ADOPTION OF AGRICULTURAL INNOVATIONS : A CASE STUDY OF MAIZE NARROW-CRIB IN SOUTHERN BENIN

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(LEGON)

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CERTIFICATION

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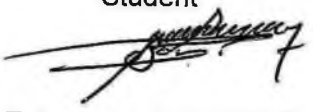

Ephrem R.C.HOUNKPE

DEDICATION

To my parents, friends, loving wife SOSSOU Ambroisine and our children Nadège, Linda, and Campbell.

I can't forget you Clémence BOHOUN.

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Ephrem Réné Comlan HOUNKPE

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LIST OF ABBREVIATIONS

CIMMYT : Centro Internacional de Majoramiento de Maiz Y Trigo

FAO :Food and Agricultural Organisation of United Nations.

GTZ:: Gesellschaft für Technische Zusammenarbeit.

SG 2000 : Sasakawa Global 2000.

USA: United States of America.

ABSTRACT

An important aspect of agricultural development involves, the adoption of innovations by farmers. Several activities were put in place by extension services in Benin to get wide spread adoption of innovations by farmers. One of these actions was the introduction of maize narrow-crib in rural areas in Benin ; but still some farmers are not adopting. After four years of the introduction of this maize narrow-crib, it is important to appreciate the factors that are affecting the adoption of this storage device. Therefore, this study was conducted to determine the factors which are related to the adoption of the maize narrow-cribinnovation.The findings from the reseach will contribute to how to enhance adoption of the maize narrow-crib technology in Benin. In total, 160 maize farmers were selected at random in 16 villages where the crib was introduced. A pretested structured questionnaire was administrated by trained enumerators. The data was analysed using the Chi-square test, the relative frequencies, the Probit and the Logit models. The result of analysis indicated that study sample was composed of mainly men (87%). Eventhough, in certain regions some women cultivate more maize than men. Most of the farmers were about 31 to 40 years old. The Chi-square test shows that the following variables significantly influence the adoption decision behaviour of the farmers : the household head age, the region (culture and the availability of sustanable bulding materials for the maize narrow-crib construction in the region), the trialability of the innovation, the language spoken by the farmers and the extension officer, the household size, the leadership status of the household head, the innovation cost, the extension contact with the farmer, the need identification and the farmers' perception about the necessity to build a maize narrow-crib. The Logit test shows that the region, the household size, the leadership status, the source of information, the extension contact, the need identification and the necessity to build a maize narrow-crib significantly influence farmers' behaviour with regard to maize narrow-crib adoption. The number of agricultural active members of the household, the type of education the household head has and his experience in farming since he became a decision maker on his own field, his wealth, his cosmopolitness, the availability of subsidy, the trailability of the innovation and the construction difficulties were not found to influence farmer' decision making behaviour with regard to the adoption of maize narrow-crib.

RESUME

La République du Bénin est un pays à économie essentiellement agricole. Plus des deux tiers de la population vivent dans les campagnes et pratiquent l'agriculture. La promotion de l'agriculture passe nécessairement par l'adoption de nouvelles technologies ou i'adoption des anciennes technologies améliorées.

Cependant, malgré tous les efforts déployés par diverses structures gouvernementales ou non pour amener les paysans à améliorer leur niveau de vie, beaucoup de ces paysans demeurent encore retissants face aux innovations.

Le projet agricole SASAKAWA GLOBAL 2000 fait partie intégrante de ces structures non gouvernementales qui interviennent dans le monde rural pour améliorer le niveau de vie des paysans. Il travaille en collaboration avec le Ministère chargé du Développement Rural (M.D.R.) à travers le service national de vulgarisation agricole et la Recherche Agronomique. Le projet depuis son avènement, a oeuvré pour la promotion de la culture du maïs. Dès lors, la résolution d'un problème a entraîné la création ou l'aggravation d'un autre. L'accroissement de la production du maïs a entraîné l'accentuation des problèmes post-récoltes. Le crib qui est une structure de stockage/conservation déjà plusieurs fois introduit en milieu paysan par la Recherche et la Vulgarisation a été très faiblement adopté. Il a été réintroduit par le projet SASAKAWA GLOBAL 2000 après amélioration et avec une autre stratégie de vulgarisation.

Il s'avère alors important de mesurer l'adoption de cette structure après 4 années d'introduction et apprécier les facteurs qui ont influencé le comportement du paysan en ce qui concerne la prise de décision de l'adopter ou non. La recherche conduite dans les 4 Départements du sud Bénin (Atlantique, Mono, Ouémé, Zou) a permit de savoir quels facteurs parmi les facteurs institutionnels, les facteurs environnementaux, les facteurs liés au ménage agricole et à l'innovation ont significativement influencé le comportement du paysan face à l'innovation (crib). A ce sujet, 160 paysans ont-ils été sélectionnés au hasard dans 16 villages (aussi sélectionnés au hasard) où le crib a été introduit. Un questionnaire structuré et prétexté a été administré par 3 enquêteurs préalablement formés à cet effet.

La connaissance de ces facteurs permettra de savoir sur quels facteurs doit-on agir pour améliorer le taux d'adoption des innovations agricoles en général et du crib en particulier. L'analyse des données collectées a révélé que l'échantillon de travail était essentiellement composé d'hommes (87%). La tranche d'âge où les paysans sont les plus nombreux est de 31 ans à 40 ans. Le taux d'adoption est de 30,6%. Le text de Khi-deux a révélé que les variables suivantes : la région (la culture de la région et la disponibilité en matériaux de construction du crib), l'âge du chef de ménage agricole, la taille du ménage, le statut de leadership du paysan chef de ménage agricole, la source d'information, la fréquence de contact entre l'agent de vulgarisation et le paysan, le coût de l'innovation ainsi que ce perception sur la nécessité de construire le crib sont autant de facteurs qui ont significativement influencé son comportement. Tandis que le text de logit a révélé que ce sont les variables suivantes qui ont significativement influencé le comportement du paysan en ce qui concerne la décision d'adopter le crib ou non. Il s'agit de: la région, la source d'information, l'identification des besoins du paysan dans le domaine de la conservation des récoltes, le statut de leadership du paysan et la taille du ménage agricole. Par contre dans un cas comme dans l'autre le nombre d'actifs agricoles dans le ménage, le niveau d'éducation du chef de ménage, son expérience dans le domaine agricole, ses revenues, la disponibilité de subvention pour la construction du crib, les difficultés de construction du crib, ainsi que la fréqence de voyage du chef de ménage sont autant de facteurs qui n'ont eu aucune influence significative sur le comportement du paysan en ce qui concerne la décision d'adopter l'innovation ou non.

CHAPTER ONE

INTRODUCTION

.0 BACKGROUND

.0.1 IMPORTANCE OF CEREALS AND STORAGE PROBLEMS IN BENIN

Cereals constitute the base of human food in developing countries. The majority of maize roduced on small farms in tropical regions is utilised as staple food by the farmer and his amily. Only about 15 - 17 percent of the total maize production is handled through central tores and marketing boards (Bodholt 1985). Post - harvest losses can be as high as 40 50 % of the total production per year and sometimes more than that, particularly in leveloping countries,Hall (1970)

Deuse (1979) mentioned that it is mainly during storage that the most important losses are recorded. According to the " Service de Protection des Végétaux du Ministère Béninois chargé du Développement rural ", post - harvest losses are put at 17 % in the humid zones. For the small scale farmer the ideal is to have safe storage of maize for seed and for the family's consumption until the next season's crop is mature or at least ready for consumption. Unfortunately, most farmers in developing countries are still using traditional storage devices which are relatively ineffective for maize storing according to a preliminary survey on this study.

The main constraint of most traditional storage devices is that they do not allow optimal free ventilation and therefore a long pre-harvest field drying as well as a further post - harvest drying are required before the maize can be stored safely. During the long pre-harvest drying period in the field, maize is exposed to negative effects of wind and rain and to attacks of moulds, insects, as well as termites, birds and rodents; the insects infestation might not be noticeable in the field or at harvest because eggs laying in the cobs start before the harvesting period, but the build - up of the infestation accelerates later on during the storage period and might lead to unacceptable high losses.

In order to meet the objectives of increased production of maize, losses which can be as high as 40 - 50 % must be reduced in the field before harvesting and during storage (Bodhohlt, 1985). The traditional storage and drying devices used all over the

country are numerous but most of them are ineffective since they do not allow free ventilation and the materials used are not durable.

1.0.2 TRADITIONAL METHODS AND DEVICES FOR CEREALS STORAGE IN BENIN

The main types of storage methods used in the various regions of Republic of Benin are shown in Figure 1.

Field drying

The habit of drying or at least pre-drying maize in the field is very popular. The harvesting period comes at least one month later with problems of insects, rodents, birds and moulds attacks.

Drying of maize on sorghum stubble on the ground or on fallen branches is common with the early harvested maize season (FAO a, 1992).

The platforms

This type of device is mostly used in the North and in the Northern part of the Central region for sorghum drying and storing .There are two type of platforms according to the shape of the floor: the granary with flat platform in the North, and the granary with cone-shaped platform in the Northern part of the Central region.

- The "Secco "

The "secco " is a drying and storage device made from vegetable material (*Andropogon*). It is used in the North and it exposes the maize to bad weather, insects, moulds, rodents, fire and animals moving to new pastures.

The progressive disappearance of the Andropogon turns farmers towards the platform for which the use of this gramineous plants is not necessary, (F.A.O. a 1992)

- The ceilings

The ceilings is a common practice in use in the south and particularly in Ouémé region. It involves maize drying on the household ceiling together with the husk without any kind of chemical treatment.

This practice presents serious risk for the inhabitant since the ceiling subsidence very often causes mortal damage (F.A.O b, 1992). A lot of children died because of this ceiling subsidence when the stock fall down on them.

The " Ago and " Ava " granaries.

The same report of F.A.O. mentioned that the "Ago " granary is a device made from the branches of trees and the palm leaf, it is used in the south.

This practice is most common in Atlantic region. Because of its short lifetime it is rebuilt every year before harvesting time. The maize is stored in this granary like in Ava granary which is used in the south in Mono region. The disadvantages of these devices is that they allow moulds growth and insects attacks.

- "Banco " granary.

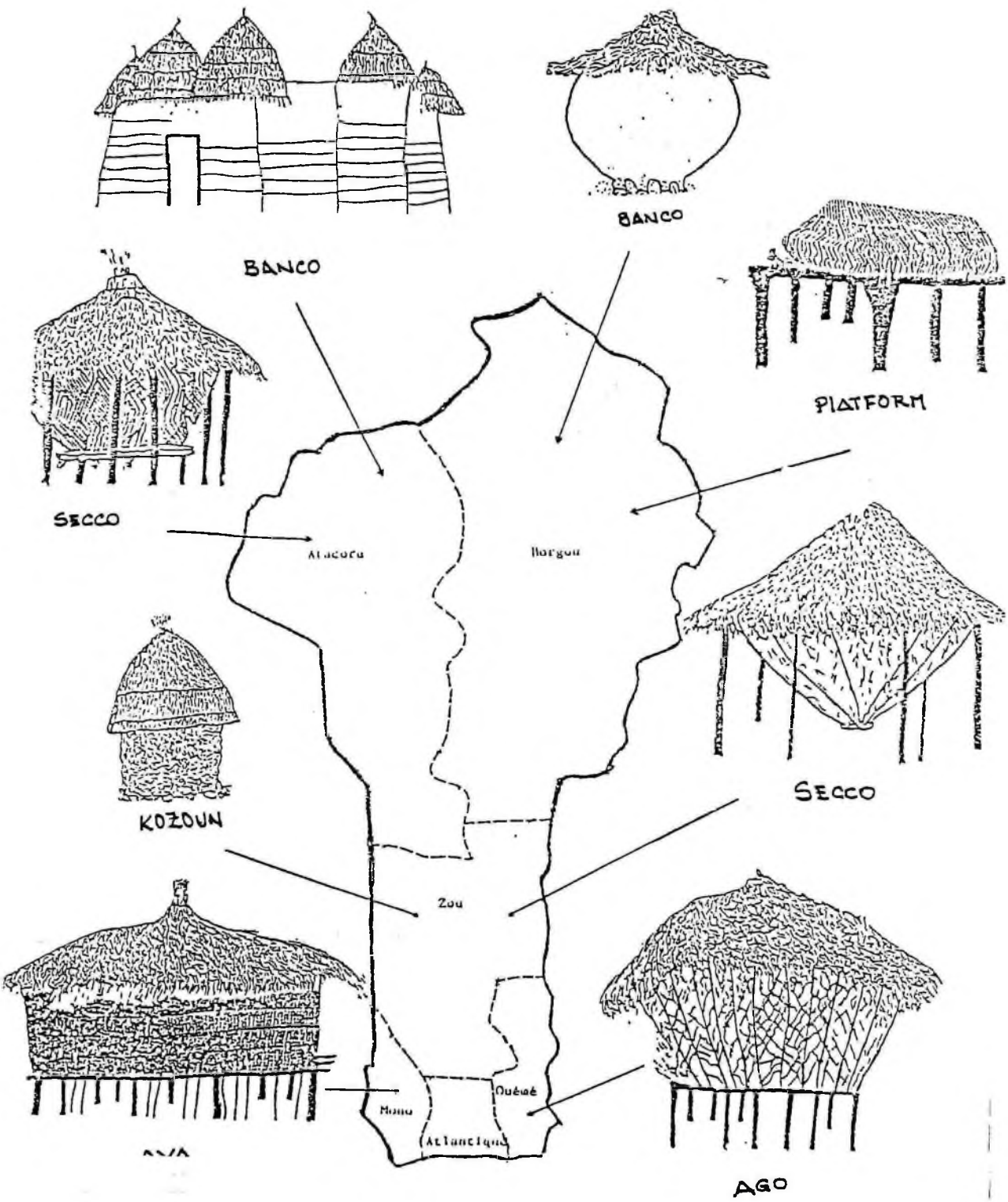
According to FAO a (1992) report, this type of device made from ant - hill clay is a strong durable device. In the same report it was mentioned that the banco granary is less used in the North than the one made from vegetable material.

According to the above inadequacies cited above concerning the traditional drying and storage devices in Benin, it was important to introduce to farmers an innovation or new technology (maize-narrow crib) to help them store their maize better (cf Figure2).

1.0.3 THE MAIZE NARROW-CRIB : An Innovation in Benin

The use of improved crib which fully use the drying capabilities of natural air appear to offer the most practical method of drying and storing maize on cob together with the husk and treatment with suitable insecticides like pirimiphos methyl at the rate of 2.2 cm^3 of active ingredient per m^2 of surface area (FAO, 1980). According to Ferland ; Messier ; Chagnon, (1986) maize needs to be exposed to direct sunshine at 0.6% moisture content in wind exposed, vertical cribs (15 75cm wide). A picture of the maize narrow-crib is shown in Figure 2 .

Figure 1: Traditional drying and storage devices in use in Benin.



This device introduced from the south of France is for maize drying. It is most useful in humid zone because of the climatic conditions .

The extension activities on this innovation were carried out in three steps in Benin. The first step was conducted in the 1960's. It was the pre - extension step in which some cribs were established in schools, markets and on some influential farmers fields and districts for demonstration but farmers did not adopt it. The second step is quite recent (in the 1980's). In this step , the crib was promoted with the support of the German Co-operation Agency (GTZ). Its double role of drying and storage was demonstrated in the southern part of Benin particularly in Atlantic region to allow people to see and appreciate its effectiveness.

The objectives of wide adoption of the maize narrow-crib were not achieved despite the hundreds of cribs built everywhere in the country. In Atlantic region, 309 cribs were built from 1967 to 1987 (Affognon, 1987). Presently, less than 5% of these storage devices are available in the rural area on some individual farms , workers and co-operative fields.

According to the FAO b (1992) report, the crib extension programme failed essentially because of some technical errors in the construction and the inappropriate use of the crib. The extension officers themselves and the farmers do not know how to construct and how to use it very well. The crib is easy to construct if one is trained properly on its construction. Further, the construction cost is too much because of the materials used (wire-nets, galvanised iron sheet, nails etc...) and most of the people have never seen or used such devices before.

The former Post-harvest Projects in Benin did not take into account the farmers revenue when introducing the crib in the rural areas. In the 1960's, the farmers in Dahomey now Benin used the local variety of maize without any fertiliser. Therefore, the average yield of maize was about 800 Kg/ha whereas the average size of the farm was less than half hectare .The maize price at farm level was not high. Together, total farm income of the typical farmer was too low to afford the cost of constructing the maize narrow-crib.

Figure 2 : **Improved drying and storage device (crib).**

Source : Picture taken by Ephrem R. C. HOUNKPE (1997)

The second step was carried out to promote the 'improved granary' in order to avoid the difficulty of high construction cost. This 'improved granary' was made from some local materials (wood) and was not so different from the previous crib apart from the material used ; therefore, the construction cost was lower. Despite this, it was not adopted by most of the farmers because, for its construction too much wood has to be used. This is because there is general scarcity of wood in the Republique of Benin.

SASAKAWA GLOBAL 2000, (SG2000) an agricultural project financed by the Japanese Riochi SASAKAWA, with the support of Jimmy CARTER former President of USA and Norman BORLAUG 1970 Nobel Price winner, was established in Benin in 1989. This project deals essentially with small scale farmers in order to improve their standard of living. Farmers involved in this project are now producing more and more maize and because of the increased maize production in Benin (Figure 3)., SG 2000 has established a post-harvest programme which is trying to change the farmers' strategy in order to obtain better results and meet their needs.

As part of the SG 2000 Project there has been a reintroduction of the maize narrow-crib through the third step by improving the technology itself and the extension

strategy in order to ensure widespread dissemination of information about it for adoption. The improvement of the technology by SG 2000 concerns the use of local materials (wood and statch) to make it afordable to small scale farmers. Whereas the improvement of the extension strategy involved the training of both the extension officers and some farmers. In addition, some subsidies were given to the farmers to demonstrate the technology at farmers level. This third step in crib introduction started with SG 2000 in 1993.

All the farmers involved in SG 2000 have the project technical assistance (extension message through extension workers), only few have the financial assistance (subsidy in the form of cash). All those who have the financial assistance have the demonstrated maize-narrow crib.

1.0.4 PROBLEM STATEMENT

Rural development in general and agricultural development in particular depends on the use of modern science and technology. In other words, the adoption of innovations. The adoption or rejection of an innovation is a decision by an individual. If s/he adopts, s/he begins using the new idea, practice, or object and often ceases using the idea that the innovation replaces. In the case of adoption of innovation, an individual must choose a new alternative over those previously in use.

But since the maize narrow-crib was introduced, many people still do not adopt it. A preliminary survey done for this study shows that in villages there are more non adopters than adopters, even though they have been introdused to the technology. Therefore it is important to find out why some farmers are not adopting the technology. What is it about the maize narrow-crib technology transfert which makes some people adopt whereas some do not adopt and how can the extension services increase the rate of crib adoption ?

1. 1 RESEARCH QUESTION

What are the factors which affect the adoption and non-adopotion of the maize narrow- crib in Benin and how can adoption be enhanced ?

Based on the previous discussions, the specific research questions for this study are :

1 - What are the (household,technological and environmental) factors which influence maize narrow-crib adoption?

2 - What are the institutional factors such as processes/strategies that were used for maize narrow-crib introduction to farmers which influence the adoption or non adoption of this technology ?

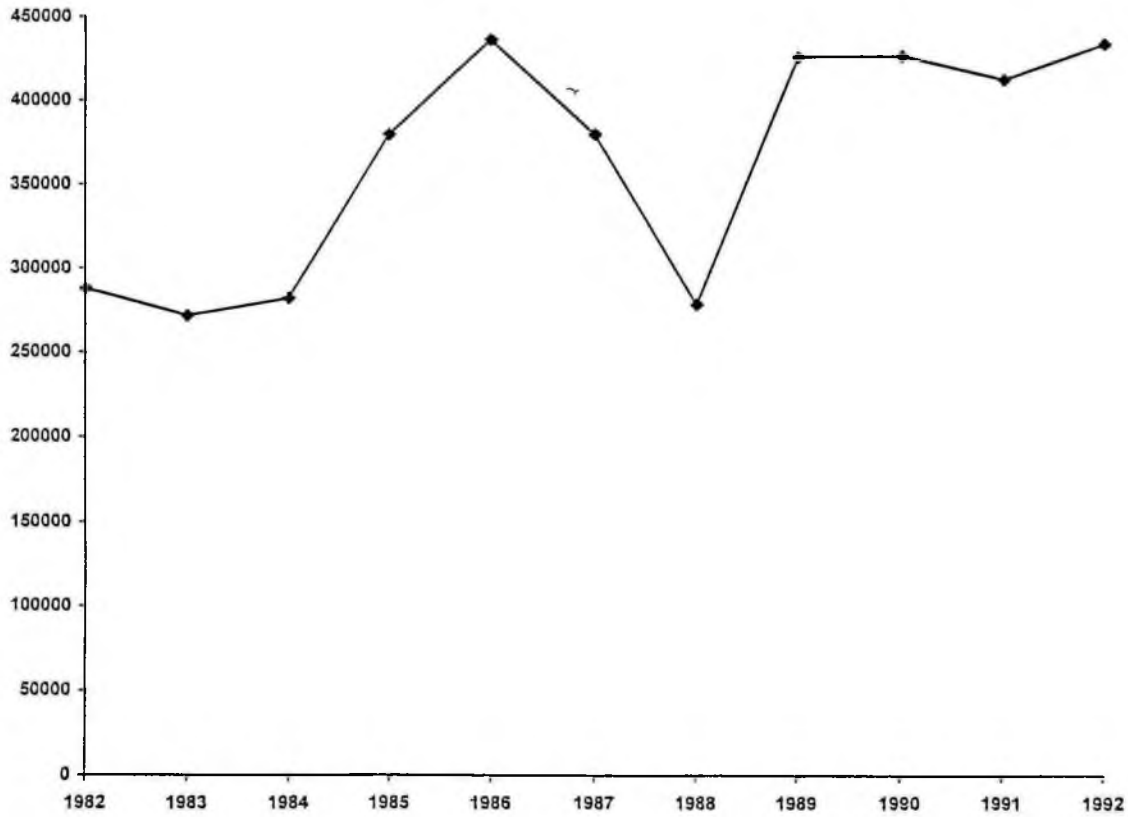
1.2 OBJECTIVES OF THE STUDY

The main objective of this study is to determine the factors which influence farmers decision making with regard to adoption of the maize narrow-crib in southern Benin, in order to suggest ways to enhance its adoption .

The specific objectives are to :

- Identify the household characteristics of the farmers who have adopted the crib compared with those who have not.
- Identify the environmental factors affecting crib adoption.
- Identify the institutional factors that affect crib adoption.
- Find out whether the characteristics of the innovation such as trialability and compatibility are related to adoption.
- Find out whether there are differences between regions as far as maize narrow-crib adoption is concerned and why ?
- Suggest relevant recommendations for future actions to be undertaken by extension services in Benin and SASAKAWA GLOBAL 2000 concerning post-harvest technology programme and how to get wide adoption of agricultural innovations in general.

Figure 3: Evolution of maize production from 1982-1992 in Republic of Benin.



Source : CARDER, 1970-1994

1.3 DEFINITION OF CONCEPTS

1.3.1 INNOVATION AND TECHNOLOGY.

Rogers, (1983) defines an innovation as an idea, practice or object that is perceived as new by an individual or other unit of adoption. Newness in an innovation need not just involve knowledge ; someone may have known about an innovation for sometime but not yet developed a favourable or unfavourable attitude towards it, nor have adopted or rejected it. The "newness" aspect of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt. "Innovation" and "Technology" are often used synonymously.

A technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome. This definition of technology is based upon Thompson, (1967) and Rogers personal communication with Dr J. D. Eveland of the National Science Foundation, (Rogers , 1983) stressed that a technology usually has two components :(1) a hardware aspect, consisting of the tool that embodies the technology as material or physical objects and (2) a software aspect , consisting of the information base for the tool.

The software component of a technology is often not so apparent to observation. A technology almost always represents a mixture of hardware and software (aspects). The technological innovation creates one kind of adopters (about its expected consequences), as well as representing an opportunity for reduced uncertainty in another sense (that of the information base of the technology). The maize-narrow crib and the inputs associated with it in the case of this study is considered the innovation. Before any innovation is adopted, it must have certain characteristics such as relative advantage. If the innovation is not perceived as better than the idea it supersedes, it will not be adopted. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption is going to be.

An idea that is not compatible with the prevalent values and norms of a social system will not be adopted as rapidly as an innovation that is compatible . The adoption of an incompatible innovation often requires the prior adoption of new value system.

In general, new ideas that are simpler to understand will be adopted more readily than innovations that require the adopter to develop new skills and understanding. Some

innovations are readily understood by most members of a social system ; others are more complicated and will be adopted more slowly.

Ryan and Neal, (1943) found out that every one of their Iowa farmer respondents adopted hybrid-seed corn by first trying it on a partial basis. This shows that an innovation that is trialable represents less uncertainty to the individual who is considering it for adoption, as it is possible to learn by doing.

As far as ease of adoption of innovation is concerned, studies have proved that the easier it is for individuals to see the results of an innovation, the more likely they adopt it. In general, innovations that are perceived by receivers as having relative advantage and are compatible, trialable, observable and less complex will be adopted more rapidly than other innovations. Rogers (1983) states that if the innovation does not take into account cultural beliefs of the users it can not succeed. The same author stressed that these are not the only qualities that affect adoption rates , but past research indicate that they are the most important characteristics of innovations in explaining rate of adoption.

Before an innovation reaches its target, it is important to transform it into messages. The messages are transferred from a source to a receiver through certain channels .We might think of the communication process in term of the oversimplified but useful S-M-C-R model. A source(S) sends a message (M) via certain channels(C) to the receiving individual (R). One can easily see how communication factors are vitally involved in many aspects of the decision process which together make social change. Adoption of technology therefore brings about social change.

1.3.2 ADOPTION

One of the most important issues in defining an adoption is the definition of criteria for adoption. If we are interested in the diffusion of a new variety, for instance, what constitutes adoption ? Are farmers who plant even a few rows of the new variety considered adopters? Do they have to plant a certain minimum proportion of their fields with the new variety before being considered adopters? If we are interested in the adoption of crop management practices, how closely does the farmer have to follow a recommendation before being considered an adopter ? In defining the criteria for adoption, it is also important to remember that although recommendations may be presented to farmers as a package of several practices, some components of the package may be adopted later, and some may never find widespread acceptance (CIMMYT, 1993).

In day to day language, the terms adoption and diffusion of innovation are often used interchangeably. The term diffusion refers to the spread of new practices and ideas in both a social and geographical sense, whereas adoption is the act of accepting an innovation, normally an individual reaction (Jones. 1967). With regards to the adoption of the maize narrow-crib at the farm level in this study, it is as defined by Feder ; Just and Zilbermann (1985) " the degree of use of a new technology in long-run equilibrium when the farmer has full information about the new technology and its potential". The individual farmer's adoption decision in a given period is assumed to be derived from the maximisation of the expected utility (his production objective) subject to, among other restrictions, his choice between traditional and modern technologies (Feder et al. 1985). As such the decision of the farmer in this respect is primarily a dichotomous choice, i.e. , he either adopts or not adopt the new technology in question. However, the question of innovation decision is not only limited to this dichotomous choice but also comprises the intensity of use in case of a positive decision. Rogers (1983) pointed out that communication is essential for social change. A social change is a process by which alteration occurs in the structure and function of a social system. So the adoption makes a social change. Therefore, if a technology is adopted, social change may occur.

In the case of this study, the adopters are the farmers who have or are still using the maize narrow-crib, except the maize narrow-cribs build fo the demontration. In other words, the adopters are farmers who have seen or have heard about it, have constructed and use it. The non adopters are the others excluding those for the demonstration.

There are certain factors that affect adoption as showed by many authors, these determinants are discussed in the next chapter.

CHAPTER TWO

LITERATURE REVIEW

FACTORS AFFECTING ADOPTION OF INNOVATIONS

2.0 INTRODUCTION

Most studies of the adoption behaviour of individual farmers use static analysis which relates the degree of adoption to factors affecting it. These studies investigate the properties of the solution to particular cases of the temporal optimisation problem of the farmer. One useful approach is to characterise the problem as one where the farmer has to choose between two technologies : one is the traditional technology and the other is a modern technology such as the use of maize narrow-crib and the inputs associated with it. The research question suggest that the adoption of maize narrow-crib is likely to be affected by four categories of factors namely : household charactertistics, innovation characteristics, environmental factors and institutional factors. These provide the basis for thematic exploration of the literature on adoption in this chapter.

2.1 HOUSEHOLD CHARACTERISTCS AS DETERMINANTS OF INNOVATION ADOPTION IN SMALLHOLDER AGRICULTURE

CIMMYT (1993) provides a guide to the household characteristics likely to affect adoption. They include: wealth, gender, age of household head, type of education, in, experience, language spoken, leadership status, household size. These determinants of adoption have been well considered in similar studies in the past and proved to be influential in adoption of agricultural innovations. The findings and relationships between these and adoption are presented below.

- Wealth / Farm size

It is often assumed that large scale farmers will be more likely to adopt a technology, especially if the innovation requires an extra cash investment . It may be that a certain farm size is necessary before the investment in a technology is worthwhile. Or it may be that on larger farms different management practices (e.g.,mechanisation) are used, making a recommendation more appropriate for them. On the other hand, certain technologies are more appropriate for intensive management characteristics of smaller farms (or at least of farms with a higher ratio of labour to land). Finally, farm size may be

related to access to information or credit that would facilitate the adoption of recommendation. (CIMMYT, 1993).

Arnon (1981) observes that in most developing countries, part of the land is either excessively split up into very small production units that are difficult to farm economically and part is concentrated in the hands of a few large land owners. Furthermore, the same author stressed that a major problem of small farms usually due to traditional inheritance producers is excessive fragmentation that may even defeat the purpose of land reform. Farm size can have different effects on the rate of adoption depending on the characteristics of the technology and institutional setting.

Considering the effect of farm size on relative land allocation, Feder et al. (1985) showed that the share of the modern crop depends on the relationship between relative risk aversion and income. Although there is no definite theory regarding this relationship, when utility is defined over income in excess of the subsistence level, the share of area allocated to the modern crop increases with farm size. A factor which may explain a positive relationship between farm size and the share of the modern crop is the existence of fixed transaction costs and information acquisition costs associated with the new technology as shown in Feder et al.(1985).

Wealthier farmers may be first to try a new technology especially if it involves purchasing of inputs. This may be because wealthier farmers are more able to take risk or have better access to extension information or to credit, or they may be able to use their own cash resources to experiment with a new techniques. (CIMMYT, 1993). Poison and Spencer (1992) have used this variable as binary variable in a study of the adoption of a variety of cassava in Nigeria and have a positive relation between the adoption probability and the farmers' income.

- Gender

Russo (1989) reported that access to formal credit services is often an insurmountable barrier to women. Olawoye, (1993) contended that the rural men have traditionally been the recipients of most of agricultural extension services. However, Spring (1986) pointed out that the assumption that agricultural messages given to men would trickle down to their wives has not usually occurred. Apart from CIMMYT which has insisted that the gender should be investigated in innovation adoption studies, generally adoption studies did not involve this variable in the models.

- Age

Studies have shown that age of farmers is related to adoption decision. A farmer's age may influence adoption in one or several ways. Older farmers may have more experience, resources or authority that would allow them more possibilities for trying a new technology. The literature presumes that younger farmers are more inclined to accept innovations than older ones because they are more knowledgeable about new practices and may be more willing to bear risk due to their longer planning horizon (Poison and Spencer, 1992); however, there are as well observations that elders in African traditional communities are widely accepted as superior because of their experiences and decisions relating to the adoption of innovations are positively influenced by these factors (Pannin, 1988).

- Education

Education may make a farmer more receptive to advice from an extension agency or more able to deal with technical recommendations that require a certain level of numeracy or literacy. Vissoh(1994), found that the level of education has significant relationships with crops rotation.

Informal education may be important as well (CIMMYT 1993). Petzel (1976) stated that farmers with better education are earlier adopters of modern technology and apply modern inputs more efficiently through the process.

- Experience

General farming experience is not relevant for empirical model since most farmers judge their total experience as starting from the first day that they started going out with their parents to field. What is important is the experience since the farmer became a decision maker on his own field (Mueller and Jansen, 1988). Therefore his experience will influence his adoption behaviour in one way or another.

- Leadership status

Haiman (1951) postulated that the extent to which new techniques are adopted by followers will largely be influenced by the adoption behaviour of the leadership. The same author has defined leadership as the process whereby an individual guides, influences or controls the thoughts, feelings or behaviour of other human beings. The maintained

hypothesis is that the leadership status of the farmer is positively related to maize-narrow crib adoption behaviour.

2.2 INSTITUTIONAL FACTORS AS DETERMINANTS OF INNOVATION ADOPTION IN SMALLHOLDER AGRICULTURE

The institutional factors which could influence the adoption behaviour of innovations include credit, subsidies, extension activities, extension contact, and source of information. The adoption of any technology which needs a significant cash investment by farmers, may be facilitated by an efficient credit programme. If the majority of adopters use credit to acquire the technology, this is of course a strong indication of credit's role in diffusing and adopting the technology. For the extension actions concerning maize narrow-crib introduction, some subsidies given by SASAKAWA GLOBAL 2000 Project were available to the farmers.

Many farmers who do not adopt may complain of a lack of cash or credit as the principal factor limiting their adoption. The credit programme may obligate farmers to use a particular technology. The credit may be offered as a package that provides a set of inputs to farmers. Parts of the package may be " adopted " simply because of this obligation although farmers may feel that they are inappropriate or unprofitable. Bhalla (1979) found that lack of credit was a major constraint for 48 percent of small farmers and only 6 percent of large farmers in India. This was confirmed by Berry and Cline (1979) who found that larger farmers adopted the techniques of the Green Revolution in Asia while small farmers have lagged behind. For Bhalla (1979) if access to credit is unequal, small farmers might be severely constrained in their desire to innovate. On the other hand, others have argued that lack of credit alone does not hinder adoption of innovation that are scale neutral. Rangaswamy (1972) suggested that since partial adoption and low level of input use are possible, a lack of credit should not be an absolute barrier to the use of a high yielding variety. In this study, the subsidy given to farmers could be considered as credit since they are supposed to pay back the loans.

- Extension Contact

In many cases, differences among groups arise from differences in the resources they manage or differences in farming systems or practices among the groups. Another possible explanation for such differences is that one group may have better access to government services (CIMMYT 1993). The contact with extension agents is expected to have a positive effect on adoption based upon the innovation-diffusion theory. Such

contacts, by exposing farmers to availability of information can be expected to stimulate adoption (Polson and Spencer, 1992).

Many findings revealed that younger, better educated farmers have more contact than other farmers with information sources such as change agents (Nowak 1987, Rogers 1983). Akinbode (1969) pointed out that the extent to which farmers use information sources could also be influenced by their socio-economic status. The more the farmers are exposed to extension agents the more likely they will adopt innovations.

- Source of Information

Some authors found that farmers who belonged to the higher castes, were literate and had higher participation in community activities. William, (1968) stated significant positive relationship between all the social participation variables and the dependent variables (innovativeness and opinion leadership) ; he reported that the extension agent still plays an important role as source of information and hence exerts considerable influence on adoption of recommended agricultural practices. Pradesh cited by Dasgupta, (1977) found that most of the information on new technology was transmitted by extension agents who prefer contacts with the richer and larger farmers and further diffusion of this knowledge is limited to their relation and friends. Any innovation to be easily and widily adopted should have certain characteristics. Some of these characteristics would be investigated in this study.

2.3 INNOVATION CHARACTERISTICS AS DETERMINANTS OF ADOPTION IN SMALLHOLDER AGRICULTURE

The innovation characteristics are those who are related to the innovation itself such as:

- Relative Advantage

The relative advantage of an innovation is the degree to which it is perceived as being better than the idea it supersedes (Rogers, 1983). Ogunfiditimi (1981) stated that, if the foreseen profits from the adoption of the new farm practice do not exceed the one obtainable without the introduction of the new farm practices enough to justify the extra risk, chances are that the new farm practices will be rejected.

Correlation of outputs under alternative technologies play an important role in determining adoption rates. In particular, if the correlation of outputs under old and new

technologies is low or negative and if the modern technology is sufficiently more risky than the traditional technology, then large farms will devote more land in absolute terms but less land in appropriate terms to the new technology than will smaller farms.

The Innovation Cost

The failure of a new technology to be accepted is sometimes attributed to risk aversion on the part of farmers. There is also the perception that some farmers are more willing to take risk than others. Besides the obvious fact that wealthier farmers will almost certainly be more willing to invest in testing a new technology, there is little in the literature that gives us a firm grounding for comparing risk attitudes to adoption behaviour.Certainly in many cases, resource-poor farmers have come to adopt practices such as growing high value cash crops that entail considerable risks, (CIMMYT, 1993).

2.4 ENVIRONMENTAL FACTORS AS DETERMINANTS OF INNOVATION IN SMALLHOLDER AGRICULTURE

The environment within which the farmers operates highly influences his decision as far as adoption of innovations is concerned. Among these factors are : geophysical factors for example (climate, soil) and sociological factors (culture, norms, attitudes, values), economic factors (market availability). The geophysical factors especially the climate have been taken into account when introducing the maize narrow-crib. That is the reason why it was introduced in the southern regions where there are two rainy seasons. Before any innovation can be adopted, it should be perceived by the farmers as culturally acceptable innovation and as innovation which fits in with the societal norms, value and attitude. The farmers' positive perceptions of the technology's specific characteristics in relation with his social and cultural environment are expected to positively influence his decision behaviour.

The likelihood of adoption increases the better physical environment of the farm. A more favorable environment (better soil and water availability for example) increases the expected utility of income from modern production and hence, increases the probability that a farmer will adopt the new technology (Nelson and Phelps, 1966).

Feder et al.(1985) assumed that uncertainty is associated only with the new crop which, unlike the traditional crop, requires the use of fertilizers. Empirical evidence shows contradictory patterns; it is abvious that results depend on other components in the model such as land quality (irrigated or not).

CHAPTER THREE

METHODOLOGY

3.0 THE STUDY AREA

This study was undertaken in 4 regions in Benin (see Figure 5 and Figure 6). One in the central part (Zou) and three in southern part (Atlantic, Mono and Ouémé) of the country.

Benin is located in the West Coast of the African Continent and shares common boundaries with Niger in the North, Burkina Faso (former Upper Volta) in the North-west , Togo in the West and Federal Republic of Nigeria in the East. It is limited in the south by the Atlantic Ocean. Figure 5 shows the map of Benin which has a lengthened form and covers an area of 112,622 km^2. The relief is rough and shows 4 main geographical zones:

- the coastal plain,
- the plateau,
- the low land,
- the Atacora mountains.

The population is estimated to be 4,700,000 people (INSAE, 1992) ; two-third of this population is concentrated in the southern part of the country. The annual rate of population growth is 3% and the youth are in the majority.

Figure 4 : **Map of Benin.**

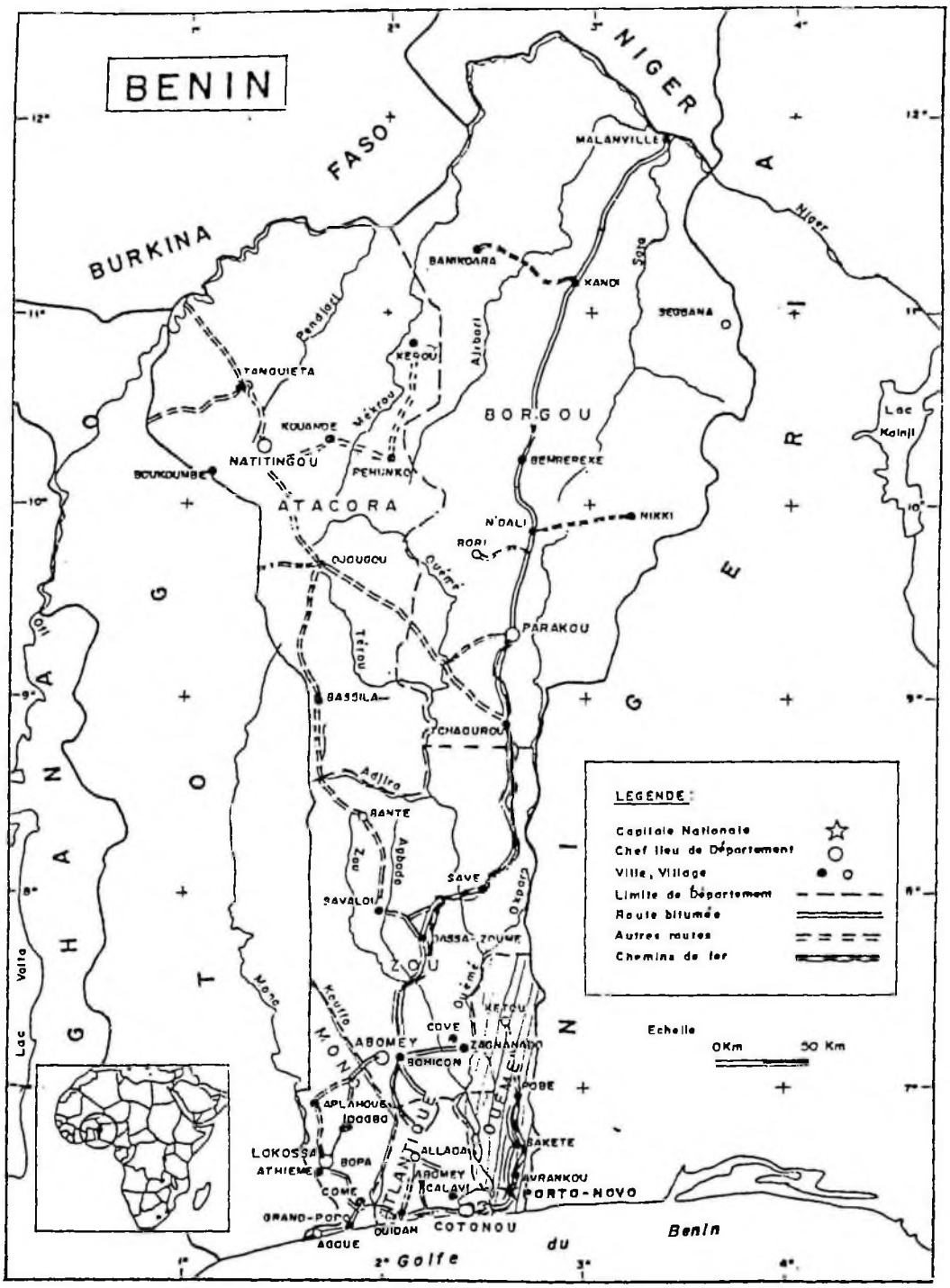
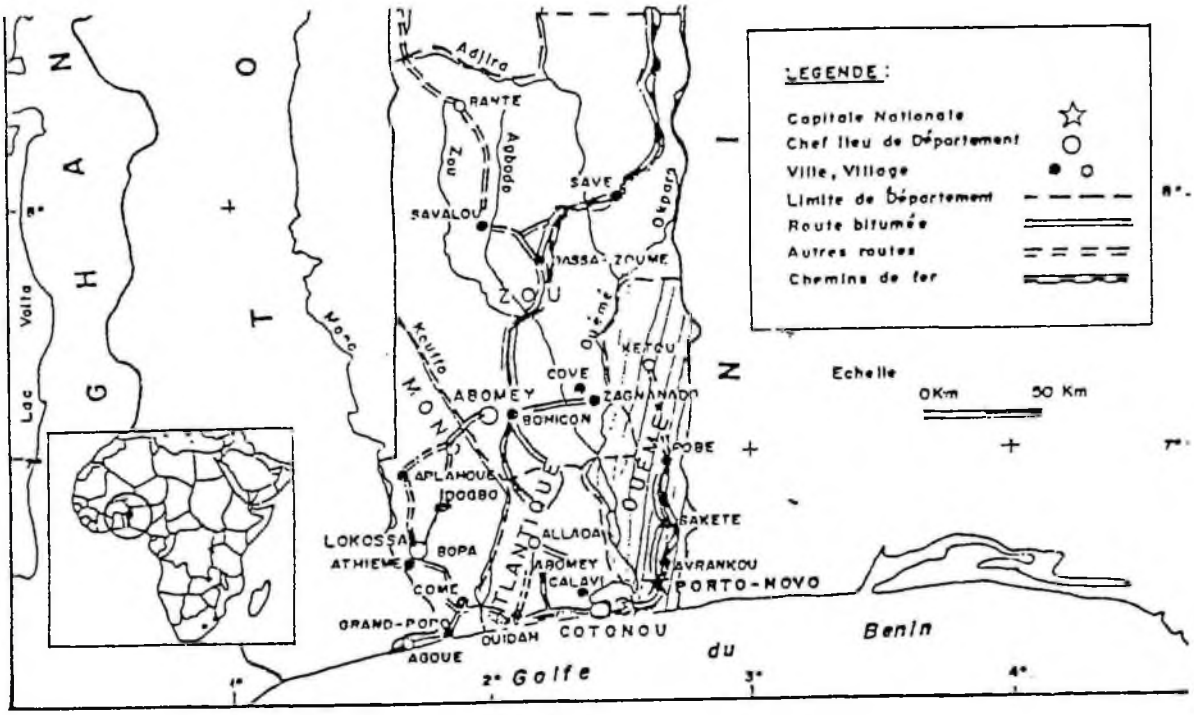


Figure 5: Map of south Benin.



Benin has 3 different climates:

a) The sub-tropical climate with 4 seasons in the south. This climate is characterised by the bimodal rainfall pattern. The first rainy season begins from mid-March and stop till mid-July, this rainy season is favourable to the growing of late maturing varieties of maize and planting of trees . It is followed by a short dry season from mid-July to mid-September. The second rainy season which is favourable only for the fast maturing varieties of crops commences in September and ends in mid-November.

b) The Soudanean climate, marked by 2 seasons in the North and Northern part of the Center.

c) Atacora climate with 2 seasons in the North West near the Atacora mountain .

s from 1100 to 1500 mm. However, the climate has been

. The annual evaporation is below 1,000mm.

3.1 SURVEYING AND SAMPLE CHARACTERISTICS

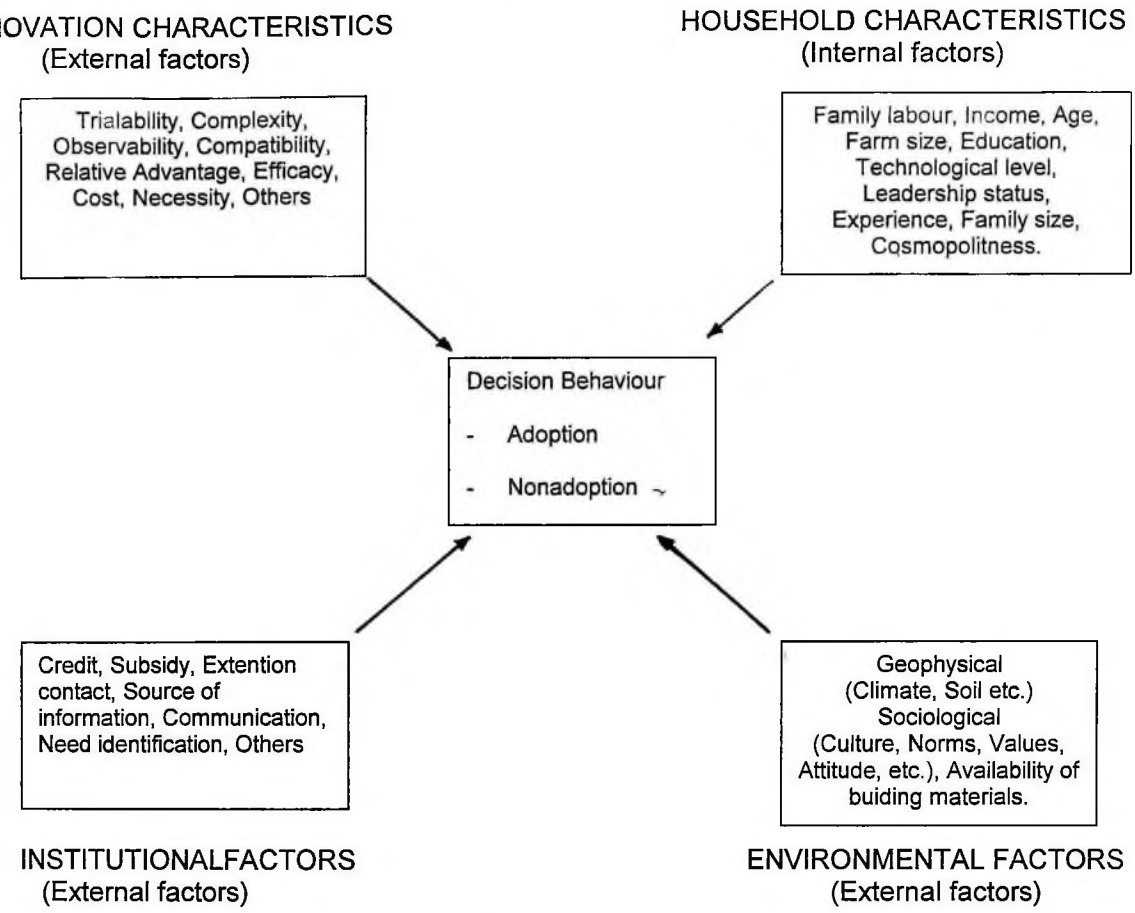
For this study, data have been collected during a field survey from some farm households heads (as unit of analysis) which were randomly selected and interviewed with respect to the use of maize narrow-crib.

3.1 .1 SAMPLING PROCEDURE

In accordance with the objectives of this study the field survey was conducted in such a way that the south zone of the country was covered. Each region was divided into two parts (North and South). In each part one subregion was selected among the subregions, where the crib was demonstrated. In each selected subregion two villages were chosen. In each village, all the crib adopters were selected since they were not numerous. The work sample was selected to get the total number of 10 respondents per village including those who have adopted as well as those who haven't adopted. The crib non-adopters were randomly selected from a list of all the farmers in the village who are supposed to have been aware of the technology. The demonstrated crib owners were excluded from the sample since the demonstrated maize narrow-crib were not build by the farmers themselves.

The size of selected crib non-adopters was proportional to the targeted population size. The number of respondents was specified after the preliminary survey and was 160 in total for the sample. Figure 6 shows the villages where the survey was conducted. In all, 49 adopters and 111 non-adopters were selected.

FIGURE 6 : INNOVATION ADOPTION DECISION BEHAVIOUR MODEL



SOURCE : ADAPTED FROM COURSE NOTES AND LITERATURE REVIEW

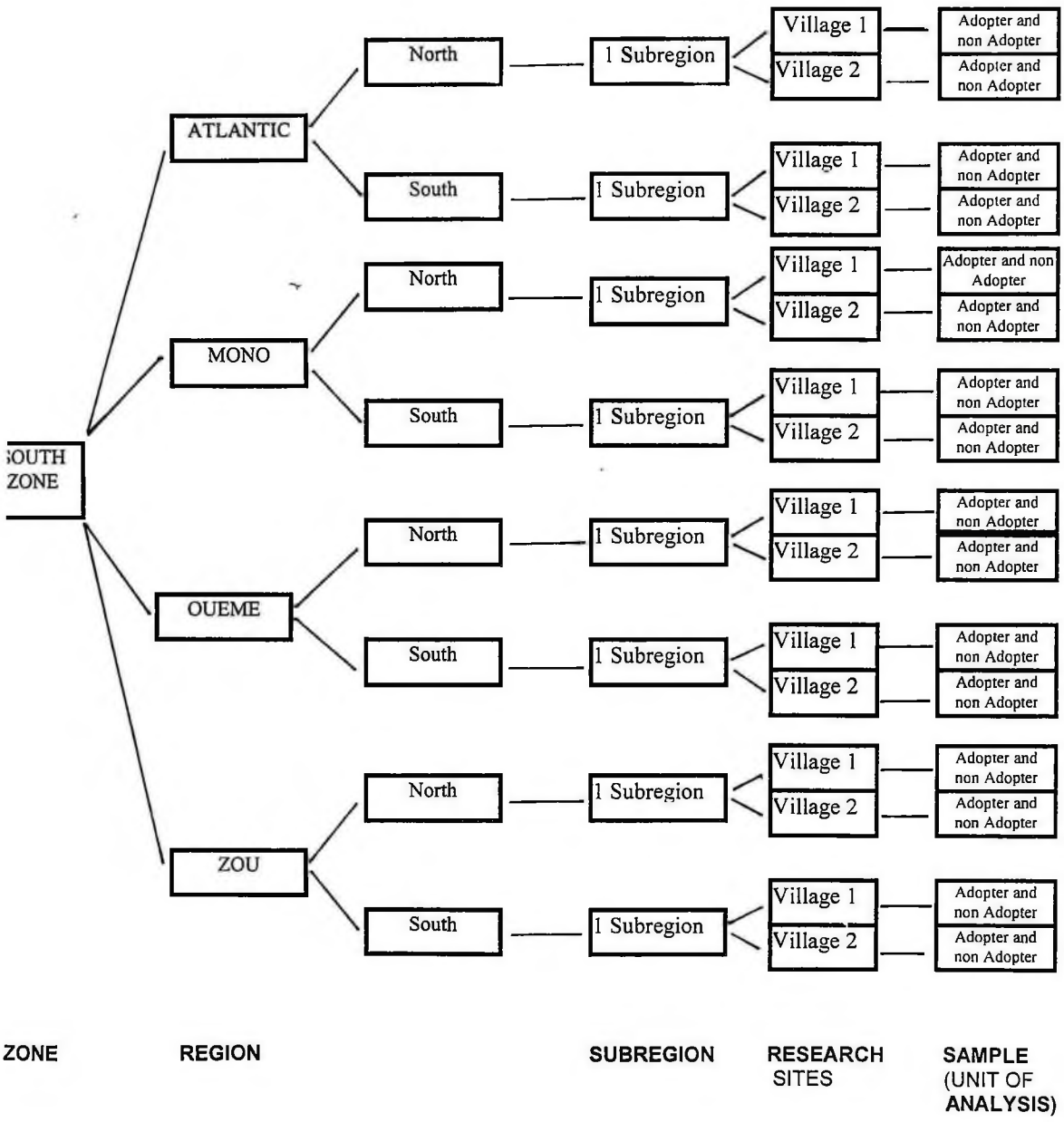
3.1 .2 DATA COLLECTION INSTRUMENTS

Information from the households was gathered through interviews. These were conducted by trained enumerators who speak the local languages using a pre- tested questionnaire. The questionnaire is structured in such a way that information on all practices under question both from users and non users are recorded, (see Appendix 4).

The questions were on households structure and characteristics, frequency of extension visits, crop yields, prevailing maize output prices at village level, credit availability, etc... .

Qualitative and quantitative data were collected through structured questionnaires, observations, and measurements.

Figure 6 : **Sampling procedure** (Cluster Random Sampling)



3.2 DATA ANALYSIS

3.2.1 DESCRIPTIVE ANALYSIS

In order to describe the work sample, some relative frequencies were calculated. These frequencies concerned the rate of adoption per region, the rate of adoption per category of age and sex, the rate of adoption was calculated by dividing the number of adopters by the number of concerned people (number of awared farmers), the extension contacts frequencies, the relative frequency distribution of age and the distribution of gender and so on. The descriptive analysis will shows which of the factors among innovation, institutional, environment and households, have influenced the adoption decision behaviour of the farmer and if there is any difference between adoption scores from different regions (Atlantic, Ouémé, Mono and Zou). For this purpose the Chi-square test was used for continuation of the extent differences or relationships.

The use of chi-square test for such studies is not new. The Chi-square test was calculated as follow :

$$\chi^2 = \sum(n_k - n_{pk})^2 \; / \; n_{pk} = \Sigma (0 - T)^2 \qquad (1)$$

Where 0 = observed proportion

T = Theoretical proportion

The degree of freedom for χ^2 is $\partial = (r - m - 1)$

Where

r = number of observations

m = number of estimated parameters

If $\chi^2 < \chi^2$ then the null hypothesis is accepted

$\chi^2 > \chi^2$ then the null hypothesis is rejected

The null hypothesis means that there is no significant difference between dependent and independent variables

3.2.2 CHOICE OF EMPIRICAL MODELS

The adoption of agricultural technology is primarily a function of a set of socio-economic, personal, institutional, cultural, and geophysical conditions that directly or indirectly influence the basic properties of the technology in question (i. e. profitability, divisibility, adaptability, and its liability to risk), the characteristics of the farm household, and the availability of the technology itself.

Application of qualitative choice models in explaining socio-economic phenomena are not new (some recent examples are ; Crapps and Kramer, 1985 ; Akinola 1987; Hailu, 1990; Polson and Spencer, 1992; Bagi, 1983; Lee, 1983). Qualitative choice models are important in analysing relationships involving a discrete dependent variable. Moreover, the use of the models will help to know the level of significance of the factors which have been found to explain the adoption behaviour of the farmer.

In such relationships, the probability of an event occurring is a function of a set of non-stochastic explanatory variables and a vector of unknown parameters. The adoption decision depends on a vector of X influential factors and a vector of unknown parameters ϕ . Nevertheless, a positive decision takes place only when the combined effect of the influential factors (Xi ϕ) reaches a certain unobservable critical value Ti. This critical value (Ti) reflects the individuals decision threshold and plays the role of the error term (Goldberger, 1964).

If Yi is a decision variable, it takes the value of 1 when a positive decision occurs and 0 otherwise. The dichotomous adoption decision model for the ith household could be specified as follows :

$$Yi=1 \text{ if } X'i\ \phi > Ti$$

$$Yi=0 \text{ if } X'i\ \phi < Ti \qquad (2)$$

The probability that $X'i\ \phi > Ti$ (Yi=1) or $X'i\ \phi < Ti$ (Yi=0) is thus :

$$Pi = Prob\ (Yi=1\ ) = G\ (X'i\ \phi)$$

$$\text{and} \qquad 1- Pi = Prob\ (Yi=0\ ) = 1- G\ (X'i\ \phi) \qquad (3)$$

When following Amemiya (1981), In (3), G (X'i ϕ) represents a distribution function evaluated at the value of the argument. It is well documented in the literature that the

specification of G(X'i ϕ) as a linear probability functional form and estimating the unknown parameters with the use of least square regression models have been found to be inefficient for a number of reasons :

a) because of the dichotomous nature of the dependent variable , the error term is found to be heteroskedastic , varying systematically with the exogenous variable Xi ;

b) since the linear probability function is unbounded, values of X'i ϕ that are outside the unit interval (0-1) could be predicted which is incompatible with the basic definition of probability.

c) classical tests of significance for the estimated coefficients are not applicable since the estimated standard errors are not consistent, (Goldberger;1964; Judge,1985; quoted by Poison and Spencer , 1992).

To overcome these estimation difficulties of dichotomous choice models a number of other alternative approaches have been developed. Otherwise, because of the unknown functional form of G, practical applications of the model are not feasible (Amemiya, 1981,); therefore, an explicit functional specification of G is necessary. Four functional relationships often specified are the Linear probability , Probit, Logit and Tobit models. An important question in this context is the appropriateness of the choice of functional forms used and the selection criteria among alternative model specifications . While choice of model can be justified on the basis of underlying theory (Crapps and Kramer, 1985), Amemiya, (1981) states that the statistical similarities between the Logit and Probit models make such a choice difficult . Choice of any one model is, therefore, not dominant and must be evaluated after the fact on statistical ground. For this study the statistical criteria used for evaluating alternative specifications were :

a) The percentage of correct predictions

b) McFadden's R^2, and

c) The likelihood ratio test

The use of linear regression for such empirical research does not produce a reliable estimation. When the dependent variable is dichotomous, the application of the linear regression is more complex.

3.2.2.1 THE PROBIT MODEL

For the Probit Model X'i ϕ is a normally distributed random variable and the estimated value of the dependent variable are converted into probabilities (for any given value of Xi) with the use of the cumulative normal distribution which is given by :

$$G(X'i\,\phi) = \int_{-\infty}^{x'\phi} \frac{1}{\sqrt{2\pi}} e^{-t^2/2}\, dt \qquad (4)$$

Where t is a random variable distributed as a standard normal deviate, i. e. , t is N(0,1). Thus, the probability of a positive decision (Yi =1), is the area under the standard normal curve between -∞ and X'i ϕ. The larger the value of X'iϕ, the more likely adoption will take place (Hanushek and Jackson, 1977). The parameters in the Probit model are estimated by maximum likelihood methods. The likelihood function is specified as the product of the probabilities of both alternatives : adopt P(Yi=1) or not adopt P(Yi=0) or 1-Pi(Yi=1).

Another approach to handle adoption of innovation study is the use of Logit model described below.

3.2.2.2 THE LOGIT MODEL

The Logit model is a logistic function which is normally distributed like the Probit model given by :

$$G(X'i\,\phi) = \frac{1}{1+e^{-(X'i\,\phi)}} \qquad (5)$$

The Probit and Logit distributions are symmetric, the mean is as well equal to 0. They provide information only with respect to the household decision to adopt or not adopt but not on the intensity or the way of maize narrow-crib utilisatuion. The use of linear regression models as well does not produce a reliable estimation.

The significance of all or a subset of the coefficients in the models will be done by the log likelihood ratio test (LRT) which is chi-square (χ^2) distributed with k degrees of freedom, where k is the number of parameters in the model less the constant and is calculated as:

$$-2 \log \lambda = -2 (\log Lmin - \log Lmax) \quad (6)$$

Lmin =log likelihood value of the constant only.

Lmax = log likelihood value when all variables are included in the model (Pindyck and Rubinfeld,1983).

On the basis of this test the null hypothesis which asserts that there is no relationship between the dependent variable and the explanatory variables in the model, is rejected if the value of the statistic exceeds the chosen critical value.

Several past studies have explored the relationship between the adoption of improved agricultural technologies and a range of factors that determine adoption with the use of analytical models just described. To mention a few of recent experiences : Akinola and Young (1985) applied Tobit model to analyse the adoption and use of cocoa spraying chemicals in Nigeria. Shakya and Flinn (1985) used Probit and Tobit models to examine the adoption of modern varieties and fertiliser use on rice in Nepal. Hailu (1990) used Tobit model to examine the adoption and use of fertiliser in Ghana. Poison and Spencer (1992) used Probit and Logit models to examine the technology adoption process in subsistence Agriculture in Nigeria. All these models allowed us to analyse the phenomena by a computer programme called SHAZAM , version 7.0.

3.3 CHOICE OF VARIABLES AND WORKING-HYPOTHESES

In accordance with the main objective of this study, the explanatory variables have been chosen among factors from all four areas of concern. These include household characteristics (age, household size, number of agricultural active members, type of education of the household head, experience and wealth of the household head, the leadership status of the household head, the cosmopolitness of the household head, the household head's perception on the necessity to build a crib as well as the language he speaks), innovation characteristics (the construction difficulties, the trailability of the innovation), the environmental factors (the availability of building materials in the region, the culture), and the Institutional factors (the extension contact, the need identification, the availability of subsidy, the language spoken by the extension officer, the source of information).

TABLE 1 : DEFINITION OF VARIABLES IN MODEL SPECIFICATION

Variables	Designation	Unit or type	Description	Expected signs
1 Adopt	ADOPT	Binary	1, if household adopts crib 0, otherwise	
2 Income	AIN	Continous	Income amount in F CFA of the household head	+
3 Age	AG	Continous	Age of household head measured in year	-
4 Education	EDU	Binary	1, if household head has formal education 0, otherwise	+
5 Leadership status	LEA	Binary	1, household head is leader 0, otherwise	+
6 Experience	EXP	Continous	Number of years	+
7 Source of Information	INF	Binary	1, if household is informed of the innovation by formal source(SG2000), 0, otherwise	+
8 Household size	HSI	Continous	Number of household members	+
9 Language spoken	COF	Binary	1, household head speaks the same language with the extension officer, 0, otherwise	+

10 Cosmopolitan	COS	Binary	1if household head often travels, 0, otherwise	+
11 Needs identification	NEE	Binary	1, if extension officer has identified farmers need before introducing the crib, 0, otherwise	+
12 Subsidy availability	ASU	Binary	1, if household head has access to subsidy, 0, otherwise	+
13 Construction difficulty	DIF	Binary	1, if construction is difficult 0, otherwise	
14 Construction cost	CRI	Continous	Crib construction cost in CFA	-
15 Trialability	TRI	Binary	1 if Crib construction is trialable 0 otherwise	+
16 Necessity	NEC	Binary	1, if for the household head the crib is necessary, 0, otherwise	+
17 Agricultural active members of the household	ACT	Continous	Number of valid household members	+
18 Region (Culture, Availability of building materials)	REG	Binary	1 if the crib fit in with the culture , the norms and building materials available) 0 otherwise	

NOTE : + = RELATIONSHIP IS HYPOTHEZISED TO BE POSITIVE

- = RELATIONSHIP IS HYPOTHEZISED TO BE NEGATIVE

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.0 INTRODUCTION

This chapter describes the norm value for each of the variables and the extent to which each component affects the phenomena under investigation (Adoption of maize narrow-crib) in its first section. The significance of those factors using empirical analysis (Logit and Probit models results) in the second section, the description and discussion of major findings in the third section and the implications of findings in the last fourth section.

4.1 DESCRIPTION AND IDENTIFICATION OF ADOPTION FACTORS

4.1.1 GENDER AND ADOPTION

For the total sample of 160 people, males are more than females (86.89 % against 13.11%). This observed proportion of men shows that the sample contained more men than women. Specifically, in Atlantique region men are more than in the other regions whereas women are more in Oueme region than in the other regions (Table 2).

This is consistant with the general pattern in southern Benin. In southern Benin, men are more involved in agriculture than women. In Atlantic, the same pattern is observed as compared with the other regions. In the other hand, women are more involved in agriculture in Oueme and Zou than in Mono and Atlantic. Table 3 shows that women (33.3%) have shown more positive attitude towards maize narrow-crib construction than men (30.2%) ; even though the difference between men and women with regard to maize narrow-crib adoption is not significant.

The fact that it is not statistically significant shows that it is not important or there is no difference between men and women with regards to adoption. In Appendice 2, the ranking of the regions with regards to adoption is highest for Zou,followed by Mono and the others.

The highest rate of adoption among women was in Zou region. Zou is one of the southern regions where women are well involved in agriculture and they are well inclined to adopt the maize narrow-crib. In spite of the fact that relatively more women have been selected in Oueme region (cf Appendice 3), none of them have adopted the maize narrow-crib (Appendice 2). The explanation to this could be found in the fact that in this research

ite women do not produce enough quantity of maize, therefore maize storing does not eem to be a felt need for them. Women in this region are more involved in business ctivities since their location is closed to Nigeria, they sell items bought from Nigeria like oap, petrol, kerosene.

Appendice 2 shows that the adoption rate among men is quite higher in Oueme ollowed by Mono (91.7%) and slightly less in Atlantique region (81.9%) and Zou (73.3%).

However, the adoption rate among women is null in Oueme and very low (8.3%) in Mono. In fact, women farmers in this part of the country are more interested in other crops tomato, pepper, okra, etc) than in maize whereas maize production is mainly men's activity. In addition, Table 4 shows that the difference between regions with regard to the adoption of maize narrow-crib is not statistically significant as shown by the chi-square test.

TABLE 2 : GENDER DISTRIBUTION OF RESPONDENTS IN THE SAMPLE

GENDER	ATLANTIQUE n= 40	MONO n= 40	OUEME n= 40	ZOU N= 40	TOTAL N= 160
MALE	23.13	21.88	20.63	21.25	86.89
FEMALE	1.87	3.12	4.37	3.75	13.11
TOTAL	25.0	25.0	25.0	25.0	100.0

Source : Field Survey, 1997

TABLE 3 : GENDER AND ADOPTION

Adoption / Non-adoption	Gender				TOTAL	
	MALES		FEMALES			
	n	%	n	%	N	%
Adopted	42	30.2	7	33.3	49	30.6
Not Adopted	97	69.8	14	66.7	111	69.4
Total	139	100	21	100	160	100

χ^2 = .08 df = 1 (NS)
*** = Overall Adoption rate**

Note : N . S = Not Significant

Source : Field Survey, 1997

TABLE 4: REGION AND ADOPTION RATE

DECISION BEHAVIOUR	ATLANTIQUE n= 40	%	MONO n=40	%	OUEME n=40	%	ZOU n=40	%	TOTAL N=160	%
ADOPT	11	27.5	12	30.0	11	27.5	15	37.5	49	30.6*
NOT ADOPT	29	72.5	28	70.0	29	72.5	25	62.5	111	69.4
TOTAL	40	100	40	100	40	100	40	100	160	100.0

χ^2 = 1.26 df = 3 (NS)

Note : N . S = Not Significant

Source : Field Survey, 1997

The extension officer should essentially deal with women farmers in the region where they are well involved in agriculture and are inclined to adopt such innovations. In Oueme region, where women are essentially involved in some other manufactured products selling like milk, sugar, cloths, petrol, kerosene, etc...imported from Nigeria, they are not very interested in maize storing. It is therefore obvious that they will not adopt the maize narrow-crib as in Zou. The extension officer to be successful, should essentially deal with women who produce more maize and are not so involved in business or any other secondary activity.

4 1. 2 FARMERS' AGE AND ADOPTION

The average age of the sample is 41 years. Farmers ageing between 41-70 years old are more inclined to adopt maize narrow-crib (23.7%) than those ageing between 10-40 years old. The most unreceptive are the younger farmers. Their ages range from 10 to 40, and they are less in the work sample (43.7%). (Table 5).

In total, Table 5 shows that the highest percentage of adoption (23.7%) is observed with elder farmers whereas the higher percentage of non adoption (36.9%) is obtained with young farmers. The lower percentage of adoption (6.9%) is far lower than the mean of adoption (30.6%). The observed difference is statistically highly significant at 10% and is due to the fact that elder farmers tend more to adopt the maize narrow-crib than the young farmers.

TABLE 5 : FARMERS' AGE AND ADOPTION

AGE / BEHAVIOUR	YEARS				TOTAL	
	Young (10- 40 years)		Old (41-70 years)			
	n	%	n	%	N	%
ADOPTERS	11	15.7	38	42.3	49	30 .6*
NON ADOPTERS	59	84.3	52	57.8	111	69. 4
TOTAL	70	100.0	90	100.0	160	100 .0

*= Overall Adoption Rate

χ^2 =13.03 df=1 (h.s.)

Source : Field Survey, 1997

4.1.3 IN8STITUTIONAL FACTORS AND ADOPTION

Mono and Zou results have shown that more adopters were informed by SG 2000 as source of information (3O %) than in Oueme (22.5%) and Atlantique (12.5) where extension did not seem to perform well. Extension officers in Ouémé and Atlantique are more involved in private activities than in their official duty. For a successful extension farmers' needs should first be identified. Evidence from the research shows that in Mono, 27.5% of the farmers revealed that their need was identified followed by Atlantic, 25.5%, Zou 25% and Oueme 22.5%.

4O,OOO F CFA were given as a subsidy to each extension officer to help at least two interested farmers to buy some building materials for the maize narrow-crib construction. The study results show that apart from Zou where 27.5% of farmers have responded that they have heard about a benefit from the subsidy only few farmers in Oueme (7.5%) and Atlantique (2.5%) and Mono (0.0%) were informed of the availability of subsidy.

The extension officers, instead of giving the subsidy to farmers preferred using it for their own business. The subsidy scheme was not very well supervised since some of the regional coordinator who were supposed to go field, prefered staying in their office by saving the provided car fuel. Hence, the availability of the subsidy could not serve the purpose it was meant for.

The contact between extension officers and farmers was higher in Zou region. In total, 47.5% of respondents revealed that they are in contact with extension officers followed by Mono region 37.5%. The contact between extension officiers and farmers is less in Oueme and Altantique where the scores were 25% and 2O% respectively. This result is in conformity with what has been found previously, concerning the source of information. The highest percentage of extension contact (47.5%) is observed in Zou region and is much higher than the mean of extension contact (32.5%).

The interaction or collaboration facilitates the communication between two people. That is why people who are in contact with each other have great chance to communicate well. Therefore, the communication result is in conformity with the extension contact and with the result of the source of information.

The higher percentages of respondents who were informed by SG 2000 is observed in Oueme and Zou (40.0%) respectively. This value is lower than the mean (46%). In total, few farmers were informed by SG 2000. The difference is significant with regard to extension contact as well as the source of information variables from one region to another. Chi-square tests of of the proportion of farmers in each category showed significant differences between the different regions in two aspects : source of information and extension contact. (Table 6).

The explanation to this is that because of the coordination activities, extension officers are more in contact with farmers in Zou region than in other regions. They have informed more farmers in Zou and Oueme regions and most of the extension officers speak the same language with their farmers.

TABLE 6 : INSTITUTIONAL FACTORS AND ADOPTION

	CHI- SQUARE VALUES			
VARIA8BLES	ATLANTIC	MONO	OUEME	ZOU
Awareness	0. 04	0.09	1.68	0.12
Source of information	14.22 s.h.	24.23 s.h.	32.30 s.h.	36.0 s.h.
Need identification	0.04	1.72	0.10	0.03
Subsidy availability				24.50
Extension contact	2.54 s.h.	21.46 s.h.	26.12 s.h.	14.77 s.h.
Communication	8.23 s.h.	10.28 s.h.	30.67 s.h.	27.31 s.h.
Farmer's satisfation	1.04	1.72	0.36	0.89

s.h. = Significant hypothesis

Source: Field S2urvey, 1997

4.1.4 HOUSEHOLD CHARACTERISTICS AND ADOPTION

Almost few respondents have formal education (12.5% in Mono, Oueme, Zou and 2O% in Atlantique). Therefore, there were more educated farmers in Atlantique region than in Mono, Oueme and Zou where people were more involved in business activities.In Mono, 30% of respondents had agriculture as main activity.

In Oueme region which shared boundry with the Republic of Nigeria, agriculture is the main activity for just 22.5% of farmers. In Zou region, 27.5% of farmers revealed that

they have travelled outside their countryside followed by Atlantique (22.5%) Mono (22.5%) and Oueme (12.5%).

The number of leaders among adopters is 5 for Atlantique and Zou, 4 and 3 for Mono and Oueme respectively. From Appendice 4, the proportion of respondents farmers who think that it is necessary to build a maize narrow-crib is significantly higher in Zou (47.5%) than in other regions (Mono, 37.5% ;Oueme,25.0% and Atlantique,20.0%). These differences occured to some extent because of some post-harvest problems farmers were facing in the region and the way they were handling the problems. The neccessity to build a maize narrow-crib is a perception variable of the household head and has significantly influence the adoption behaviour of the farmer (Table 7).

TABLE 7 : HOUSEHOLD CHARACTERISTICS AND ADOPTION

VARIA8BLES	CHI- SQUARE VALUES			
	ATLANTIC	MONO	OUEME	ZOU
Education	0. 50	0.27	0.45	0.01
Cosmopolitness	0.20	0.06	0.44	0.41
Main activity	0.20	0.12	1.68	0.41
Crib necessity	2.54	21.46	18.43	9.14
Leadership status	0.60	0.06	1.04	0.67

df =1

Source: Field Survey, 1997

4.1.5 ENVIRONMENTAL FACTORS AND ADOPTION

The possibility to sell the maize after storage at the nearest market has been noticed in Zou region by 27.5% of sampled farmers as we can get from Appendice 4. In Zou, (42.5%) of farmers found that the maize narrow-crib fit in with their culture. In Oueme, there is a possibility to sale the maize at a good price after storing as well but most of the buyers come to the village to buy their product. Since market is not available near the village (2.5%). The Chi-square test applied to the environmental factors showed that only the culture and the existence of market near the farmers' village had significantly influenced farmers' decision behaviour with regard to maize narrow-crib adoption.

The proportion of farmers who revealed that the maize narrow-crib fit in with their culture is much higher in Oueme (47.5%) than in other regions (15%, 17.5%, 42.5%)

respectively for Atlantique, Mono and Zou. This highest observed frequency is even more higher than the mean (30.6%). In Zou more farmers (27.5%) confirmed that there is a market near their village, therefore sale facilities are likely to enhance maize narrow-crib adoption.

TABLE 8 : ENVIRONMENTAL FACTORS AND ADOPTION

VARIA8BLES	CHI- SQUARE VALUES			
	ATLANTIC	MONO	OUEME	ZOU
Building	6.71	13.33	14.46	8.72
Culture	5.43	14.17	7.17	4.97
Norms	0.00	0.63	0.29	0.03
Climate	0.29	0.29	0.41	0.12
Market availability	7.69	13.30	48.31 s. h.	
Price	0.20	0.04	0.20	0.67

df=1
s.h. = Significant hypothesis

4.1.6 INNOVATION CHARACTERISTICS AND ADOPTION

Most of the farmers in the study area have responded that this innovation is not trialable (78.8%). Almost in all the regions farmers revealed that it is difficult to construct the maize narrow-crib (94.4%). Zou region have shown the highest percentage of farmers who revealed that the construction cost is affordable and Appendice 4 shows that Zou is the region where the building materials are more available (37.5%).

Statistically the only significant difference between regions is in the cost of the innovation and this may have occure because of the availability of building materials in the region as shown in Table 9. The higher proportion of farmers who revealed that building materials were available in Zou might cause the significance of this variable. Therefore a region where building materials are available the maize narrow-crib construction cost may be cheaper and this may likely enhance the adoption of the innovation.

TABLE 9 : INNOVATION CHARACTERISTICS AND ADOPTION

VARIA8BLES	CHI- SQUARE VALUES			
	ATLANTIC	MONO	OUEME	ZOU
Trialability	0. 04	1.72	0.02	
Construction cost	35.40	9.64	5.43	14.16
Construction difficulties	0.44	1.61		

df =1
s.h. = Significant hypothesis

It should be pointed out that chi-square do not allow us to make precise predications about individuals. We will establish the nature of the relationship between all the explanatory and dependent variables. Qualitative choice models are important in analysing relationship involving a discrete dependent variable.

The Probit and Logit models analysis will allow us to do and moreover to predict farmers' behaviour.

4.2 PRESENTATION OF LOGIT AND PROBIT MODELS RESULTS

The results of the two models are presented in Table 10. for the Logit and Table 11 for the Probit models as the estimates of the determinants of maize narrow-crib adoption.

TABLE 10: ESTIMATES OF THE DETERMINANTS OF MAIZE NARROW-CRIB ADOPTION : LOGIT MODEL (1997, southern Benin)

VARIABLES	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-VALUES	ELASTICITY AT MEANS	WEIGHTED AGGREGATE ELASTICITY
egion (REG)	0.5685	0.4010	1.4175**	1.1519	0.3808
ge (AG)	-05413E-02	0.7749	-0.6986E-02	-0.1919E-02	-0.6121E-03
ousehold size ISI)	0.6176E-01	0.7715E-01	0.8006*	0.5713	0.1890
gricultural Active embers (ACT)	-0.3614E-01	0.8106E-01	-0.4459	-0.1342	-0.4855E-01
ducation (EDU)	-0.3651	0.6940	-0.5261	-0.1276	-0.4190E-01
xperience (EXP)	-0.7677E-02	0.3058E-01	-0.2511	-0.1680	-0.5390E-01
'ealth (AIN)	0.5758E-06	0.1526E-05	0.3773	0.1447	0.4005E-01
eadership Status EA)	-1.0025	0.9221	-1.0872*	-0.2539	-0.8450E-01
osmopolitness OS)	-0.1567	0.8014	-0.1955	-0.6351^{E}-01	-0.2028E-01
ource of formation (INF	0.7241	0.9649	0.7504*	0.4695	0.1633
xtension Contact XT)	1.5784	1.3472	1.1716**	1.1274	0.3785
eed identification EE)	0.8700	0.8138	1.0692*	0.4848	0.1857
ubsidy vailability (ASU)	-0.1209	0.8676	-0.1393	-0.1776^{E}-01	-0.6420E-02
rialability (TRI)	2.3941	0.7552	0.1701	0.7519	0.3811
ommunication OM)	-1.3094	0.7986	-1.6396**	-0.7959	-0.2383
onstruction ifficulties (DIF)	-0.1538	0.7543	-0.2039	-0.6231^{E}-01	-0.1970E-01
onstruction Cost RI)	4.9573	2.4121	2.0104***	3.9937	1.2512
rib necessity EC)	-1.2496	1.3259	-0.9425*	0.9685	-02921
onstant	-5.2068	2.5012	-2.0817	-4.2201	-1.3328

Likelihood Ratio Test (LRT) 113.51 Significatif at 1%
sample size 160
Estimated rate of adoption 30.62
Observed rate of adoption 30.62
Percentage of right Predictions 91%
Significance Levels : * =80% ; ** = 95% ; *** = 99%
McFadden R^2 = 0.5758

Source: Field Survey, 1997

TABLE 11 : ESTIMATES OF THE DETERMINANTS OF MAIZE NARROW-CRIB ADOPTION : PROBIT MODEL (1997, southern Benin)

VARIABLES	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-VALUES	ELASTICITY AT MEAN	WEIGHTED AGGREGATE ELASTICITY
Region (REG)	0.2597	0.1949	1.3321	0.8732	0.3257
Age (AG)	-08663E-01	0.4055	-0.2137	-0.5098E-01	-0.1777
Household size (HSI)	0.2091E-01	0.3762E-01	0.5558	0.3209	0.1204
Agricultural Active members (ACT)	-0.8228E-02	0.4350E-01	-0.1892	-0.5070E-01	-0.2058E-01
Education (EDU)	-0.2257	0.3703	-0.6095	-0.1309	-0.4835E-01
Experience (EXP)	-0.2413E-02	0.1382E-01	-0.1746	-0.8765E-01	-0.3153E-01
Wealth (AIN)	0.3106E-06	0.8104E-06	0.3833	0.1296	0.4084E-01
Leadership Status (LEA)	-0.5551	0.4810	-1.1331	-0.2333	-0.8554E-01
Cosmopolites (COS)	-0.2926E-01	0.4239	-0.6903E-01	-0.1968E-01	-0.7136E-02
Source of information (INF)	0.3439	0.5029	0.6840	0.3701	0.1456
Extension Contact (EXT)	0.8429	0.7215	1.1682	0.9991	0.3790
Need identification (NEE)	0.5647	0.4409	1.2808	0.5225	0.2263
Subsidy availability (ASU)	-0.3724E-02	0.4714	-0.7901E-02	-0.9080E-03	-0.3743E-03
Trialability (TRI)	1.2070	0.3919	3.0797	0.6291	0.3387
Communication (COM)	-0.6530	0.4345	-1.5027	-0.6587	-0.2263
Construction difficulties (DIF)	-0.5756E-01	0.3796	-0.1516	-0.3871E-01	-0.1366E-01
Construction Cost (CRI)	0.7586E-04	0.1843E-04	4.1160	0.8569	0.2726
Crib necessity (NEC)	-0.5730	0.7499	-0.7641	0.7370	-02546
Constant	-2.7729	1.3308	-2.0837	-3.7298	-1.3346

Likelihood Ratio Test (LRT) 112.453 Significatif at 1%
Sample size 160
Estimated rate of adoption 30.62
Observed rate of adoption 30.62
Percentage of right Predictions 91%
McFadden R^2 = 0.5704
Source: Field Survey, 1997

4.3 DESCRIPTION AND DISCUSSION OF FINDINGS OF LOGIT AND PROBIT MODELS

Most of the parameters in the Probit and Logit models have shown negative signs. The Likelihood ratio tests (113.510 for the Logit and 112.453 for the Probit) are all significant at the 1%, and confirm that some of the explanatory variables in the models as a whole do influence farmers' decision behaviour in the study area. The McFadden R-Square (0.5757 for the Logit and 0.5704 for the Probit) are equal and the percentages of right predictions (0.9125 for the Logit and the Probit) are the same. Since the statistical results are similar for both Logit and Probit models, (See Table 12) the use of one or another model will lead to the same result. Based on this and on the fact that more variables have been shown to be significant in the logit model, only this model will be used for the continuation of the discussion .

TABLE 12 : STATISTICAL RESULT OF LOGIT AND PROBIT MODEL

	Probit	Logit
LRT	113.510	112.453
R^2 McFadden	0.5758	0.5704
Percentage of right Predictions	0.9125	0.9125

Source : Field survey.

Based on the likelihood Ratio test (LRT) the Logit model specified to examine the maize narrow-crib adoption is significant at the 1% level and confirms that some of the explanatory variables in the model as a whole do influence farmers decision behaviour as far as maize narrow-crib adoption is concerned in the study area.

Since the likelihood ratio test is significant at the 1%, the null hypothesis for which all the coefficients are equal to zero is rejected but the alternative hypothesis for which at least one coefficient of variables is not equal to zero or is different from zero is accepted. The McFadden R^2 value (0.5757) is high enough for the qualitative dependant variables

models and is better than those of Houndekon A. Victorin and Gogan A. Arnaud (0.5389) ; Polson & Spencer, 1992 (0.33) ; Crapps and Kramer, 1985 (0.25).

The percentage of right predictions are also high (91%) and prove the validity of the two models to make right predictions. Similarly, according to the asymptotic t-values of the coefficients in Table 10 above, Only seven (9) out of eighteen (18) variables included in the model were found to be significantly related to the adoption of maize narrow-crib in the study area. Some of them have confirmed the hypotheses laid down above, whereas some have not.

These seven (9) variables which were found to be significantly related to the adoption of maize narrow-crib are below.

- Household characteristics : Leadership status (LEA), farmers' perception about the necessity to build a maize narrow-crib (NEC), Household size (HSI)

- Institutional factors : Source of information (INF), Extension contact (EXT), Need identification (NEE) and communication (COM).

- Environmental factors : Region (culture, availability of building materials). These variables have confirmed the hypotheses laid down above. Specifically 6 variables (HSI,NEC, NEE, EXT,LEA and INF) are significant at the 90% level and 2 variables (LEA, EXT, NEE, NEC) are significantly associated with the adoption of maize narrow-crib at the 95% level whereas only one variable (REG) is significantly associated with the adoption of maize narrow-crib at the 99% level.

-Innovation Characteristics: the construction cost

The majority of variables for which the estimated coefficients are significantly different from zero have shown the expected signs. Nevertheless 2 coefficients (LEA and NEC) have shown the opposite signs to the one expected.

The negative sign of the variable which characterised the leadership status (LEA) means that although significantly related to the crib adoption, 50%, of the leaders have adopted the technology (25 out of 50 leaders) whereas 21.8% of non leaders have adopted it (24 out of 110 non leaders). This does not show the expected sign. Fifteen percent (15%) of adopters are leaders whereas 15.6% of non leaders from the total population have adopted the crib. The low proportion of non leaders who have adopted

shows that the leaders have not convinced farmers as much as expected, they would have made the extension worker's task easier by convincing or influencing other members on the necessity of changing their practices.

According to the asymptotic t-values of the coefficients, some of the explanatory variables were not found to be in conformity with the hypotheses established in advance. These variables are :

The age (AG), the number of agricultural active members of the household (ACT), the education (EDU), the experience (EXP), the wealth (AIN), the cosmopolitness (COS), subsidy availability (ASV), Trialability (TRI), the communication aspect (COM), the construction difficulties (DIF), the construction cost (CRI). The communication aspect in this study included only the language spoken by the extension officer and his audience. If they speak the same language then COM = 1 otherwise COM = 0.

4.4 IMPLICATIONS OF RESULTS

Two categories of implications emanated from the results. The first one consisting of the variables for which the coefficients are significantly different to zero and the second one for which the coefficients are not significantly different to zero.

In total seven (9) variables out of eighteen (18) included in the model have shown significant coefficients. The first implication of this result is that these variables influence the adoption probability in such a way that any change in their value will lead to the change of the crib adoption rate in the study area.

4.4.1 IMPLICATIONS OF SIGNIFICANT EXPLANATORY VARIABLES

Specifically, the positive sign of the variable which characterises the region (REG) confirms that the probability of maize narrow-crib adoption differs from one region to another. Therefore this adoption probability would be higher in the region where the maize narrow-crib fits in with the culture, and where the building materials are more available. Table 4 shows that the region Zou has the highest rate of adoption (37. 5%) followed by Mono (30.0%), Atlantique and Oueme (27.5%). This result might be due to the success of the extension co-ordination actions in Zou. In fact SG2000 regional co-ordinator always visited the extension officers ; therefore they have to prove the co-ordinator their efficiency by convincing more farmers to build a crib. Apart from this reason Zou region is one of the southern regions where the building materials are more available at cheaper

cost. The following region where the adoption rate is also high (30.0%) is Mono (Table 4). In this region so many activities were put in place by the regional agricultural service and by SG2000 as well to enhance maize narrow-crib adoption rate in the region.

As expected the household size (HSI) has shown a positive and significant coefficient thus the implication to this is that the maize narrow-crib adoption increases with the increment of household size. The higher the number of the members of the household the more willing they would be to produce more food to adopt post harvest technologies particularly storage devices. To be successful, extension officers should deal essentially with the households having larger number of members. Similarly the source of information as expected is found to be a significant determinant of maize narrow-crib adoption in the study area.

The maize narrow-crib adoption probability is higher with farmers exposed to SASAKAWA GLOBAL 2000 or National extension officers (INF=1) than farmers not exposed to these informations sources (INF=0). In fact, SASAKAWA GLOBAL 2000 working in collaboration with the Ministry of Rural Development (MDR) essentially uses the MDR extension officers as source of information to disseminate ideas in rural areas.

These extension officers are the only one having the attributes of being communicators (communication skills, knowledge, attitude, culture, value, idea) that fit in with those of the communicatees (farmers) since they are all living in the same social system. In order to get a better rate of adoption, any action should involve well trained extension officers who should live in the same social system with farmers. The extension contact variable has also shown positive and significant coefficient. This means that the probability of maize narrow-crib adoption increases with the increment of the extension contact.

Apart from the change agent empathy, credibility, humility and professional commitment as important factors contributing to the success of his job, he must establish rapport with farmers. This may involve spending several weeks living among them, or visiting them most of the time during which time the extension worker must bring himself to the level of the people and talk, act and behave as one of them. The National extension worker by living with farmers became involved in patterns of reciprocal friendship that entitle him to co-operation and brings about this result. If it is so, why do some of those who are in contact with the extension officer not show positive attitude towards maize-narrow crib adoption? Do they have any apprehension or fear about innovation and are

waiting to see how efficient this storage device will be ? then, are the three years of crib introduction enough to appreciate the adoption of such innovation in the study area ? Does the extension officer have interfaced well with farmers to identify their needs? Some of these questions will be answered in the following discussions. The need identification variable (NEE) is associated with the extension contact ones. All that we've said previously is suitable for this variable. By living with farmers the extension worker's ideas are accepted when farmers are convinced that he is working for their welfare and respects their norms. This supposes that he has discussed with the farmers about the problems they are having as a as post-harvest storage is concerned and the type of storage device which is suitable with their norms, beliefs, culture, attitude etc...

This need identification aspect is so important that any action towards farmers' welfare should start from this stage. The maize narrow-crib was introduced to farmers four (4) years ago. Historical records show that the rate of adoption is a geometric rather than an arithmetic progression (see Figure. 8)

One last important factor at the household level concerns his perception about the innovation. One of the farmers' perception about the innovation namely, the necessity to construct the crib (NEC) also related to adoption decisions as far as maize narrow-crib is concerned. The necessity to construct a crib might be related to the needs identification. But here the negative sign showed proves that it is not because the farmers think that the crib is necessary that they adopt it. Therefore why have some farmers adopted the innovation which does not seem to be necessary for them ? Might it be because the extension officer did not explain or convince farmers about the necessity to build a crib ? or do they just want to benefit by the subsidy or might it be a way to prove the extension officer that one is following his advice ? Since some have adopted maize narrow-crib even though they think that building a crib is not necessary, how much are they going to use it ? There is hence a need to further explore this aspect. The Tobit model could be use since it incorporates both forms of the dependent variable (dichotomous and continuous) and provides informations on all aspects of the decision making process, i. e. the probability of adoption and the intensity of use thereafter. In the first year after farmers are introduced to the maize narrow-crib (a new practice), only five percent might adopt it. If the program only extends for one year, the program might be judged a failure.

In the second year, however, a further ten percent might adopt it and then in the third year a further twenty percent. After three years, thirty-five percent might have

adopted and this may be judged moderately successful. This is particularly the case when one considers that the geometric progression will probably continue until a saturation point, when no further adopters will be added. As this might be a total of sixty percent of possible adopters, the thirty-five percent achievement is all the more significant. Giving a program long enough to achieve its stated objectives is therefore a very important part of program planning (Brown, 1981) . In the case of this maize narrow-crib program, it has been stopped after 4 years. This and the fact that the change agent did not convince farmers well on the necessity to construct a crib, and they did not ask any contribution from the farmers and just gave them enough subsidy to build a crib without working with more leaders to quickly disseminate informations might be the reasons why after three years the rate of the crib adoption is still low (30.62%) as compared with the literature (35%) after three years. However this rate of adoption is very important and would have been higher if the program did not stop earlier.

4.4.2 IMPLICATIONS OF NON SIGNIFICANT EXPLANATORY VARIABLES

Some of the explanatory variables namely number of agricultural active members of household (ACT), Education (EDU), Cosmopolitness (COS), Subsidy availability (ASU), Communication (COM), Construction cost (CRI), in the study case of maize narrow-crib adoption in the selected area neither showed the expected sign nor were statistically significant. However, the following variables Income (AIN), Experience (EXP), Trialability (TRI), Construction difficulty (DIF) and Household head age (AG), although not significant have shown the expected signs.

All of the explanatory variables cited above do not influence the adoption behaviour in the study area. Thus whatever the number of active members of the household (ACT), the farmer could adopt the crib. The crib adoption does not depend on the number of actifs household members. Even, if the number of household actif members is low, the head can hire a labour force if there is a need to produce a big quantity of maize. In this case, what is important might be the quantity of maize produced.

Similarly, whatever the type of education reached (Formal or non Formal) if the farmer produces maize in quantity big enough and is having a problem of storage he would be probably likely to adopt the crib. This result in the case of maize narrow-crib adoption in the study area is in contrast with a commonly known opinion for which formally educated people would be more likely to have positive attitude towards adoption of

innovations and the more complex is the innovation, the more the farmers' level of education influence the adoption of innovation, (CIMMYT, 1993 ; Rogers 1983). In fact the maize narrow-crib construction is not difficult if one is well trained on it, that is why the type of education does not deter the adoption of this innovation.

The cosmopolitan farmer would be more likely and always willing to take a risk, they travel a lot and they have seen a lot of things, so they want to try but in the case of this study, whether the farmer is cosmopolitan or not if he has post-harvest problem and has seen the crib or heard about it he may adopt it. Since the average cost of the crib is about 28,353 F CFA and the annual average income of the farmer is about 665,726 FCFA he does not necessarily need to wait for a subsidy before constructing a crib, if he knows that he does not have to rebuild it every year. The average duration of a crib is about 3 years. Hence the availability of the subsidy (ASU) does not influence the farmers' decision behaviour as far as crib adoption is concerned. Normally the communication factor should positively influence the decision behaviour. Extension officer communicating with farmers should speak the language people understand to realise that mutual understanding is going on between him and his audience. In the case of the crib adoption, the innovation itself is a communication factor. Farmers who have seen it, know what it is for and do not necessarily need the extension officer to talk to them before adopting.

According to the asymptotic t-values of the coefficients, the age variable neither showed the expected sign nor was it found to be significant, apparently the explanation to this is that no matter how old the household head is, if he has a large household size, he is more incline to adopt such innovation than an elder with a small household. The household head's age in this case does not play any important role in the crib adoption behaviour in the study area.

The experience variable (EXP) was not found to be statistically significant on the basis of the asymptotic t-values tests but has the expected sign and thus the hypothesis in this respect could be rejected. Therfore, the experience variable does not seem to influence the adoption decision behaviour of the farmer.

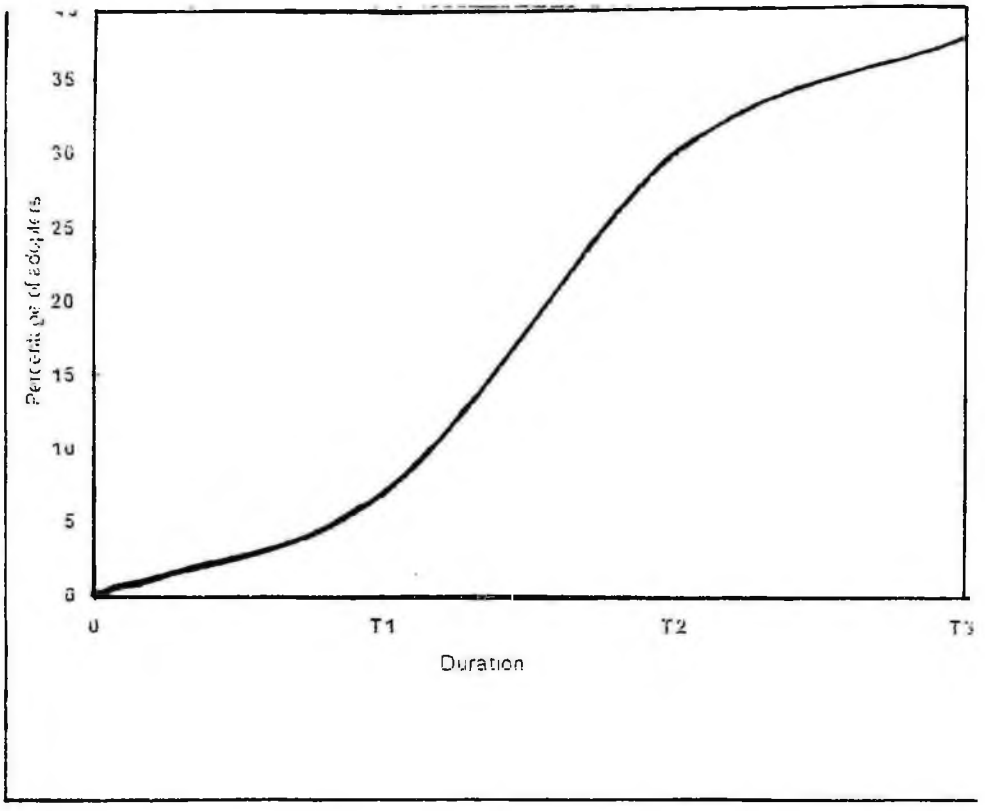
Similarly the difficulty variable (DIF) also was not found to be statistically significant on the basis of the asymptotic t test but has shown the expected sign. The explanation to this may be found in the fact that the difficulty variable does not seem to influence the adoption decision behaviour of farmers. Whether the maize narrow-crib construction is difficult or not, farmers would adopt it when there is a need to construct it.

Specifically, as far as farmers perception is concerned, about the cost of the innovation, for a total sample of 160 people, 87% have revealed that the crib construction cost in high although not too much for them to build a crib. This theoretical constraint of maize narrow-crib adoption like the following constraints discussed below have seem to significantly influence the adoption behaviour of farmers. However 31% of respondents think that the removing of husk from the maize before storing would be in certain manner a constraint for the adoption whilst 25% of respondents have told about lack of wood as major constraint. While 25% of respondents revealed that the cost of insecticide would have been the major constraint, 7% rather told of the lack insecticide.

For almost all the respondents this storage device is quite useful. Only 1% of them said it is useless whereas 4% revealed that it is not effective ; most of the time those who said that the crib is not effective did not take care of their storage, some of them did not use insecticide ; even those who have use it did not apply it at the right dosage or not at time. Some of them think that the exposure of the crib to sunshine and rains would lead to the changing of maize colour. But this changing of the maize colour is not so important since only the superficial exposed grains changed their colour. When they are mixed with the other grains, there is no significant difference with unexposed store one.

Because of the jealousy or envy of the other farmers, 19% of respondents said that the exposure of the store to other farmers would have been a constraint as well whereas for 19% the major constraint would be the construction difficulties. By the same way the farmers income and the trialability (TRI) variables do not show any significance and hence do not influence farmers' behaviour as far as maize narrow-crib adoption is concerned.

Figure 8 :Adoption progression.



Source : Marketing extension program

Sheila A. Brown

Uit : Blacburn, D. J. , Extension Handbook (1984)

4.5. CONCLUSION

In total, chi-square test shows that tree variables among the institutional factors (source of information, extention contact and the communication), two variables from the household characteristics (the farmers perception about the necessity to build a maize narrow-crib and the household head age), tree variables (existence of markets near farmers' village, the culture of the region and the availability of building materials in the region), whereas only one variable in the characteristics of the innovation (the cost of the innovation) have significantly influence farmers' decision behaviour whith regard to maize narrow-crib adoption in the study area.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 SUMMARY OF FINDINGS

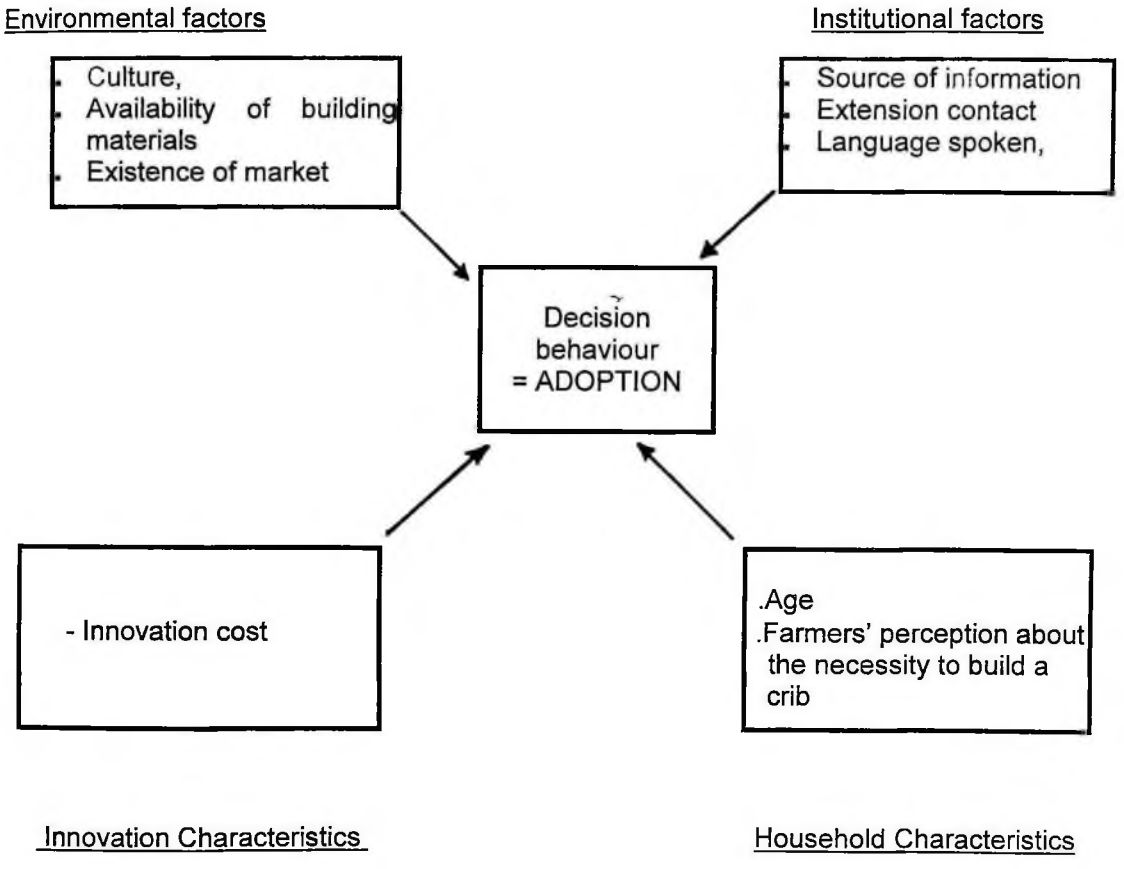
In the background of this study, the persisting problem of maize storage is investigate. Several activities were put in place to handle this issue but still, farmers are having the same problem although various supporting policy measures to promote maize narrow-crib adoption were put in place recently by SASAKAWA GLOBAL 2000 Project.

Despite all this, some people are still not adopting. On the basis of this background, the aim of this study was to examine the factors that are influencing the adoption of crib by farm households.

The analysis of the findings of this study has clearly shown that the rate of maize narrow-crib adoption considered is relatively low (30 %). The chi-square test shows that the environmental factors (culture, existance of market near farmers' villages, availability of building materials), the istitutional factors (source of information, extension contact, communication), the innovation characteristics (cost of innovation) and the household characteristics (age and farmers' perception about the necessity to buid a crib) have significantly influence maize narrow-crib adoption behaviour of farmers. The model of adoption used for this study confirmed with reliable statistical analysis (Logit) that the following factors considered do influence the adoption decision behaviour of sampled respondents ; the suitability of the culture, and the availability of crib building materials (REG), the household size (HSI), the leadership status of the farmer (LEA), the source of information (INF), the extension contact (EXT), the need identification (NEE) and the necessity to construct a crib have been found to be important determinants in maize narrow-crib adoption decision process.

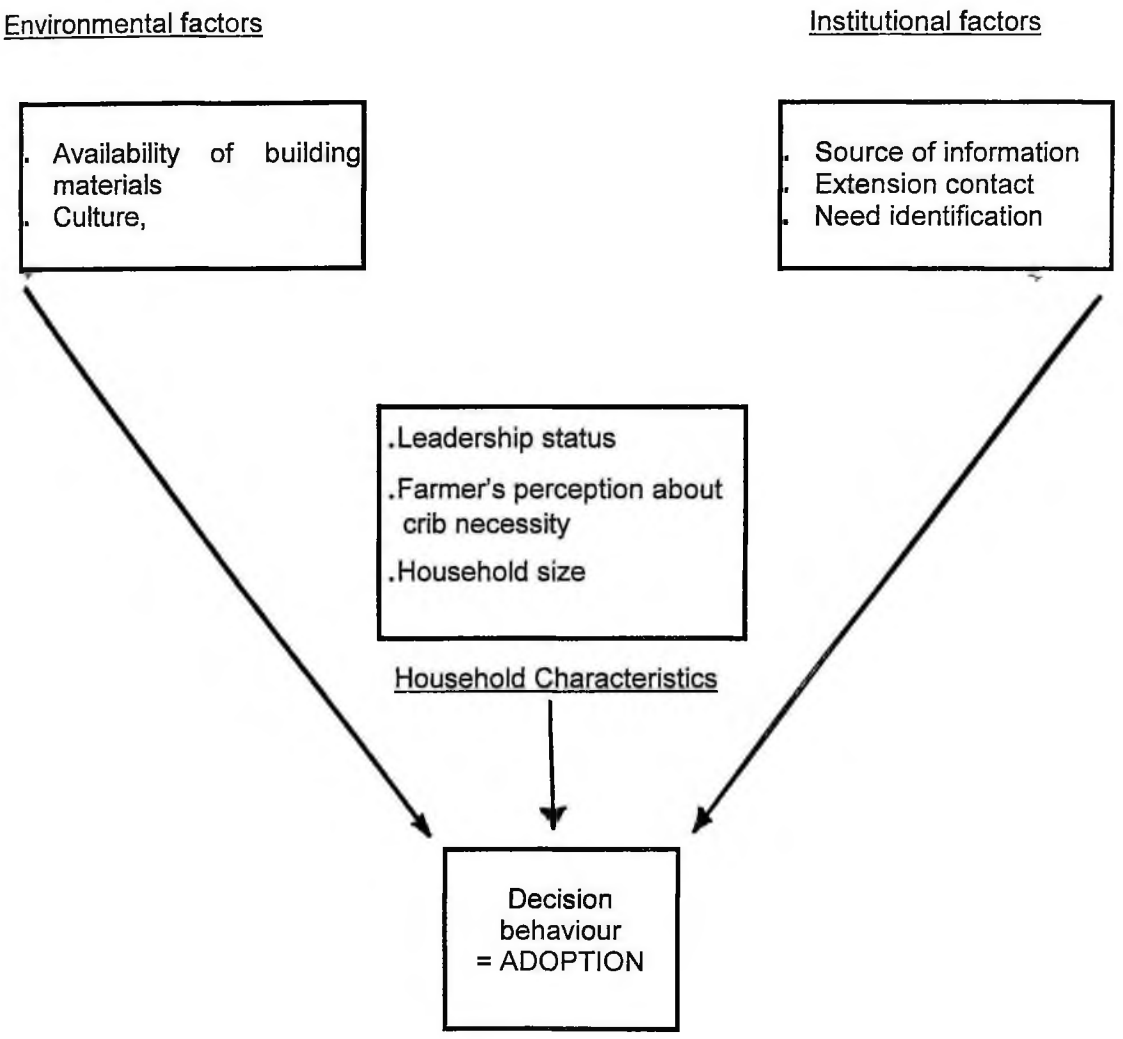
The possible relationship between all these variables and the adoption behaviour of farmers is summarised below in Figure 9 for the Chi-square test results and in Figure 10 for Logit model.

Figure 9 Maize narrow-crib adoption decision behaviour model emanated from χ^2 test in southern Benin 1997



Source : Field Survey, 1997

Figure 10 Maize narrow-crib adoption decision behaviour model emanated from Logit model in southern Benin 1997



Source : Field Survey, 1997

5.1 CONCLUSION AND RECONMMENDATIONS

SASAKAWA GLOBAL 2000 strategy of using well trained extension officers from the Ministry of Rural Development is important precondition for an acceleration of the adoption of maize narrow-crib since from this study, the culturally acceptability of the maize narrow-crib and the locally availability of building materials have influenced the adoption behaviour of the farmer in the study area.

Futhermore the extension officer should often visit farmers, identify their needs and essentially deal with large household who think that it is necessary for them to build a maize narrow-crib otherwise he should convince them before.

To ensure quick dissemination of widespread ideas and accelerate rate of adoption, the extension officer should collaboratively work with local leaders.

The extension worker should consider specific farmers' environment (culture,and the availability of resources) when introducing innovation through extension. The national farming policy towards farmers welfare by which Research, Extension and Farmers are working collaboratively is hence a right policy measure to enhance adoption effect.

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APPENDICE 1 . IMPROVED DRYING AND STORAGE DEVICE : CRIB PRESENTATION

The narrow crib is a rectangular structure on posts. Each post has a plain galvanised iron sheets or old tin playing the role of rat-guards. The main posts are buried in a 50 cm hill after distemperily with product against termites.

The height of the main posts from the surface of soil to the floor of the crib should be 1m. If more than 1m the crib will be unstable but if it is lees than 1m it will allow the rodents to jump into the crib from the ground.

The maximum overall height of the crib should be about 300 cm above ground level. If it is higher than this, it would make the crib less stable and a fully laden crib higher than this would wobble and could easily collapse, (OBENG & ASSOCATES). For Bodholt, (1985) width recommendation vary according to mean daily relative humidity

0.6 m > 80 %

1.0 m 75 - 80 %

1.5 m 65 - 75 %

2.0 m < 55 %

Therefore a check of appropriate crib width is required. The crib wall is made with wire netting or bamboo or other wood. The ventilation gap in the improved crib wall is approximately 50 % .

The roof can. be made from galvanised corrugated iron sheet, grass, papyrus or palm leaves depending on the need and revenue of the farmer . The floor sticks is made from any type of hardwood.

APPENDICE 2 : NUMBER OF ADOPTERS PER SEX

	ATLANTIQUE		MONO		OUEME		ZOU		TOTAL	
	n	%	n	%	n	%	n	%	n	%
MALE	9	81.9	11	91.7	11	100.0	11	73.3	42	85.7
FEMALE	2	18.1	1	8.3	0	0.0	4	26.7	7	14.3
TOTAL	**11**	**100.0**	**12**	**00.0**	**11**	**100.0**	**15**	**100.0**	**49**	**100.0**

Source : Field Survey, 1997

APPENDICE 3: SEX RATIO PER REGION

	ATLANTIQUE	MONO	OUEME	ZOU	TOTAL
MALE	37	35	33	34	139
FEMALE	3	5	7	6	21
TOTAL	**40**	**40**	**40**	**40**	**160**

Source : Field Survey, 1997

APPENDICE 4 :

INSTITUTIONAL FACTORS

AWARENESS

ATLANTIC

	AWARE	NON-AWARE	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	7	22	29
TOTAL	10	30	40

$\chi^2 = 0.04$ df = 1

MONO

	AWARE	NON-AWARE	TOTAL
ADOPTERS	4	8	12
NON-ADOP.	8	20	28
TOTAL	12	28	40

$\chi^2 = 0.09$ df = 1

OUEME

	AWARE	NON-AWARE	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	5	24	29
TOTAL	9	31	40

$\chi^2 = 1.68$ df = 1

ZOU

	AWARE	NON-AWARE	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	7	18	25
TOTAL	12	28	40

$\chi^2 = 0.12$ df = 1

SOURCE OF INFORMATION

ATLANTIC

	SG 2000	OTHERS	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	0	28	28
TOTAL	5	35	40

$\chi^2 = 14.22$ df = 1 s.h. at p<0.001

MONO

	SG 2000	OTHERS	TOTAL
ADOPTERS	7	5	12
NON-ADOP.	2	26	28
TOTAL	9	31	40

$\chi^2 = 10.73$ df = 1 s.h. at p<0.01

OUEME

	SG 2000	OTHERS	TOTAL
ADOPTERS	11	0	11
NON-ADOP.	5	24	29
TOTAL	16	24	40

$\chi^2 = 22.76$ df = 1 s.h. at p<0.001

ZOU

	SG 2000	OTHERS	TOTAL
ADOPTERS	15	0	15
NON-ADOP.	1	24	25
TOTAL	16	24	40

$\chi^2 = 36.0$ df = 1 s.h. at p<0.001

NEED IDENTIFICATION

ATLANTIC

	IDENTIFIED	NON-IDENTI.	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	7	22	29
TOTAL	10	30	40

$\chi^2 = 0.04$ df = 1

MONO

	IDENTIFIED	NON-IDENTI.	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	6	22	28
TOTAL	11	29	40

$\chi^2 = 1.72$ df = 1

OUEME

	IDENTIFIED	NON-IDENTI.	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	5	24	29
TOTAL	9	31	40

$\chi^2 = 0.10$ df = 1

ZOU

	IDENTIFIED	NON-IDENTI.	TOTAL
ADOPTERS	4	11	15
NON-ADOP.	6	19	25
TOTAL	10	30	40

$\chi^2 = 0.03$ df = 1

SUBSIDY AVAILABILITY

ATLANTIC

	AVAILABLE	NOT	TOTAL
ADOPTERS	1	10	11
NON-ADOP.	0	29	29
TOTAL	1•	39	40

MONO

	AVAILABLE	NOT	TOTAL
ADOPTERS	0	12	12
NON-ADOP.	0	28	28
TOTAL	0•	40	40

• = Chi-square test was not directly applied to these cells. They were combined with other cells so that each expected frequency is at least 5.

OUEME

	AVAILABLE	NOT	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	0	29	29
TOTAL	3•	37	40

ZOU

	AVAILABLE	NOT	TOTAL
ADOPTERS	9	6	15
NON-ADOP.	2	23	25
TOTAL	11	29	40

$\chi^2 = 24.50$ df = 1 s.h. at p<0.001

•= Chi-square test was not directly applied to these cells. They were combined with other cells so that each expected frequency is at least 5.

EXTENSION CONTACT

ATLANTIC

	IN CONTACT	NOT	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	4	25	29
TOTAL	8	32	40

$\chi^2 = 2.54$ df = 1

MONO

	IN CONTACT	NOT	TOTAL
ADOPTERS	11	1	12
NON-ADOP.	4	24	28
TOTAL	15	25	40

$\chi^2 = 21.46$ df = 1 s.h. at p<0.001

OUEME

	IN CONTACT	NOT	TOTAL
ADOPTERS	9	2	11
NON-ADOP.	1	28	29
TOTAL	10	30	40

$\chi^2 = 26.12$ df = 1 s.h. at p<0.001

ZOU

	IN CONTACT	NOT	TOTAL
ADOPTERS	13	2	15
NON-ADOP.	6	19	25
TOTAL	19	21	40

$\chi^2 = 14.77$ df = 1 s.h. t p<0.001

COMMUNICATION

ATLANTIC

	WELL	BAD	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	2	27	29
TOTAL	7	33	40

$\chi^2 = 8.23$ df = 1 s.h. at p<0.01

MONO

	WELL	BAD	TOTAL
ADOPTERS	9	3	12
NON-ADOP.	6	22	28
TOTAL	15	25	40

$\chi^2 = 10.28$ df = 1 s.h.at p<0.01

OUEME

	WELL	BAD	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	2	27	29
TOTAL	7	33	40

$\chi^2 = 30.67$ df = 1 s.h. at p<0.001

ZOU

	WELL	BAD	TOTAL
ADOPTERS	9	3	12
NON-ADOP.	6	22	28
TOTAL	15	25	40

$\chi^2 = 27.31$ df = 1 s.h. at p<0.001

SATISFIED WITH EXTENSION

ATLANTIC

	SATISFIED	NOT	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	6	23	29
TOTAL	10	30	40

$\chi^2 = 1.04$ df = 1

MONO

	SATISFIED	NOT	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	6	22	28
TOTAL	11	29	40

$\chi^2 = 1.72$ df = 1

OUEME

	SATISFIED	NOT	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	8	21	29
TOTAL	12	28	40

$\chi^2 = 0.36$ df = 1

ZOU

	SATISFIED	NOT	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	5	20	25
TOTAL	10	30	40

$\chi^2 = 0.89$ df = 1

HOUSEHOLD CHARACTERISTICS

EDUCATION

ATLANTIC

	FORMAL	INFORMAL	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	5	24	29
TOTAL	8	32	40

χ^2 =0.50 df = 1

MONO

	FORMAL	INFORMAL	TOTAL
ADOPTERS	2	10	12
NON-ADOP.	3	25	38
TOTAL	5	35	40

χ^2 = 0.27 df = 1

OUEME

	FORMAL	INFORMAL	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	5	24	29
TOTAL	8	32	40

χ^2 = 0.45 df = 1

ZOU

	FORMAL	INFORMAL	TOTAL
ADOPTERS	2	10	12
NON-ADOP.	3	25	28
TOTAL	5	35	40

χ^2 = 0.01 df = 1

COSMOPOLITNESS

ATLANTIC

	COSMO	NON-COS.	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	6	23	29
TOTAL	9	31	40

χ^2 = 0.20 df = 1

MONO

	COSMO	NON-COS.	TOTAL
ADOPTERS	3	9	12
NON-ADOP.	6	22	28
TOTAL	9	31	40

χ^2 = 0.06 df = 1

OUEME

	COSMO	NON-COS.	TOTAL
ADOPTERS	2	9	11
NON-ADOP.	3	26	29
TOTAL	5	35	40

χ^2 = 0.44 df = 1

ZOU

	COSMO	NON-COS.	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	6	19	25
TOTAL	11	29	40

χ^2 = 0.41 df = 1

MAIN ACTIVITY

ATLANTIC

	AGRICULTURE	OTHERS	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	63	23	29
TOTAL	9	31	40

$\chi^2 = 0.20$ df = 1

MONO

	AGRICULTURE	OTHERS	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	7	21	28
TOTAL	12	28	40

$\chi^2 = 0.12$ df = 1

OUEME

	AGRICULTURE	OTHERS	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	5	24	29
TOTAL	9	31	40

$\chi^2 = 1.68$ df = 1

ZOU

	AGRICULTURE	OTHERS	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	6	19	25
TOTAL	11	29	40

$\chi^2 = 0.41$ df = 1

CRIB NESSITY

ATLANTIC

	NECESSARY	NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	5	24	29
TOTAL	10	30	40

$\chi^2 = 2.54$ df = 1

MONO

	NECESSARY	NOT	TOTAL
ADOPTERS	6	6	12
NON-ADOP.	9	19	28
TOTAL	15	25	40

$\chi^2 = 21.46$ df = 1 s.h. at $p<0.001$

OUEME

	NECESSARY	NOT	TOTAL
ADOPTERS	6	5	11
NON-ADOP.	7	22	29
TOTAL	13	27	40

$\chi^2 = 18.43$ df = 1 s.h. at $p<0.001$

ZOU

	NECESSARY	NOT	TOTAL
ADOPTERS	11	5	15
NON-ADOP.	8	16	25
TOTAL	19	21	40

$\chi^2 = 9.14$ df = 1 s.h. at $p<0.01$

LEADERSHIP STATUS

ATLANTIC

	LEADER	NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	7	22	29
TOTAL	12	28	40

$\chi^2 = 0.60$ df = 1

MONO

	LEADER	NOT	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	6	22	28
TOTAL	11	29	40

$\chi^2 = 0.06$ df = 1

OUEME

	LEADER	NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	5	24	29
TOTAL	10	30	40

$\chi^2 = 1.04$ df = 1

ZOU

	LEADER	NOT	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	5	20	25
TOTAL	10	30	40

$\chi^2 = 0.67$ df = 1

ENVIRONNEMENTAL FACTORS

AVAILABILITY OF BULDING MATERIALS

ATLANTIC

	AVAILABLE	NOT	TOTAL
ADOPTERS	6	5	11
NON-ADOP.	7	22	29
TOTAL	13	27	40

$\chi^2 = 6.71$ df = 1 s.h. at p<0.01

MONO

	AVAILABLE	NOT	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	5	23	28
TOTAL	10	30	40

$\chi^2 = 13.33$ df = 1 s.h. at p<0.001

OUEME

	AVAILABLE	NOT	TOTAL
ADOPTERS	6	5	11
NON-ADOP.	6	23	29
TOTAL	12	28	40

$\chi^2 = 14.46$ df = 1 s.h. at p<0.001

ZOU

	AVAILABLE	NOT	TOTAL
ADOPTERS	10	5	15
NON-ADOP.	5	20	25
TOTAL	15	35	40

$\chi^2 = 8.72$ df = 1 s.h. 0.01

CRIB FITS CULTURE

ATLANTIC

	FITS	DOES NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	5	24	29
TOTAL	10	30	40

$\chi^2 = 5.43$ df = 1 s.h. at p<0.05

MONO

	FITS	DOES NOT	TOTAL
ADOPTERS	7	8	15
NON-ADOP.	6	19	25
TOTAL	13	27	40

$\chi^2 = 14.17$ df = 1 s.h. at p<0.001

OUEME

	FITS	DOES NOT	TOTAL
ADOPTERS	9	2	11
NON-ADOP.	10	19	29
TOTAL	19	21	40

$\chi^2 = 7.17$ df = 1 s.h. at p<0.01

ZOU

	FITS	DOES NOT	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	14	11	25
TOTAL	17	23	40

$\chi^2 = 4.97$ df = 1 s.h. at p<0.05

CRIB FITS WITH NORMS

ATLANTIC

	FITS	DOES NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	6	23	29
TOTAL	11	29	40

$\chi^2 = 0.00$ df = 1

MONO

	FITS	DOES NOT	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	5	23	28
TOTAL	10	30	40

$\chi^2 = 0.63$ df = 1

OUEME

	FITS	DOES NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	7	22	29
TOTAL	12	28	40

$\chi^2 = 0.29$ df = 1

ZOU

	FITS	DOES NOT	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	5	20	25
TOTAL	10	30	40

$\chi^2 = 0.03$ df = 1

CLIMATE

ATLANTIC

	FITS	DOES NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	7	22	29
TOTAL	12	28	40

$\chi^2 = 0.29$ df = 1

MONO

	FITS	DOES NOT	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	6	22	28
TOTAL	11	29	40

$\chi^2 = 0.29$ df = 1

OUEME

	FITS	DOES NOT	TOTAL
ADOPTERS	5	6	11
NON-ADOP.	10	19	29
TOTAL	15	25	40

$\chi^2 = 0.41$ df = 1

ZOU

	FITS	DOES NOT	TOTAL
ADOPTERS	5	10	15
NON-ADOP.	7	18	25
TOTAL	12	28	40

$\chi^2 = 0.12$ df = 1

MARKET AVAILABILITY

ATLANTIC

	AVAILABLE	NOT	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	1	28	29
TOTAL	5	35	40

$\chi^2 = 7.69$ df = 1 s.h. at $p<0.01$

MONO

	AVAILABLE	NOT	TOTAL
ADOPTERS	5	7	12
NON-ADOP.	0	28	28
TOTAL	5	35	40

$\chi^2 = 13.3$ df = 1 s.h. at $p<0.001$

OUEME

	AVAILABLE	NOT	TOTAL
ADOPTERS	1	10	11
NON-ADOP.	0	29	29
TOTAL	1•	39	40

$\chi^2 = 48.31$ df = 1 s.h. at p<0.001

ZOU

	AVAILABLE	NOT	TOTAL
ADOPTERS	9	6	15
NON-ADOP.	2	23	25
TOTAL	11	29	40

• = Chi-square test was not directly applied to these cells. They were combined with othe cells so that each expected frequency is at least 5.

PRICE

ATLANTIC

	GOOD	NOT	TOTAL
ADOPTERS	2	9	11
NON-ADOP.	3	26	29
TOTAL	5	35	40

$\chi^2 = 0.20$ df = 1

MONO

	GOOD	NOT	TOTAL
ADOPTERS	2	10	12
NON-ADOP.	4	24	28
TOTAL	6	34	40

$\chi^2 = 0.04$ df = 1

OUEME

	GOOD	NOT	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	6	23	29
TOTAL	9	31	40

$\chi^2 = 0.20$ df = 1

ZOU

	GOOD	NOT	TOTAL
ADOPTERS	5	11	15
NON-ADOP.	4	21	25
TOTAL	8	32	40

$\chi^2 = 0.67$ df = 1

INNOVATION CHARACTERISTICS

TRIALABILITY

ATLANTIC

	TRIALABLE	NOT	TOTAL
ADOPTERS	3	8	11
NON-ADOP.	7	22	29
TOTAL	10	30	40

$\chi^2 = 0.04$ df = 1

MONO

	TRIALABLE	NOT	TO2AL
ADOPTERS	5	7	12
NON-ADOP.	6	22	28
TOTAL	11	29	40

$\chi^2 = 1.72$ df = 1

OUEME

	TRIALABLE	NOT	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	9	20	29
TOTAL	13	27	40

$\chi^2 = 0.02$ df = 1

ZOU

	TRIALABLE	NOT	TOTAL
ADOPTERS	4	11	15
NON-ADOP.	0	25	25
TOTAL	4.	36	40

• = Chi-square test was not directly applied to these cells. They were combined with other cells so that each expected frequency is at least 5.

CONSTRUCTION COST

ATLANTIC

	HIGH	NOT	TOTAL
ADOPTERS	11	0	11
NON-ADOP.	1	28	29
TOTAL	12	28	40

$\chi^2 = 35.40$ df = 1 s.h. at p<0.001

MONO

	HIGH	NOT	TOTAL
ADOPTERS	6	6	12
NON-ADOP.	2	26	28
TOTAL	8	32	40

$\chi^2 = 9.64$ df = 1 s.h. at p<0.01

OUEME

	HIGH	NOT	TOTAL
ADOPTERS	4	7	11
NON-ADOP.	2	27	29
TOTAL	6	34	40

$\chi^2 = 5.43$ df = 1 s.h. at p<0.05

ZOU

	HIGH	NOT	TOTAL
ADOPTERS	2	13	15
NON-ADOP.	13	12	25
TOTAL	15	25	40

$\chi^2 = 14.16$ df = 1 s.h. at p<0.001

CONSTRUCTION DIFFICULTY

ATLANTIC

	DIFFICULT	NOT	TOTAL
ADOPTERS	2	9	11
NON-ADOP.	3	26	29
TOTAL	35	5	40

$\chi^2 = 0.44$ df = 1

• = Chi-square test was not directly applied to these cells. They were combined with other cells so that each expected frequency is at least 5.

MONO

	DIFFICULT	NOT	TOTAL
ADOPTERS	11	1	12
NON-ADOP.	38	0	28
TOTAL	39	1•	40

OUEME

	DIFFICULT	NOT	TOTAL
ADOPTERS	8	3	11
NON-ADOP.	29	0	29
TOTAL	37	3•	40

$\chi^2 = 1.61$ df = 1

•= Chi-square test was not directly applied to these cells. They were combined with other cells so that each expected frequency is at least 5.

ZOU

	DIFFICULT	NOT	TOTAL
ADOPTERS	13	2	15
NON-ADOP.	25	0	25
TOTAL	38	2•	40

APPENDICE 5 : QUESTIONNAIRE FOR SURVEY

QUESTIONNAIRE

BACKGROUND : Study of socio-economics, technological, environmental and institutional factors affecting maize narrow-crib adoption by maize farmers in the southern Benin.

Date : .....
Region : .....
Zone : .....
Village : .....
Name of the head of the household : .....
Name of interviewer : .....

SECTION A : Socio - economics factors.

1 How old are you ?

a) 0 - 20 years ☐
b) 21 - 30 years ☐
c) 31 - 40 years ☐
d) 41 - 50 years ☐
e) 51 - 60 years ☐
f) Over 61 years ☐

2 - Sex

a) male ☐ b) Female ☐

3 - What is your marital status ?

a) Married ☐
b) Divorced ☐
c) Single ☐
d) Separated ☐
e) Widow ☐
f) Widower ☐

4 - What is the number of wives that you have ? .....
5 - What is the number of children that you have ? .....
6 - What is the number of relatives living in the household ? .....
7 - What is the total number of members of the household ? .....
8 - What is the number of household members who really work on the .....

9 - What is your level of education ?

a) Formal education ☐ Please specify level reached .....
b) Non Formal education ☐ Please specify the type .....
c) None of the above ☐

10 - What is your major occupation ?

a) farming ☐
b) Business ☐
c) Others ☐ , Please specify.....

11 What is your secondary occupation ? .....
.....

12 - How long have you been in farming ? .....Years

13 - What is the estimated size of your farm ?

Number of Plots	Acreage per crop. (ha)	Crops	Average Yield kg/ha	Average sale price Frs CFA/kg
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

14 - How many bags of fertilizer have you used the last croping year ? .....

15 - How much is the bag of fertilizer ? .....Frs CFA.

16 - What is your actual leadership status ?
(you can tick more than one box)

a) chief of village ☐
b) Member of village council ☐
c) Member of contact group ☐

d) Head of farmer's orgnisation ☐
e) Religious leader ☐
f) Member of farmers' organisation ☐
g) Others ☐ , Please specify .....

17 - What is the widely spoken language in the region ? .....

18 - Do you speak that language ?

a) Yes ☐ b) No ☐

19 Does the extension officer speak that language ?

a) Yes ☐ b) No ☐

20 Have you ever travelled outside your region ?

a) Yes ☐ b) No ☐

21 - If yes, how many times ?

a) Often ☐ b) Rarely ☐ From time to time ☐

22 - For which reason have you travelled ?

a) Agricultural purpose ☐

b) Others ☐ , Please specify .....

23 - Have you seen some farming practices that you were interested in ?

a) Yes ☐ b) No ☐

24 - If yes, which one ? Please specify .....
.....

SECTION B **Institutional factors.**

25 - Are you informed or have you ever seen a crib ?

a) Yes ☐ b) No ☐

26 If yes, what are your sources of information on crib ?

a) Friends ☐
b) Relatives ☐
c) CARDER ☐
d) Radio /TV ☐
e) Others farmers
f) posters ☐
g) NGO ☐
h) Field trips ☐
i) SG 2 000 ☐
j) Others ☐ , Please specify.....

27 - How often does the extension officer visit your village ?

a) Never ☐
b) Everyday ☐
c) Once a week ☐
d) Twice a week ☐
e) Every two weeks ☐
f) Others ☐ , Please specify.....

28 - Did the extension officer, before introducing the crib to you, discuss with you about your problems as far as storage devices are concerned ?

a) Yes ☐ b) No ☐

29 - Did he discuss with you about the type of storage device which would be suitable to your conditions?

a) Yes ☐ b) No ☐

30 - If no, do you think that there would have been better adoption if he has discuss with farmers before ?

a) Yes ☐ b) No ☐

31 - Are you satisfied with the work of extension officer ?

a) Yes ☐ b) No ☐

32 - Have you ever been trained by the former post-harvest project on the crib construction ?

a) Yes ☐ b) No ☐

33 -Do you know some people who have been trained in the past on crib construction ?

a) Yes ☐ b) No ☐

34 - Was there any subsidy or assistance to help farmers build cribs ?

a) Yes ☐ b) No ☐

35 - Is there any credit facility available in the village for crib construction ?

a) Yes ☐ b) No ☐

36 - If no, how do you manage to construct your storage devices ?.....
.....
.....

37 If yes, specify the amount ..... F CFA ?

38 - What is the name of the institution giving the credit ? .....

39 - What are the conditions ?.....
.....

40 - Is there any subsidy or assistance to help farmers build cribs ?

a) Yes ☐ b) No ☐

SECTION C : **environmental factors**

41 - Is there any marketing facility in or near your village ?

a) Yes ☐ b) No ☐

42 - Will it be possible for you to sell your maize at a good price after keeping it for some time ?

a) Yes ☐ b) No ☐

43 - If yes, what is the average price of the kg ? .....Frs CFA.

44 - If no, why ? Please give reasons .....
.....
.....

45 - Do you think that it is necessary to dry maize in crib under your climatic conditions ?

a) Yes ☐ b) No ☐

SECTION D : innovation factors.

46 - Have you ever tried to build a crib ?

a) Yes ☐ b) No ☐

47 - If yes, do you think it is easy to build a crib ?

a) Yes ☐ b) No ☐

48 - If no, which part of the crib is more difficult ? Please specify .....
.....

49 Have you ever used a crib ?

a) Yes ☐ b) No ☐

50 - If no, why ? .....

51 - If yes, do you continue using it ?

a) Yes ☐ b) No ☐

52 - If no, why did you stop using it ?

.....
.....

53 - In case you continue using it how long have you been using it ?

a) One year ☐
b) Two years ☐
c) Three years ☐
d) More than three years ☐

54 - How many days did you take to construct your crib ?
.....

55 What is the type of labour available to you for crib construction ?

a) Family labour ☐
b) Hired labour ☐
c) Self labour ☐
d) mutual aid labour ☐
e) Others ☐ , Please specify
.....

56 - If it is a hired labour, what is the daily cost of labour ? .....Frs CFA

57 - How many people have worked for the crib construction ? .....

58 - How many people have you paid for the crib construction ? .....

59 - What is the total cost of the crib? .....Frs CFA

60 - Do you think it is too expensive ?

a) Yes ☐ b) No ☐

61 - If yes, is it necessary to construct a crib in spite of the cost ?

a) Yes ☐ b) No ☐

62 - If yes, why ?

a) Because of its durability as compared with the traditional storage devices ☐

b) Because of its durability as compared with the other improved storage devices. ☐

c) Because of its efficiency as compared with other storage devices ☐

d) Others ☐ , Please specify .....

63 - In your view, what are the factors which could prevent you and other farmer's from adopting the crib ?

a) The cost of construction ☐
b) The construction difficulty ☐
c) The lack of technician ☐
d) The useless of the crib under your climatic conditions ☐
e) The inefficiency of the crib as compared with other improved storage devices ☐
f) The exposure of the stock to other jealous farmers ☐
g) The lack of wood ☐

h) The cost of insecticide ☐
i) The availability of insecticide ☐
j) The exposure of the stock to sunshine and rains ☐
k) The removing of the maize husk ☐
l) The incompatibility of the crib with your way of doing things (norms, attitudes, value system) like housing and granaries building ☐

64 - Do these constrains explained the low use of the crib ?

a) Yes ☐ b) No ☐

65 - How many farmers are using the crib in your village ? .....

66 - Do you know some farmers in your village who have used and have abandoned using it ?

a) Yes ☐ b) No ☐

67 - If yes, why did they abandon it ?

.....

.....

68 - If wood was available and it was possible to store the maize with the husk would the crib be widely adopted ?

a) Yes ☐ b) No ☐

69 - Do you know other improved storage devices ?

a) Yes ☐ b) No ☐

70 - If yes, which one ? Please specify .....

.....