmers take time to try out and evaluate the technologies before they reach a decision to adopt or reject. It is possible that farmers may re-adopt the packages when they see them fit or may modify the technologies to suit their conditions. This conforms with CIMMYT (1993) assertion that although recommendations may be presented to farmers as a package of several practices some components may be adopted first and others later; and some may never find wide spread acceptance. It should be born in mind that individual components may be adopted at different times under different conditions.

#### **4.3 FACTORS ASSOCIATED WITH ADOPTION OF INTRODUCED TECHNOLOGIES**

The purpose in this section was to investigate the extent to which the identified factors influenced the adoption of the technological packages introduced by the SG2000 project. Factors identified and investigated were: farmers' characteristics, innovation characteristics, and institutional characteristics.

##### **4.3.1 Farmers' characteristics**

As mentioned in the literature review chapter of this report, one of the influencing factors on the adoption of technologies is farmers characteristics.

Under this factor the demographic and socio-psychological factors were studied.

#### **4.3.1.1 Demographic factors**

The variables of age, education level, gender and farm size of respondents were investigated to determine their association with the adoption of technologies.

##### **a) Age**

It is sometimes unlikely that the demonstration of a relation between age and adoption will be of immediate importance. However, it could be of interest to examine if the association with age is more a reflection of characteristics of the farm household that includes access to resources, labour availability or source of income.

Results of the relationship between age and adoption of each of the six technologies are presented in Table 9. The results show that statistical association between farmers' age and adoption of five technologies was not significant. However, there was a statistical significance between age and the adoption of weeding technology (Chi-square = 10.5,  $df = 3$ ,  $p = .01$ ). The age group between 41-50 years appear to have adopted more the weeding technology than any other group.

Table 9: Relationship between age and adoption of the six SG2000 technologies (N = 119)

Age (Yrs)	Adoption of Six Technologies N (%)											
	Tegemeo var.		Tillage		Weeding		Spacing		Fertilizer		Insecticide	
	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not ado.
20-30	19 (16.0)	1 (0.8)	14 (11.8)	6 (5.0)	13 (10.9)	7 (6.0)	16 (13.4)	4 (3.4)	1 (0.8)	19 (16.0)	1 (0.8)	19 (16.0)
31-40	24 (20.2)	4 (3.4)	21 (17.6)	7 (6.0)	26 (21.8)	2 (1.7)	20 (16.8)	8 (6.7)	0 (0.0)	27 (22.7)	2 (1.7)	26 (21.8)
41-50	44 (36.9)	1 (0.8)	40 (33.6)	5 (4.2)	40 (33.6)	4 (3.4)	40 (33.6)	6 (5.0)	3 (2.5)	43 (36.1)	2 (1.7)	44 (37.0)
> 50	24 (20.2)	2 (1.7)	21 (17.6)	5 (4.2)	25 (21.0)	2 (1.7)	24 (20.2)	1 (0.8)	1 (0.8)	25 (21.0)	0 (0.0)	25 (21.0)
Total	111 (93.3)	8 (6.7)	96 (80.7)	23 (19.3)	104 (87.4)	15 (12.6)	100 (84.0)	19 (16.0)	5 (4.2)	114 (95.8)	5 (4.2)	114 (95.8)
X <sup>2</sup>	4.4		3.9		10.5		4.9		1.8		1.7	
df	3		3		3		3		3		3	
Sign.	0.24		0.26		0.01**		0.17		0.6		0.62	

Although the relationship between age and other technologies in the package did not show any significant differences, old farmers above 40 years have higher adoption percentages than young farmers below 40 years of age. Based on these results, we can conclude that older farmers may be having more experience, resources, or authority that could give them possibilities for trying a new technology. However, since the adoption of five technologies is independent of age, the adoption rate of young farmers might be because they had more schooling than older generation or perhaps have been exposed to new idea as migrant labourers (CIMMYT, 1993).

**b) Educational level**

The proposed hypothesis that the adoption rate of the SG2000 technological package is independent of farmers educational level was tested by chi-square statistic. From the results presented in Table 10, we fail to reject hypothesis among the package of all six technologies. However since the highest level of education attained was primary education, it does not distinguish farmers very much from those without formal education at all especially in technical recommendations that require very little formal schooling skills such as simple arithmetic to determine dosage of herbicides. The technology advocated by SG2000 did not need formal education to practice.

Table 10: Relationship between education level and adoption of SG2000 technologies (N = 119)

Educ level	Adoption of Six Technologies N (%)											
	Tegemeo var.		Tillage		Weeding		Spacing		Fertilizer		Insecticide	
	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not ado.
Pr. sch	80	51	70	15	69	14	68	17	2	83	3	81
	(67.2)	(42.9)	(58.8)	(12.6)	(58.1)	(11.8)	(57.1)	(14.2)	(1.7)	(69.7)	(2.5)	(68.0)
Adult educ.	19	3	18	5	23	1	20	3	2	20	1	22
	(16.0)	(2.5)	(15.1)	(4.2)	(19.3)	(0.8)	(16.8)	(2.5)	(1.7)	(16.8)	(0.8)	(18.4)
No edu	12	0	8	3	12	0	12	0	1	11	1	11
	(10.0)	(0.0)	(6.7)	(2.5)	(10.1)	(0.0)	(10.1)	(0.0)	(0.8)	(9.2)	(0.8)	(9.2)
Total	111	8	96	23	104	15	100	19	5	114	5	114
	(93.3)	(6.7)	(80.7)	(19.3)	(87.4)	(12.6)	(84.0)	(16.0)	(4.2)	(95.8)	(4.2)	(95.8)
X <sup>2</sup>	2.6		0.6		4.16		3.2		2.5		0.5	
df	2		2		2		2		2		2	
Sign.	0.26		0.7		0.12		0.19		0.28		0.74	

CIMMYT (1993) contended that the adoption of a new variety among farmers may not depend at all on their education level, while the adoption of a chemical inputs (if needs computations) may be rapid among farmers who have a certain minimum level of education. The critical minimum level in SG2000 project may be assumed to be the basic functional literacy which many respondents seemed to had.

**c) Gender**

The relationship between the respondents' gender and adoption of the six technologies was also tested by the Chi-square statistic for independence.

The result in Table 11 reveals that five technologies showed no statistical difference in the adoption of technologies between women and men. The only statistical difference was observed in the insecticides use. Where as all men indicated to have not adopted, 100% of women interviewed indicated to have adopted it. However, percentagewise women slightly overscored men in about five technologies. The results confirm the fact that women play a key role in most agricultural systems. Since they are involved practically in all farm activities, they may have high levels of adoption compared to men who may have some other non-farm activities.

Table 11: Relationship of gender and adoption of six packages (N = 119)

Gender	Adoption of Six Technologies N (%)											
	Tegemeo var.		Tillage		Weeding		Spacing		Fertilizer		Insecticide	
	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not ado.
Male	71 (59.7)	7 (6.0)	63 (52.9)	16 (13.4)	68 (57.1)	7 (6.0)	64 (53.8)	15 (12.6)	2 (1.7)	76 (63.9)	0 (0.0)	78 (65.5)
Female	40 (33.6)	1 (0.8)	33 (27.7)	7 (6.0)	36 (30.2)	8 (6.7)	36 (30.2)	4 (3.4)	3 (2.5)	38 (31.9)	5 (4.2)	36 (30.2)
Total	111 (93.3)	8 (6.7)	96 (80.7)	23 (19.3)	104 (87.4)	15 (12.6)	100 (83.3)	19 (16.7)	5 (4.2)	114 (95.8)	5 (4.2)	114 (95.8)
X <sup>2</sup>	1.8		0.12		2.43		0.47		0.55		9.9	
df	1		1		1		1		1		1	
Sign.	0.33		0.9		0.20		0.49		0.45		0.0016**	

**(d) Farm size and its association to adoption rate of technologies**

Farm size is a common variable examined in adoption studies and is often a good indicator of wealth. It is often assumed that larger-scale farmers will be more likely to adopt a technology especially if the innovation requires an extra cash investment. The influence of farm size on the adoption rate was tested by the chi-square statistical test for independence.

Based on the results presented in Table 12, we fail to reject the hypothesis that the adoption of the five technologies is independent of the farm size. That is the influence of farm size on Tegemeo variety, tillage, spacing, weeding and fertilizer use was not statistically significant.

However the same table shows that there is enough evidence to reject the hypothesis that adoption of insecticides was independent of farm size. The chi-square test was highly significant (Chi-square = 6, df = 2,  $p = .004$ ) indicating that non-adoption of insecticides is dependent of farm size. Small farm sizes abandoned insecticides use (55%) than large size farms (8%) as show in Table 12.

Table 12: The relationship between farm size and adoption of the six technologies (N = 116) df = 2

Adoption	Farm size (acres)			Total	X <sup>2</sup> value	X <sup>2</sup> prob.
	1 - 3	4 - 6	>6			
<b>Tegemeo variety</b>						
Adopted	51 (43.9)	44 (37.9)	13 (11.2)	108 (93.1)	1.12	0.56
Not adopted	4 (3.4)	4 (3.4)	0 (0.0)	8 (6.9)		
<b>Tillage</b>						
Adopted	44 (37.9)	41 (34.5)	9 (7.8)	94 (81.0)	3.7	0.1
Not adopted	11 (9.5)	6 (5.1)	5 (4.3)	22 (19.0)		
<b>Spacing</b>						
Adopted	43 (37.0)	41 (34.5)	14 (12.0)	98 (84.5)	4.06	0.13
Not adopted	12 (10.3)	8 (6.9)	0 (0.0)	18 (15.5)		
<b>Weeding</b>						
Adopted	43 (37.0)	41 (34.5)	14 (12.0)	98 (84.5)	5.2	0.07
Not adopted	11 (9.5)	6 (5.1)	0 (0.0)	18 (15.5)		
<b>Fertilizer</b>						
Adopted	0 (0.0)	4 (3.4)	1 (0.8)	5 (4.3)	4.7	0.09
Not adopted	54 (46.6)	46 (39.7)	11 (9.5)	111 (95.7)		
<b>Insecticides</b>						
Adopted	0 (0.0)	3 (2.5)	2 (1.7)	5 (4.3)	6.2	0.04
Not adopted	55 (47.4)	48 (41.4)	8 (6.9)	111 (95.7)		

These results leads to a speculation that farmers think that their small farms are unprofitable to use insecticides since the incremental yields may not cover the added costs. However, a close examination of the table indicates that insecticides were not widely adopted.

The same issue can be attributed to risk and uncertainties in farming conditions. Since farmers in the study area have small plots, it is possible that the non-use of insecticides gives them a relief of the uncertain returns. This goes in line with the fact that smallholder farmers are less wealthier and hence are risk averters.

#### **4.3.1.2 Socio-psychological factors**

These are factors which influence the farmers' minds in deciding whether to adopt or not. They include motivation, and satisfaction of social needs. Farmers may adopt a certain technology if they are motivated, for example by providing credits, and by solving problems according to their needs. This study investigated how the SG2000 project motivation variables such as increase in yield per area, (which was a result of demonstrations) and provision of credit to see how they influenced the adoption of the packages involved. Farmers were asked to give their opinions on how the project helped them to attain food sufficiency.

Table 13: Responses on how SG2000 motivated farmers to achieve food sufficiency ( N=120)

Motive	Response in %	
	Yes	No
1. Increase yield/acre	98.3	1.7
2. Provision of credit	88.9	10.7
3. Provision of drought tolerant variety	62.4	37.6
4. Training of good agronomical husbandry	55.8	43.2

Table 13 shows the response of farmers on how SG2000 motivated them to solve their chronic hunger problems. The majority (98.3%) strongly agreed that through demonstration the project helped them to increase yield per area, 88.9% appreciated the provision inputs at farm gate on credit and 62.4% appreciated the new variety for its tolerance to drought.

During the SG2000 project every cooperating farmer had one acre under MTP where demonstrations were conducted by the extension agent. All activities from land clearance to harvesting were done by a farmer himself/herself. The increased yield, therefore, was a result of

the farmer's efforts following SG2000 demonstrations on the field. The influence of demonstration that resulted in increased yield which motivated farmers to adopt will be discussed later under institutional factors together with the provision of credit. Provision of a drought tolerant variety will be discussed under the section of innovation factors.

#### **4.3.2 Innovation factors**

The innovation factors studied were, variety tolerance to disease and drought, labour requirement, farm equipment and tools.

##### **4.3.2.1 Variety tolerance to drought and diseases**

It was previously mentioned in this study that the variety Tegemeo has gained strong importance among farmers interviewed. Farmers were asked if they believed that Tegemeo variety was tolerant to drought and if they had adopted the variety from that belief.

The results in Table 14 show that the variety Tegemeo is strongly accepted with total 93.3% of the farmers interviewed. This means that the majority of farmers agreed that the variety is tolerant to drought. Again almost all farmers have adopted it except nine farmers out of the 120 interviewed. With this evidence, it seems that the widespread of the variety among farmers confirms the close dependence of its adoption to its tolerance to drought.

Table 14: Influence of Tegemeo variety tolerance to drought to adoption in percentage (N = 120)

Response to tolerance	Adopted		Not adopted	
	No.	%	No.	%
Tolerant	111	93.3	9	6.7
Not tolerant	-	-	-	-

Table 15 indicates that about 72% of the respondents who adopted the Tegemeo variety disagreed that tegemeo variety was tolerant to diseases. This from the fact that a variety may be drought tolerant but may not necessarily be disease tolerant. Farmers evaluate which quality they like most for adoption. From this percentage we can ascertain that the adoption of tegemeo was not influenced by tolerance to diseases of the variety.

Table 15: Influence of Tegemeo variety resistance to diseases to adoption in percentage (N=119)

Disease tolerance	Adoption of tegemeo		Total
	Adopted	Not adopted	
Resistant	23 (19.3)	-	23 (19.3)
Neutral	8 (6.7)	-	8 (6.7)
Not resistant	80 (67.2)	8 (6.7)	88 (73.9)
Total	111 (93.3)	8 (6.7)	119 (100.0)

By relating the two tables (14 and 15 ) we can conclude that although 74.0% of farmers said that the variety is susceptible to diseases, they ignored this factor in favour of the tolerance to drought characteristics. These findings confirm Rogers (1983), assertion that technologies that are easily observable, triable and compatible are easily adopted. The performance of Tegemeo variety in the fields is obvious and it leads to high yields. Since the major problem in this area on food production is drought, any

technology that addresses this problem by giving a variety to suit their environment will most likely be adopted.

#### **4.3.2.2 Labour requirements**

Technologies have different labour requirement characteristics. Some reduce the amount of labour required, while others significantly increase it. In this study, labour implications of each technology were examined. Farmers were asked to indicate whether the adoption of tillage and spacing were influenced by labour requirements. The findings are presented in Tables 16 and 17. The majority of respondents indicated that although they adopted tillage and spacing technologies, they believed that the activities were labour intensive. About 90% and 69% adopted SG2000 spacing and tillage technologies respectively despite their high demand for labour.

Table 16: The influence of labour requirement on the adoption of tillage in percentages (N=119)

Labour requirement	Adopted	Adoption N/% Not adopted	Total
<b>Tillage</b>			
Intensive	86 (72.3)	22 (18.5)	108 (90.8)
Neutral	5 (4.2)	-	5 (4.2)
Not intensive	5 (4.2)	1 (0.8)	6 (5.0)
Total	96 (80.7)	23 (19.3)	119 (100.0)

Practically, farmers from the study area are used to zero tillage and broadcasting sorghum seeds. These activities to them require minimum labour. It is therefore true that the implementation of the two technologies will result in labour increase. However, the effect is not so strong to limit the adoption of these technologies. A possible reason for adoption may be because they have small plots on which the family labour is enough to adopt the two technologies. The increased benefits due to increased yields may be important to justify the added labour requirement on adopting the technologies.

Table 17: Influence of labour requirement on adoption of spacing (N=120)

Labour requirement	Adoption of spacing		Total
	Adopted	Not adopted	
Labour intensive	69 (57.5)	14 (11.7)	83 (69.2)
Undecided	7 (5.8)	1 (0.8)	8 (6.7)
Not labour intensive	24 (20.0)	5 (4.2)	29 (24.2)
Total	100 (83.3)	20 (16.7)	120 (100.0)

#### 4.3.2.3 Inferior equipment

Farmers' ownership of equipment or machinery may influence their ability to adopt a technology. Farmers responses indicated in Table 18 show that the status of farm equipment did not influence the adoption of tillage and weeding. However, 99% of all respondents who adopted the two technologies agree that the equipments used were inferior. These findings should not be surprising because the hand-hoe was found to be the most used farm tool.

Table 18: Influence of inferior equipments on the adoption of timely weeding and tillage (N=119)

Adoption	Inferior	Not inferior	Total	X <sup>2</sup> value	X <sup>2</sup> prob
<b>Tillage</b>					
Adopted	95 (79.8)	1 (0.8)	96 (80.6)	0.00	1.00
Non-adopted	23 (19.3)	0 (0.0)	23 (19.3)		
<b>Weeding</b>					
Adopted	100 (84.0)	4 (3.4)	104 (87.4)	0.00	1.00
Non-adopted	15 (12.9)	0 (0.0)	15 (12.9)		

#### 4.3.3 Institutional factors

As indicated in the literature review of this report, institutional characteristics are derived from those publicly and privately operated systems for providing support services such as extension, research, credit, input supply and markets. The relationship between adoption of technologies and some institutional factors were also investigated.

#### **4.3.3.1 Relationship between credit and adoption of technologies**

It was mentioned earlier in this study that all cooperating farmers under the SG2000 project were provided with inputs such as improved Tegemeo variety seeds, fertilizers and insecticides on credit. Also all cooperating farmers were asked to adhere to extension workers' advises to implement all the six technologies. After harvesting a farmer was supposed to repay the loan either in kind or in monetary terms. It seems that a mere provision of credit in time worked as a motivation for farmers to adopt the technologies for increased yield.

##### **Credit as a motivation variable**

The hypothesis that credit as a motivating factor influenced the adoption of four technologies was not rejected (Table 19). However, by percentage, it can be deduced that motivation by provision of credit was among the factors that partly influenced the adoption of the four adopted technologies. For example, in the case of Tegemeo variety, 90.7% out of the respondents who adopted the variety indicated to have been motivated by the credit provided.

Table 19: Relationship between credit as a motivation and adoption of the four adopted technologies (N=116)

Adoption	Credit as motivation			X <sup>2</sup> value	X <sup>2</sup> Prob
	Motivated	Not motivated	Total		
<b>Tegemeo variety</b>					
Adopted	98 (84.5)	10 (8.6)	108 (93.1)	2	0.36
Non-adopted	6 (5.2)	2 (1.7)	8 (6.9)		
<b>Tillage</b>					
Adopted	83 (71.6)	11 (9.4)	94 (81.0)	5.2	0.075
Non-adopted	21 (18.1)	1 (0.8)	22 (18.9)		
<b>Spacing</b>					
Adopted	86 (74.1)	11 (9.4)	92 (79.3)	5.5	0.06
Non-adopted	18 (15.5)	8 (4.1)	24 (20.7)		
<b>Weeding</b>					
Adopted	89 (76.7)	9 (7.8)	98 (84.5)	1.7	0.42
Not adopted	12 (10.3)	6 (5.2)	18 (15.5)		

An examination on other technologies adopted such as tillage, spacing and weeding show the same trend in the same table.

On the other hand, less than 11% of the respondents in each technology who adopted the technologies indicated to have not been motivated by the credit provided. These results may lead the researcher to believe that by tying the credit to the joining instructions to each cooperating farmer for about three years under the project motivated farmers to adopt these four packages. Their need for credit led them to adopt these technologies so that they could increase yields which in turn enabled them to repay the loan after harvesting. Also, their need for credit led them to adhere to extension workers advise which insisted on the condition to implement the whole package of technologies in order to qualify for credit on the next season. It was therefore this repeated use of the technologies that have influenced the adoption.

A logical argument is that since the respondents were no longer receiving credit at the time of the interview (have been phased out), it can be see how important the credit was to fertilizers than to Tegemeo variety seeds. Farmers agreed strongly that credit was useful. Its withdrawal may have rendered farmers unable to

buy fertilizers due to lack of funds. However, farmers adopted the Tegemeo variety despite the withdrawal of credit since they could select the seed from their produce without necessarily buying new ones. It should be remembered that even farm yard manure was used to substitute fertilizers.

#### **4.3.3.2 The influence of Extension services on adoption of technologies**

Farmers were asked to give their opinions on how effective the extension services were rendered to them. The relationship between the variable and adoption of technologies was analyzed. Results in Table 20 indicate that about 94.6% of respondents who have adopted Tegemeo variety agree that extension service is educative and had influenced them to adopt. The same table shows that in each technology more than 90% of farmers who adopted believe that the demonstration as a strategy of extension was educative and contributed substantially to the adoption of four technologies adopted namely Tegemeo variety, tillage, timely weeding, and proper spacing. Even the respondents who did not adopt fertilizers and insecticides appreciate that demonstration was educative. It is therefore, have good evidenced and concluded that adoption of the variety was partly due to the educativeness of the demonstration extension approach.

Table 20: Influence of demonstration method to the adoption of technologies in percentage (N=119)

Adoption	Educative		Demonstration Not Educative		Total	
	No.	PCT	No.	PCT	No.	PCT
<b>Tegemeo variety</b>						
Adopted	105	94.6	6	5.4	111	93.3
Not adopted	8	100.0	0	0.0	8	6.7
<b>Tillage</b>						
Adopted	93	96.9	3	3.1	96	80.7
Not adopted	20	87.0	3	13.0	23	19.3
<b>Spacing</b>						
Adopted	94	94.0	6	6.0	100	83.3
Not adopted	20	100.0	0	0.0	20	16.7
<b>Weeding</b>						
Adopted	96	95.0	5	5.0	101	87.1
Not adopted	15	100.0	0	0.0	15	12.9
<b>Fertilizer use</b>						
Adopted	5	100.0	0	0.0	5	4.2
Not adopted	108	94.7	6	5.3	114	95.8
<b>Insecticides</b>						
Adopted	5	100.0	0	0.0	5	4.2
Not adopted	108	94.7	6	5.3	114	95.8

#### 4.3.3.3 Influence of Inputs supply on adoption of technologies

Farmers were trained to use inputs such as improved Tegemeo variety seeds, fertilizer and insecticides. An investigation to determine whether the supply of these inputs influenced their adoption of the package was carried out.

Table 21: Influence of input supply to the adoption of fertilizers and insecticides (N=118) N/%

Adoption category	Supply of Inputs			
	Unreliable	Undecided	Reliable	Total
<b>Fertilizer</b>				
Adopted	4 (3.6)	0 (0.0)	1 (0.8)	5 (4.2)
Not adopted	107 (90.6)	3 (2.5)	3 (2.5)	113 (95.8)
<b>Insecticide</b>				
Adopted	3 (2.5)	2 (1.7)	0 (0.0)	5 (4.2)
Not adopted	112 (94.9)	0 (0.0)	1 (0.8)	113 (95.8)

Table 21 shows that 90.6% and 94.9% of respondents indicated that unreliable supply of fertilizers and insecticides also contributed to the non-adoption or drop out of these technologies. This is inspite of the high prices mentioned earlier.

Table 22: Input supply with and without SG2000 (N=120)

Period	Suppliers in %							
	Stockist		Neighbors		B/shamba		No supply	
	No	PCT	No	PCT	No.	PCT	No.	PCT
Supply before	1	0.8	3	2.5	0	0.0	115	95.8
Supply with	0	0.0	0	0.0	119	100.0	0	0.0
Supply after	3	1.7	1	0.8	0	0.0	116	97.5

Table 22 further substantiates the general situation in the study area of lack of elaborate supply system of inputs supply. The results shows that before SG2000 project 95.8% of respondents had no fertilizer supply but during the project all respondents (100%) got their fertilizer supply from SG2000. However, after the project, 97.5% of the farmers in the sample indicated to have

no supply of inputs. This is taken to be a sad precedence because the project seems to phase out without establishing an elaborate system to supply inputs to farmers. Farmers were made to believe that the project is a supplier of inputs for a long time. The project withdrawal seems to leave an input supply gap that may further jeopardise the continued use of inputs.

#### 4.3.3.4 Influence of availability of market to the adoption of technologies

The existence and type of markets to both local and Tegemeo sorghum varieties was also studied to identify its influence on adoption.

Table 23: Market availability and channels for both Tegemeo and local sorghum varieties (N=120)

Variety	Markets in N %			
	Neighbour		Business	
	Available	Not available	Available	Not available
Tegemeo variety	33 (27.5)	84 (70.0)	3 (2.5)	0 (0.0)
Local sorghum	25 (20.8)	95 (79.2)	0 (0.0)	0 (0.0)

The results in Table 23 show that there is no ready market for the local and Tegemeo varieties as indicated by low percentages of 20.8% and 27.5% respectively. The table shows further that the existing channels are through parallel markets of neighbors and to a small extent some businessmen. These markets absorb very little quantities.

It should be noted that adoption of a new technology can be hindered or enhanced depending on whether it is in accordance with the past utilization and marketing system. For example CIMMYT, (1993) observed that a technology may lead to increase in crop production, but if the extra production cannot be utilized or marketed effectively, that technology may be rejected. Results in Table 24 show the relationship of market availability and its influence on the adoption of the technologies advocated by SG2000. It is noted from the results that there is no enough evidence to reject the hypothesis that the adoption of the Tegemeo variety is independent of markets. On this ground, it is concluded that the adoption of this technology is independent of the availability or non-availability of markets. Even the levels of percentage on the same table favours this criterion.

Table 24: Influence of market availability to the adoption of six technologies (N=117)

Market availability	Adoption of six technologies N (%)											
	Tegemeo var.		Tillage		Weeding		Spacing		Fertilizer		Insecticide	
	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop	Adop	Not adop
Available	34	0	27	6	29	3	29	4	2	32	5	29
	(29.0)	(0.0)	(23.0)	(5.1)	(24.8)	(2.6)	(24.8)	(3.4)	(1.7)	(27.3)	(4.3)	(24.7)
Not available	75	8	66	17	71	14	69	15	3	80	3	80
	(64.1)	(6.8)	(56.4)	(14.5)	(60.7)	(11.9)	(58.9)	(712.8)	(2.6)	(68.3)	(2.6)	(68.3)
Total	109	8	94	23	100	17	98	19	5	112	8	109
	(93.2)	(6.8)	(80.3)	(19.6)	(85.5)	(14.5)	(83.8)	(16.2)	(4.3)	(95.7)	(6.8)	(93.1)
Chi-square	3.5		0.32		0.47		0.32		0.39		13.29	
df	2		2		2		2		2		2	
Significance	0.17		0.84		0.79		0.84		0.82		0.0013	

For example, a total of 68.9% respondents who adopted tegemeo variety indicated that they had no market for their produce. These results show that although there is no market for the produced sorghum, farmers do still adopt the technologies such as Tegemeo variety.

However, results in the same table on the two non-adopted packages namely fertilizer and insecticides which together can be termed money oriented packages, show a different relation with market availability. Adoption of insecticides seem to show enough evidence to reject the null hypothesis at 0.05 significance level hence speculating that perhaps the unavailability of markets for the produced sorghum influenced the non-adoption of pesticides. Again results for fertilizer use on the same table seem to follow the same trend. Percentages show that 71.4% of respondents who did not adopt fertilizer use had no market for their sorghum. Almost 74.1% respondents who did not adopt insecticides did not have market for sorghum.

In general, the adoption of money oriented packages depends on the availability of market since farmers have to sell some of their

produce to the market to get money to buy these inputs for the next season. For labour intensive packages farmers would adopt these packages to fulfil their food needs that do not depend on markets. This conforms with CIMMYT (1993) assertion that if the technology is under-utilized because of problems with input or product markets, then the results of adoption study may be used to demonstrate to policy-makers the advantages of improving these markets.

#### **4.4 FARMERS' PERCEPTIONS OF THE SG2000 INNOVATION AND APPROACH**

The perception of farmers on the six technologies of the SG2000 package in general were obtained using an opinion scale. The results obtained are given below.

##### **4.4.1 Farmers' perceptions on SG2000 innovation**

The investigated variables included the labour requirements, compatibility, comparison with past experience, increasing yield, appropriateness, need for modification, effectiveness of services and usefulness of credit.

The results in Table 25 show that in general, 99% of the respondents

felt that the innovations was labour intensive. This is because they were used to zero tillage, less frequent weeding and planting by broadcasting. However, 55% of the respondents view the innovation as compatible to their farming systems. This comment indicates that farmers are willing to adopt the package although it is new to them. Farmers have therefore seen the importance of the innovation as compared to the non-project era. Furthermore the package was seen appropriate by 58.8% although 92.4% of farmers called for modification in some technologies . The SG2000 project is hailed for being effective and timely in the delivery of services such as training, credit, and supervision. Almost 99% of farmers acknowledged these services.

#### **4.4.2 Farmers perception on SG2000 innovations**

The SG2000 innovation included six packages as follows; Tegemeo variety, tillage, proper spacing, timely weeding, use of fertilizers and use of insecticides.

##### **4.4.1.1 Tegemeo variety**

This is an improved sorghum variety. Results in Table 25 show that 100% of the respondents agreed that the variety is tolerant to drought and has solved the critical need of food sufficiency. However, 74% of them indicated that the variety was susceptible to diseases.

Table 25: Respondents perceptions of the SG2000 innovations and approach (N=120)

Innovations and approach	Responses in %		
	Agree	Undecided	Disagree
Innovation is laborious	90.9	4.2	5.0
Innovation is incompatible	23.3	21.7	55.0
Past experience is better	27.5	9.2	63.4
Innovation increase yield	100.0	-	-
Technology is appropriate	23.	17.6	58.8
Some packages inappropriate	87.4	4.2	8.4
Technology needs modification	92.4	3.4	4.2
SG2000 is effective & timely	95.8	1.7	2.5
Credit is useful	98.3	-	
Teaching methods effective			
Teg. var. drought tolerant			
Var. disease tolerant			
Tillage is labour intensive			
Tillage past exp. is better			
Tillage equips. are inferior			
Planting in lines is laborious			
Timely weeding is difficult			
Fertility is not a problem			
Fertilizer prices are high			
Fertilizer supply is unreliab.			
Chemicals are costly			
Disease.& pests not a problem			
Chemical app.is not understood			

98.4	-	1.6
100.0	-	-
19.2	6.7	74.2
90.9	4.2	5.0
27.5	9.2	63.4
99.1	0.1	0.8
69.1	6.7	24.2
66.4	4.2	29.4
15.1	1.7	83.2
99.1	-	0.8
94.1	2.5	3.4
97.4	1.7	0.8
14.4	6.8	78.8
5.0	4.2	89.9

#### 4.4.1.2 Tillage

As it was mentioned earlier, tillage was perceived as being labour intensive. The results can be interpreted better by using knowledge of their indigenous technology. Farmers in this area are practically used to non-tillage due to reasons of drought. Land preparation includes burning or removing trash and grasses on soil surface leaving a bare land. This practice requires minimum labour and it enables a farmer to make use of the nitrogen flush from the first rains. Tillage was being done during first weeding. The introduction of the actual tillage requires much labour in land preparation before the first rains or before planting. Since they have poor equipments such as hand hoe, the exercise may take longer. In plots where the soils are unworkable during the dry season, a farmer has to wait until the first rains start. However, farmers are now aware that the old experience is not better as indicated by the majority of respondents (Table 25). It is therefore possible that with better tools the available labour may be well utilized to facilitate tillage in time for high yields. This is inline with CIMMYT (1993) assertion that it is essential to know if labour demands of a new technology conflict with particularly busy time of a year or not.

#### **4.4.1.3 Proper spacing**

Similarly, Table 25 indicates that about 69% of farmers who responded said that planting in line is very labour intensive because traditionally, farmers broadcasted and haphazardly planted sorghum. This was a result of rushing for precious rains. Labour use in this case is small. The SG2000 technology requires a farmer to use a graduated rope to get a proper spacing of 25 cm from plant to plant and 80 cm from row to row. This requires bending and digging holes for seeds and also holding of the rope and its graduation. However, farmers seem to appreciate its importance in increased yield and have adopted it. Although the lines are not exactly to the required standards, they are at least, close to the actual recommendation. Sometimes, farmers do not use ropes but approximate distances during planting to reduce labour requirement. This is again in line with Rogers (1983) that farmers may modify a package to suit their situation.

#### **4.4.1.4 Timely weeding**

Timely weeding has also been perceived to be difficult due to unworkable soils (Table 26). Dodoma region, always has a long dry spell just after one month of first rains. Because they do not

till their fields, the soils compact strongly to make it almost impossible for weeding in time. One has to wait for more rains to make soils soft to enable weeding to take place. In some cases soils are water logged. In this case, a farmer has to wait for water to dry before weeding is done.

#### **4.4.1.5 Use of fertilizers**

Although Table 25 shows that 83.2% of respondents claimed that soil fertility was a problem, and that they acknowledge the importance of fertilizers in crop production, the majority do not use fertilizers because fertilizer prices were beyond reach (99.1 %) and the supply is unreliable (94.1%). Instead, farmers have adopted farm yard manure as an alternative to commercial fertilizers. The problem with farm yard manure is the bulkiness, transportation costs for long distant plots, and lack of transport facilities (Table 26). For plots that are close by houses, farm yard manure is substituted to fertilizers.

Table 26: Problems with the use of farm yard manure in percentages (N = 120)

Reasons	Percent	
	No.	PCT
Bulkiness	56	91.8
Costly in terms of transport	50	82.0
Lack of transport facilities	50	82.0

#### 4.4.1.6 Insecticides

As with the case of fertilizers, insecticides were perceived negatively. Table 26 indicates that farmers know that pests and diseases are a problem and that 89.9% know how to use the insecticide, but the table shows that the reason for its non-adoption is the cost and unavailability. It appears that the solution provided by SG2000 is expensive. If a cheap method of insect control could be introduced, it will definitely be accepted since the pest problem is already acknowledged by farmers.

#### 4.4.2 Farmers perception on SG2000 approach

The SG2000 approach included; the extension methodology, credit and follow-ups.

Table 27: Technology transfer methods used by SG2000 (N=120)

Method	Percent	
	No.	PCT
Demonstration	114	95.0
Face to face	113	94.2
Meetings	102	85.0
Field tours	90	75.6

Results in Table 27 show that among the extension methods used by SG2000, demonstrations was indicated to have been more effective as it was ranked high by 95% of respondents. It was followed by face to face (94.2%) and meetings (85%). These results suggest further that SG2000 was effective in delivering the message to farmers by using different methods. This is the part where SG2000 obtained its credibility by being able to influence farmers and win their confidence.

## **CHAPTER FIVE**

### **CONCLUSIONS AND RECOMMENDATIONS**

Adoption has been studied through the analysis of data from interviews and observations. The SG2000 programme was selected as a case study.

#### **5.1 CONCLUSIONS**

1. On the extent of adoption, the study indicates that the project has managed to increase yield per area in demonstration plots and the adoption of the underlying packages stands at 67%. This is a commendable work since four out of six technologies namely, Tegemeo variety, tillage, spacing, and timely weeding have widely been adopted with some modifications.
2. Farmers' perception of the technology and approach advocated by SG2000 was positive. They generally appreciated the approach used with its close supervision and the technological packages involved. However, although farmers perceived the project packages and approach as compatible, triable and appropriate, the adoption and non-adoption depended on other factors such as cost and supply of inputs, markets, farming tools,

credit, teaching methods, and time of phasing out.

3. The continued use of the technologies was found to be influenced by the duration a farmer has stayed out of the project after being phased out. With time farmers will be likely to adopt the four labour intensive technologies that is, Tegemeo variety, tillage, proper spacing, and timely weeding. On the other hand, as time lapses, farmers who have been phased out were found to drop the use of money oriented technologies especially fertilizers and insecticides.
4. The study reveals that high prices of both fertilizers and chemicals are beyond farmers reach. The problem is complicated by government's continuous removal of subsidies on these items year after year. This has a negative influence on adoption.
5. Some of the technologies in the package have high labour requirements. Given the short period of many activities in both farm and livestock as dictated by unreliable rainfall, any constraint in family labour may easily lead to the drop out of some activities or technologies if they are not modified. For

example, tillage, planting in lines, fertilizer application and in some cases timely weeding are labour demanding and may be dropped despite the recognition of their usefulness

6. It was found that before and after the project there was almost no supply of inputs. The area under study had no supplier. Farmers obtained the inputs from Dodoma municipal town, which is about 40 km away. Tegemeo improved seeds are no longer available since there is no multiplication farm. Farmers have therefore to select from their produce year after year hence degradation in seed quality as a result of segregation.
7. The study found that almost all farm activities were done by hand hoe, that is, tillage, planting, weeding and fertilizer application. Application of farm yard manure on homestead plots also involve carrying on heads. The use of drought power is insignificant. This means that if adoption is to be improved, ox-training need to be well popularized among farmers.
8. One of the most important component on the success of SG2000 project was credit since it enabled farmers to adopt most

technologies that led to tremendous increase in production per area. All farmers interviewed had obtained credit previously. The fact remains that credit influenced farmers to practice technologies such as fertilizers, insecticides and improved seeds together with other adopted technologies that led to increased yield. Withdrawal of credit left most farmers unable to buy these costly inputs hence the drastic drop in the adoption of insecticides and fertilizers.

9. The three year through which a farmer stayed in the project was found to be rather short to make a farmer make a rational decision. Most of them seem to be left at trial and evaluation stages. The results show further that villages that had been phased out of the project earlier have high adoption rate than those who have recently phased out. This shows a possibility of all technologies being adopted after sometime. Again it is therefore implied that even after the project phasing out, farmers still try and evaluate and finally decide to adopt some and/or majority of the technologies.

10. The study indicates that the technology transfer methods combinations such as demonstrations, face to face, field and home visits were effective and successful to reach farmers. Farmers appreciated the close supervision they obtained from the SG2000 project. The project was less bureaucratic and emphasized timely delivery of inputs and messages. In short, the extension service was rendered effectively.
11. The study indicates that the produced sorghum has no ready markets and prices were low. Only parallel markets exist but they absorb very insignificant quantity of produce.

## **5.2 RECOMMENDATIONS**

In order to improve the adoption level of the SG2000 project technology and approach and other related programmes, it is recommended that:

1. An open and ready market locally and externally for the produced sorghum need to be sought. This may include diversification of sorghum utilization so that apart from sorghum being used as ugali for food and brewing only, it can be used to make other food recipes such as bread, porridge, animal feeds, etc. This may increase the demand for the produce hence its marketability. Alternatively the use of sorghum in industrial brewing industries

such as Tanzania Breweries (TBL) or KIBUKU, may help to improve the market. All these efforts will provide good prices and assure farmers good incomes to buy necessary inputs.

2. Improvement of ox-training programme so that farmers can use animals power in tillage, weeding, planting, transportation and farm yard manure to distant fields by ox-carts is examined further.
3. Motivation of private businessmen to serve as suppliers so that they can deliver the required inputs in time and close to the farmers should be explored. A good number of stockists are needed to increase competition and possibly lower prices.
4. Modification in the project's packages to suit farmers environment and needs be made. For example, the use of farm yard manure may be encouraged hand in hand with ox-training programme. Compost manure can also be applied.
5. Credit should be re-introduced as it is vital for continued adoption. However, other organizations to administer credit

without involving the extension staff should be established. The creation of voluntary farmers group that may be credit worthy will be appreciated if loan recovery exercise can be well managed.

6. The bottom-up approach should be used right from the beginning, that is, from planning, implementation and evaluation. Farmers' participation in this case will help to know their problems and put their needs in priorities and make decisions on the packages suitable to the prevailing conditions.
7. Selection of contact farmers need to include all social groups in the villages whether ethnic, religious, gender, age, wealth and so on . This will give equal chances to different farmer categories to participate.
8. Further studies should be done on the diffusion of the SG2000 technologies to assess the adoption of the technologies over time. This is important because this study emphasised on farmers who participated in the SG2000 in three years only. A comparative study between the non-project and project farmers and villages would enable to determine the multiplier effect of the project technologies to other areas.

**REFERENCES**

- Alam, J. A. K. M. (1989) Reports Bangladesh: The Pivotal Activity? Literacy in Village Development - Some Contrasting Experience: Literacy Before Everything: In *AERDD Bulletin* 27 December, pp.35-36.
- Acharya, B. and S. Vermal, (1994) Participatory Training for Social Development. In: *The Rural Extension Bulletin*, December. pp 8-12
- Axinn, G. and Thorat, S. (1972) Modernizing Worlds Agriculture. *A Comparative Study of Agricultural Extension Education Systems*. Praeger Publications, New York. pp 216.
- Ashby, J. A. (1982) Technology and Ecology: Implications for Innovation Research in Peasant Agriculture. *Rural Sociology* 47(2). pp 234-250.
- Bell, J. (1987) *Doing Your Research Project: A Guide for First-Time Researchers In Education and Social Science*. Open University Press; Milton Keynes, Philadelphia. pp 145.
- Benad, A. (1988) Constraints in the Adoption of Agricultural Innovations in Tanzania. In: J. M. Teri and A. Z. Mattee (eds) *Science and Farmers in Tanzania*, SUA, Morogoro. pp 146-161.

- Bonitatibus, E. (1991) *Kenya: More than "Old wives tales"*. A Review of the Strengths and some Weaknesses of ITK on Rusinga Island. *In Bulletin 31 University of Reading Agric. Extension and Rural Development Department* pp 34.
- CIMMYT, (1993). *The Adoption of Agricultural technology: A guide for survey design*. Mexico, D.F. pp 88.
- Fliegel, F.C.(1984) Extension Communication and the Adoption Process. *In: E. Swanson (Ed). Agricultural Extension. A reference manual*. Second Edition, FAO of the UN, Rome. pp 77-88.
- Fowler, A. (1990) Doing it better? Where and How NGO's have a Comparative Advantage in Facilitating Development. *In: Bulletin 28 February*, University of Reading, England. pp 11-15
- Foster, A. M. (1993) *Sasakawa Global 2000 Agricultural Project. Tanzania Annual Report*, Ministry of Agriculture, Dar es Salaam, Tanzania. pp 30.

IITA, (1994) Research Perspective: Promoting Adoption and Spread of Agricultural Innovations. *In: Interpacks Digest Vol. 12 No.1 Spring.*  
pp 8-10

Jahangir, J.A (1989) Reports Bangladesh: The pivotal activity? Literacy in Village Development - Some Contrasting Experience: Literacy and Basic Needs: *In AERDD Bulletin 27 December.* pp 37-38.

Kauzeni, A. S. (1988) The Transfer of Agricultural Technology in Tanzania. *In: J.M. Teri and A.Z. Mattee (eds). Science and Farmers in Tanzania*  
pp 129-135.

Lionberger, H. F. and P. H. Gwin (1991) *The technology transfer.*  
*University of Missouri, MX 381.* pp 189.

Minde, I. J. (1991) Factors Affecting Marketable Agricultural Surplus in Tanzania: The Case of Maize. *In: African Rural Social Sciences Research Networks; Issues in Africa Rural Development: (Eds) Cheryl, R. D. and C. Alson, Winrock International Institute for Agricultural Development,*  
pp.508-525.

- Ministry of Agriculture (1989) Annual Report, Dar es Salaam. Ministry of Agriculture, (1990) Annual Report, Dar es Salaam.
- Ministry of Agriculture, (1992) Annual Report, Dar es Salaam. Mascarenhas, O. and M. Mbilinyi (1983). *Women In Tanzania: An Analytical Bibliography*. Scandnavian Institute of African Studies, Upsala Swedish International Development Authority, Stockholm. pp 256.
- Mattee, A. Z. (1994) Adoption of Agricultural Innovations by Small Farmers in Tanzania: An Analysis of Research Needs. *In: African Study Monograph 15(4)* pp 167-176.
- Mlozi, M.R.S. and Mvena Z.S.K.(1990), Advancement of Small Farmers Through the Transmission of Agricultural Innovations: The case of Sokoine University of Agriculture. *In: A. Z. Mattee, E. Evers and N. M. Mollel (Eds). The Role of Agricultural Institutions in The Advancement of Small Farmers in Developing Countries*, SUA, Morogoro. pp 35-40.
- Monu, E. d. (1993) *The Technology Gap in Agriculture: Who is to Blame?* An Unpublished Inaugural Lecture at University of Gaborone, Botswana pp 41.

- Mvena, Z. S. K. and A. Z. Mattee (1988) The Adoption of Modern Agricultural Technology by Farmers in Tanzania. *In: J. M. Teri and A.Z Mattee (Eds). Science and Farmers in Tanzania*, SUA, Morogoro. pp 136-145.
- Njoku, E. N. (1991) Determinants of Adoption of Improved Oil-Palm Production Technologies in Imo State, Nigeria. *In: African Rural Social Sciences Research Networks: Issues in African Rural Development*. (eds) Cheryl R. D. and C. Olson. Winrock International Institute for Agricultural Development, pp.218-233.
- Peter, S. (1993) Obstacles to Participation in Rural Development Program: A Case Study of a Land Development Project in Sarawak, Malaysia. *In: Adult Education and Development For Institutional Cooperation*, German. pp 19-25.
- Ponjee, C.K.J (1975) Participation in Agricultural Extension and Village Development Activities. A Case Study of Six Villages in Mbeya Region. Unpublished MSc Thesis, University of Dar es Salaam.

- Quinones, M. and Sicilima, N.P (1992) The Kilimo Sasakawa Global 2000 Agricultural Project in Tanzania. In: N. C. Russell and C. R. Dowswell (eds). *Africa's Agricultural Development in (1990). Can it be sustained?* Mexico.
- Rogers, A. (1988) Making Aid Invisible: Development as seen by an Adult Educator: *In Bulletin 23 February, University of Reading, Agricultural Extension*, London Road Reading, England. pp 6-8
- Rogers, E. M. (1983) *Diffusion of innovations*. New York: Free Press.  
pp 453.
- Rutatora, D. F. and V. Rutachokoziwa (1993) *Utilization of Agricultural Research Results by Beneficiaries. The Case of Tanzania, SUA, Morogoro*. Paper presented at the Faculty of Agriculture Research Workshop, March, 1993. pp 1-21.
- Sharland, R. (1991) ITK and Extension: How can Extension to Low Resource, Subsistence Farmers Better Relate to Indigenous Knowledge? *In: Bulletin 31 University of Reading. Agric. Ext. and Rural Development* pp 3- 11.

- Swanson, B.E, N. Roling, and J. Jiggins (1984), Extension Strategies for Technology Utilization. *In: Agricultural Extension. A Reference Manual*, (Ed) B.E.Swanson. 2nd Edition, FAO, Rome. pp 89-106.
- Van den Ban A. W. and H. S. Hawkins (1988): *Agricultural Extension*, Longman. pp 328.
- Wallace, I.(1994) A Growing Movement; Issues in Participatory Training for Rural Development. *In: The Rural Extension Bulletin*, December. pp 3-7.
- Wambura, R. (1988) An Assessment of the Transfer and Utilization of Selected Agricultural Innovation in Musoma District. Unpublished MSc Thesis, SUA, Morogoro.
- Zeremiam, Fre (1991) Eritrea: Breeding for Adversity: How Bin-Amer Cattle Herders have Changed Standards to Cope with War and Drought. *In: Bulletin 31 University of Reading Agricultural Ext. and Rural Development Department* pp 18.

APPENDIX I: FARMERS' QUESTIONNAIRE

SOKOINE UNIVERSITY OF AGRICULTURE

DEPARTMENT OF AGRICULTURAL EDUCATION AND EXTENSION

FACTORS ASSOCIATED WITH ADOPTION OF AGRICULTURAL TECHNOLOGIES: A

CASE OF SG2000 PROJECT IN DODOMA REGION

FARMERS' INTERVIEW SCHEDULE

Identification No.:----- Village -----

A FARMERS CHARACTERISTICS

- 1. What is your age? -----(years)
- 2. What is your highest level of education
  - 1. Primary education
  - 2. Secondary education
  - 3. Adult education
  - 4. No education at all
  - 5. Other (Specify)-----
- 3. Gender: 1. Male -----
  - 2. Female -----
- 4. What is your farm size? (in acreage)-----
- 5. Have you ever experienced food shortage in your household before SG2000? ----- 1. yes
  - 2. No
- 6. How did SG2000 project help you in achieving food sufficiency at your household level? (probe for answers)
 

-----

-----

7. Do you generally have a ready market for the produced sorghum?

	Local	Tegemeo
1. Yes	-----	-----
2. No	-----	-----

8. If yes what is that market?

- 1. Neighbours
- 2. Businessmen
- 3. Others

9. If no in (7) above what did you do with that sorghum?

- 1. Consumed only
- 2. Brewed only
- 3. Both

**B GENERAL AGRICULTURE AND LIVESTOCK ACTIVITIES**

10. What are your main cash crops?

-----  
 -----  
 -----

11. List in order of importance the food crops grown and acreage in your farm in the last season 1993/94.

	Crop	Acres
1.	-----	-----
2.	-----	-----
3.	-----	-----

12. What was the highest yield (bags/acre) attained under SG2000? ----- bags

13. What was the highest yield in other traditional local sorghum? ----- bags
14. What is the source of power on your farm?
- 1. Hand hoe
  - 2. Own ox-plough
  - 3. Hired ox-plough
  - 4. Hired tractor
15. Under SG2000 project, what was the source of technology
- 1. Bwana shamba
  - 2. Friends
  - 3. Others (specify-----)
16. Do you still grow Tegemeo variety?
- 1. Yes
  - 2. No
17. If no when and why did you stop growing it ?----- (year)
- 
- 
- 
18. Are you still using improved seeds?
- 1. Yes-----
  - 2. No -----
19. Where do you get the seeds for?
- Local sorghum -----
- Tegemeo -----

Planting

20. What method do you use for planting?

Method	Local sorghum	Tegemeo
Proper spacing (25 cm x 80cm) Broadcasting No proper spacing Plant in lines only		

21. Do you still use proper spacing?

---- 1. Yes

---- 2. No

22. If no when did you stop and why ? -----(year)

-----  
 -----  
 -----

Manure and Fertilizer Application

23. Have you ever used manure in sorghum production?

----- 1. Yes

----- 2. No

24. If yes do you still use it?

----- 1. Yes

----- 2. No

25. If no when did you stop using it and what are the reasons  
----- (Year)

- 1.-----
- 2.-----

26. Have you ever used fertilizer in sorghum production?

- 1. Yes
- 2. No

27. If yes in above,when did you start using it----- (year)

28. Are you still using it?

- 1. Yes
- 2. No

29. If no in above, when did you stop it and what are the  
reasons ----- (Year)

-----  
-----  
-----  
-----

**Weeding**

30. When do you weed in both Tegemeo and local sorghum

-----  
-----

31. Do you continue to weed in time and frequency as  
recommended by SG2000? ----- 1. Yes

- 2. No



37. What is your feeling on the extension method used by Bwana shamba under SG2000?

Good Satisfactory Poor Very poor

Demonstration -----

Field/Home visit -----

Field tours -----

D. CREDIT

38. Which inputs did you get credit for? Also indicate whether the amount you got was enough

Input How much (bags) Enough Not enough

-----  
-----  
-----  
-----

39. How useful to you was the input credit given by SG2000?

Explain-----

-----

40. Were the conditions of credit explained to you well in advance

----- 1. Yes

----- 2.No

41. If yes were they clear to you ?

Explain-----

-----

- 42. How much of the loan did you pay back ?
  - 1. Full amount -----
  - 2. Part of it -----
  - 3. None at all -----
- 43. Did you repay in time ?
  - 1. Yes
  - 2. No
- 44. Give reasons -----  
-----  
-----

**E. INPUTS SUPPLY**

- 45. Where did you use to get inputs before SG2000 project?  
-----
- 46. With SG2000 where did you use to get the inputs?
  - 1. Bwana shamba
  - 2. Stockist
  - 3. Other (Specify -----)
- 47. After SG2000 where do you get the inputs?
  - 1. Bwana shamba
  - 2. Stockist
  - 3. Other (Specify -----)

**F SPECIFIC ISSUES ON SG2000**

- 48. When did you join SG2000 project ?----- (year)
- 49. What was the size of the demonstration plot under SG2000 ?  
----- (acres)

50. Who selected you to join the SG2000 ?

- 1. Village government -----
- 2. Bwana shamba-----
- 3. Both-----

**G. FARMERS PERCEPTION**

51. I would like to get your opinion on the following:

\* (Write the number of from the opinion scale in the corresponding space of the chosen statement.)

OPINION SCALE:

- 1. Strongly agree            2. Agree            3. Undecided
- 4. Disagree                5. Strongly disagree

**SG2000 packages**

1. Tegemeo variety

- a) The variety is resistant to drought 1, 2, 3, 4, 5.
- b) The variety is resistant to diseases 1, 2, 3, 4, 5.
- c) The variety is resistant to storage pests 1,2,3 ,4, 5.

2. Tillage

- a) Labour intensive-----
- b) Incompatible in local farming system -----
- c) Past experience is better-----
- d) We have inferior equipment to work with-----
- e) No enough time to practice due to unreliable rainfall

3. Plant density

- a) Laborious exercise of planting in lines-----
- b) Inconsistence with past experience-----
- c) Increases yield per area -----

- 4. Timely weeding
    - a) Difficult to practice -----
    - b) Soils are unworkable -----
  - 5. Fertilizer application
    - a) Fertility is not a problem -----
    - b) The prices are beyond reach -----
    - c) Supply not reliable-----
    - d) Not profitable to use-----
    - e) Fertiliser use is not an appropriate technology
  - 6. Use of pesticides
    - a) Diseases and pests are not a problem -----
    - b) Chemicals are costly -----
    - c) Incompatible technology -----
    - d) Application is not clearly understood -----
- Satisfaction on SG2000 activities
- a) Operations are timely and effective -----
  - b) Credit is useful -----
  - c) Inputs are appropriate -----
  - d) Extension services is effective -----
  - e) The whole technology is appropriate -----
  - f) Some packages are not appropriate -----
  - g) The technology needs modification -----
  - h) Encourages participation of farmers -----
  - i) Empowers the farmers -----

THANK YOU

APPENDIX II: EXTENSION WORKERS' QUESTIONNAIRE

FACTORS ASSOCIATED WITH ADOPTION OF TECHNOLOGIES:

A CASE OF SG2000 PROJECT IN DODOMA REGION

AGRICULTURAL EXTENSION WORKERS QUESTIONNAIRE

DODOMA REGION

ID -----

DISTRICT -----

A: CHARACTERISTICS OF EXTENSION WORKERS

1. What is your gender?
  - 1. Female
  - 2. Male
2. What is your age? ----- (years)
3. What is your marital status? -----
4. What is your highest level of education?
  - 1. Standard Seven
  - 2. Standard Twelve
  - 3. Standard Fourteen
5. What professional training have you obtained, and what was the duration of training and the year obtained?
 

Professional	Duration(years)	Year obtained
1. Certificate	-----	-----
2. Diploma	-----	-----
3. Degree	-----	-----
6. How long have you been working as an extension officer?
  - (years)
7. How many villages do you serve? ----- (no of villages)

8. How many years have you worked in this /these villages?

Village	Number of years
-----	-----
-----	-----

9. If you have attended any in service training, what was the type and duration of the training

Type of training	Duration	Dates
1. -----	-----	-----
2. -----	-----	-----

**GENERAL EXTENSION ACTIVITIES**

10. What are the major day to day agriculture and livestock activities which you engage yourself with farmers?

- 1. -----
- 2. -----
- 3. -----

11. On average, how many days in a week do you spend contacting farmers?

- 1. Contact in farmers homesteads (how many contacts ----)
- 2. Contact in your office/home (how many contacts-----)

12. Who initiates those contacts?

-----  
-----

13. What agricultural and livestock materials do you give to farmers? (example leaflet ) -----

-----  
-----

14. What agricultural messages have you disseminated to farmers in the past three years?

- 1. -----
- 2. -----
- 3. -----

15. What were the sources of the message?

	Message	Source
1.	-----	-----
2.	-----	-----
3.	-----	-----

16. What extension methods do you use to pass agricultural information to farmers?

- 1. -----
- 2. -----
- 3. -----

17. Describe your involvement with farmers in the past three years in the following activities.

- 1. Organizing farmers meetings  
-----
- 2. Holding seminars/workshops for or with farmers  
-----
- 3. Holding field days for farmers  
-----
- 4. Conducting demonstrations to farmers  
-----

C. INFORMATION ON SORGHUM TECHNOLOGY

18. What sorghum varieties are grown in this area and where did they come from?

Variety	Source	Approximate %growing
1. -----	-----	-----
2. -----	-----	-----
3. -----	-----	-----

19. What do you think are the reasons for growing these varieties?

Variety	source	Reasons for growing
1. -----	-----	-----
2. -----	-----	-----
3. -----	-----	-----

20. What important recommendations on sorghum production have you emphasized to farmers on extension activities?

1. -----
2. -----
3. -----

21. Generally, how did farmers respond to the recommendations? (describe)

Recommendations	Response
1. -----	-----
2. -----	-----
3. -----	-----

22. What new varieties have been introduced in this area during the past five years?

Variety	Year introduced	Who introduced it
1. -----	-----	-----
2. -----	-----	-----

23. What were the reasons for introducing that variety?

Variety	Reason for introducing
1. -----	-----
2. -----	-----

24. What was the adoption/response rate (in percent)?

Variety	percent adoption/response
1. -----	-----
2. -----	-----

25. What factors facilitated your effective transfer of sorghum technology?

- 1. -----
- 2. -----
- 3. ....

26. Which sorghum varieties are no longer grown by farmers in this area and what are the reasons for abandoning them?

Variety	Reasons for abandoning
-----	-----
-----	-----

D. SPECIFIC INFORMATION ON SORGHUM (TEGEMEO) VARIETY

27. Were you involved in any way in the process of developing a new technical package for sorghum

- 1. Yes
- 2. No

28. If your answer is Yes in question 27 above describe your involved

-----  
-----

29. If your answer is No in question 27 above how would you have liked to be involved?

-----  
-----  
-----

30. Were farmers involved in the development of tegemeo variety?

- 1. Yes
- 2. No
- 3. Don't know

31. If your answer is Yes in question 30 describe there involvement

-----  
-----  
-----  
-----  
-----  
-----

32. If your answer is No how could they have been involved?

-----  
-----  
-----

**E. SG2000 PACKAGE INFORMATION**

33. In your opinion what do you think are the reasons for low adoption of SG2000 packages ?

- 1. -----
- 2. -----

34. Which packages of SG2000 are mostly adopted and what are the reasons

Package	Reasons for adoption
1. -----	-----
2. -----	-----
3. -----	-----
4. -----	-----

35. Did SG2000 assist you in visiting other villages under the project to see what others do?

- 1. Yes -----
- 2. No -----

36. What is your opinion on the SG2000 approach.  
( Choose from the opinion scale)

OPINION SCALE:

- 1. Strongly agree 2. Agree 3. Undecided 4. Disagree
- 5. Strongly disagree
- a) SG2000 had closer supervision.
- b) SG2000 had more incentives to extension officers.
- c) SG2000 doesn't encourage farmers participation.
- d) SG2000 had top down approach.

37. Do you need SG2000 project again?

- 1. ----- Yes
- 2. ----- No

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