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Family social structure, farm operation characteristics and the adoption of new technologies for sustainable farming systems in Mali

Mahamadou Tangara
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Family social structure, farm operation characteristics and the adoption of new technologies for sustainable farming systems in Mali

Tangara, Mahamadou, Ph.D.

Iowa State University, 1992
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farm operation characteristics and the adoption of new technologies for sustainable farming systems in Mali

by

Mahamadou Tangara

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
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Department: Sociology
Major: Rural Sociology

Approved:
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Ames, Iowa
1992

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CHAPTER 1. INTRODUCTION

During the last three decades, important efforts have been made to increase food production in developing countries where agriculture is the main occupation of the majority of the population. Many different agricultural technologies have been generated and diffused among African small farmers but their adoption has not been as satisfactory as expected.

In Mali, since the early 1960s just after the political independence, many development and extension projects based on the diffusion of new farming technologies have been implemented by the government with the hope of improving quickly the well being of rural communities. This effort has continued since the period of French colonization in the 1930s to the 1950s when the first agricultural extension efforts began with the intent to develop the colonies. But the majority of farmers remained reticent to adopt the newly generated technologies. They were at first accused of not being open-minded or being influenced by traditional beliefs that are not favorable to new farming practices. In the late 1970s, farming system research (FSR) projects began to be implemented by the government for a better understanding of attitudes and behavior toward the proposed new technologies.

FSR has been defined as agronomic research that goes beyond the usually restricted on-station and multi-local agronomic research and proceeds by a more holistic
research approach to address the socio-economic, the political and the institutional constraints of farmers (Norman, 1976; Dillon, 1976). In the FSR approach, it is recognized that considering only physical or technical factors and rationalities may not be enough to explain farmers' reticence to adopt many innovations. The FSR approach considers the needs, objectives and attitudes of the entire farm household and farm operations and evaluates the farming system from the perspective of the sub-systems of production and consumption units (Gilbert et al., 1980). This approach implies that the farm family as a production unit can be the most important unit of analysis. The unit of analysis of this study is the farm production Unit (FPU). The FPU is defined as a household or a group of households whose members work together on communal fields and share the resources of these fields. The household is defined as a married man with his wife or wives, his born and/or adopted children and his dependent widow parents, if any.

The head of the FPU in Africa is usually the head of a farm family unit and the objectives and decisions of the head of the farm family are assumed to reflect the needs and objectives of the farm production unit as a whole (Kleene, 1976; Newman et al., 1980). This relationship means that farming decisions made by the head of the farm family to adopt new technologies may be affected largely by interpersonal factors beyond the individual characteristics of the decision maker.

As Rogers (1983: 267) suggested, research may be needed "...to explore other independent variables in their relationship with innovativeness, especially network variables and system level variables that could help us escape the overwhelming "individualism" of past research on innovativeness in which most of the independent variables of study were individual characteristics that did not encompass the inter-
personal relationships that are also an important part of diffusion."

This research is an attempt to examine how family structural and farm operation characteristics are related to traditional farmers’ innovativeness. The structural perspective called for by Rogers and used in this research, has been recognized by Wellman (1988) to be a shift from methodological individualism toward a new relational method where the redefined units of analysis are relations, such as kinship relations among persons; or friendship structure within small groups.

**Research Problem and Objectives**

In developing countries farmers experience strong social influence on farming decisions. Most traditional farmers in African developing countries are integrated in complex networks of extended family relationships that can determine their positions and roles and therefore can influence their decisions beyond their individual motivations. In the present Development Project and/Extension project being executed in the “Operation Haute Vallee” (OHV) area in Mali, researchers and extension agents are highly concerned with farmers’ attitudes and decisions to adopt technologies already generated or being adapted to their farming needs. Farmers’ slow response to research and extension activities for the adoption of new technologies hinders the development in the area. The knowledge of sociological factors that affect farmers’ likelihood of adopting improved farming technologies can be important in designing new technologies that will suit specific target groups in order to promote a larger participation in development efforts. Research is needed to address this concern.

The purpose of this study is to investigate to what extent the social structure of the family farm production unit and farm operation characteristics are related to
the adoption of new farming technologies in the OHV area. The specific objectives of this study are:

- To determine the type and nature of interpersonal relationships in the FPU and their effect on the adoption of new technologies.

- To determine the farm operation characteristics of the FPU and their effect on the adoption of new technologies.

- To determine the interaction effect of FPUs' structure and farm operation characteristics on the adoption of new technologies.

From a sociological perspective, this study addresses the issue of how traditional farmers' adoption of new technologies may be related to their relational network elements and position in the social structure: these positions can be head of household, matrimonial statuses and/or head of farm production units and the elements can be wealth or labor.

The rural farming communities of the OHV area are organized in extended family systems that comprise the sub-systems of the FPUs. At the level of the FPUs, the production functions (i.e., all the farming activities) are carried out by one center of decision: a position institutionalized as the head of the FPU and customarily occupied by the oldest male member of the sub-unit. But women can be heads of households when they are divorced or widowed and when their husbands are absent for various reasons during long periods. Women may also be held as informal heads of households when they actually make decisions to a significant extent about the management of the FPU (Shaner et al., 1982). Although any FPU can hire external labor or perform labor exchanges with other FPUs, the FPUs are primarily based on family ties. The farm operation and management decisions or the choice and
use of agricultural equipment and techniques are made by the head of the FPU for communal fields and some heads of households are responsible for such decisions about specific individual fields. But the decision maker in any case should take into account the needs and ability of the group members. The diversity and complexity of the social structure of FPUs often makes it difficult to define the limits of FPUs (Ancey, 1976; Meillassoux, 1980). Some major categories of social relationships that characterize the FPUs in the OHV area are:

1. The number of households in the FPU.
2. The number of persons in each FPU.
3. The number of wives in the FPU.
4. The decision making process in the FPU.
5. Group work and other off-farm work as mutual help among FPUs.
6. The availability of other workers for the FPU.
7. The indigenous land tenure systems at family, household or individual level for the FPUs.
8. The importance of common and individual fields.

These social structural characteristics of the FPUs can be considered as reflecting the beliefs and values of farmers in the culture and the tradition of the extended family system. These social structural characteristic may affect the adoption of new farming technologies, as affirmed by Smelser (1965) when he stated that social structures can be classified in terms of directional tendencies of social systems. He defined social structure as recurrent interactions among two or more persons that are regulated by values, norms and sanctions, and he conceived the notion of system as an analytic concept that enables the generation of propositions about the relations
among structural units. Indeed, Parsons and Smelser (1965) noted that the household and the productive unit constitute one single collectivity in classical peasant agriculture.

**Dissertation Outline**

The dissertation is organized in six chapters. The first chapter is the introduction. It starts with a brief history of agricultural extension efforts under way in Mali to help traditional farmers produce more by using improved farming technologies. Then the problem and objectives of the study are stated in terms of trying to determine to what extent farm family social structural and farm operation characteristics affect farmers' behavior in adopting new farming practices in the "Operation Haute Vallee area". In Chapter 2, a brief literature review of the important elements of the adoption and diffusion model and farming system research and extension approach are presented. Chapter 3 presents the theoretical framework for the research, and the hypotheses. Chapter 4 presents the research setting and the operationalization of variables and the sample important descriptive statistics. Chapter 5 presents an analysis and discussion of the research results. The conclusion and perspectives are presented in Chapter 6.
CHAPTER 2. LITERATURE REVIEW

Introduction

This chapter presents a brief literature review of the important elements of the adoption and diffusion model and its use in different approaches. It includes discussion about farming system research and the extension approach and their possible links to the adoption/diffusion model.

Important Elements of Adoption and Diffusion Model

Empirical studies recorded on the processes of adoption and diffusion are numerous: Rogers (1983) reports that the number of empirical research reports had increased up to about 3,000 in the early 1980s. Some related studies to this subject are recognized to have been conducted since the 1930s, although Ryan and Gross's study (1943) on the diffusion of hybrid corn in Iowa is among the first known studies on adoption and diffusion. Lately, there has been a large range of studies on diffusion in developing countries. The important elements and concepts of the general adoption/diffusion model will be presented.

Rogers and Shomaker (1971: 26) defined adoption as "a decision to make full use of a new idea as the best course of action available." Later, Rogers (1983: 163) explained adoption as the "innovation decision" being "...the process through which
an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, to the confirmation of this decision.” Diffusion may be defined as the spreading of an innovation or a new idea or practice perceived as new through a social system from the source of its generation to institutions or individuals who adopt it.

Despite the complexity and the subsequent diversity of opinion about the different steps of adoption process, Rogers (1983) developed the following stages to describe it: (1) The knowledge or awareness stage when the potential adopter is first exposed to the new idea and may gather some information about it. (2) The persuasion stage is the stage of evaluation when the potential adopter makes judgement about an innovation and forms either a favorable or an unfavorable attitude about it. (3) During the decision stage, the potential adopter undertakes actions (e.g. trials) that may lead to full use or rejection of the innovation. (4) The implementation stage is when the innovation is actually used. (5) In confirmation stage, the use is reinforced, unless the adopter decides later to stop using the innovation for any reason.

No matter what the qualities or attributes of an innovation, its continuous or discontinuous use is recognized to depend to some extent on how its qualities or attributes are perceived by the users. Five attributes of innovations have been cited by Rogers (1983): 1) Relative advantage indicates the extent to which an innovation is perceived as better than the former techniques in use. 2) Compatibility is the perceived conformity of the innovation with existing socio-cultural values and needs of client groups. 3) Complexity and 4) trialability are respectively the perceived
difficulty of understanding an innovation and how it lends itself to experimentation to reduce its uncertainty. 5) Observability is the extent to which innovations' results can be seen by others.

Many approaches to adoption and diffusion have focused on different factors to explain the likelihood of farmers to adopt innovations. Geographical approaches (Ramachandran, 1969; Garst, 1972; Brown, 1975) have argued that spatial distance (e.g. the distance from the point of introduction of an innovation to other potential adopters, to the market or to support institutions such as credit or extension facilities) is crucial in determining the rate of diffusion and adoption of innovations. But as Brown and Lentnek (1973) have pointed out, the spatial model of adoption based on information gaining in different localities did not take into account the availability criteria of an innovation to potential adopters.

Byrnes (1981) reported that economic approaches arguing profit gaining is the most important variable in determining the rate of diffusion of innovations and their consistent use by potential adopters have failed to explain the social variables that might make significant differences in the rate of adoption in different socio-cultural situations. He adds that the literature available does not mention sound and consistent findings that economic constraints entail adoption of improved technologies in developing nations. The market and infrastructure approach developed by Brown (1981) and other sociological perspectives such as adopter progressiveness (Roling et al., 1976) and motivation (Bangura, 1983) have increased the understanding of the adoption of innovations.
Farming System Research and Extension and the Adoption/Diffusion Model

Darlton (1982) mentioned that systems can be simplified into endogenous and exogenous elements and components. He affirmed that while exogenous elements are much less controllable, endogenous elements are within the reach of people and can be further classified into inputs and outputs. Spencer (1991) states that systems are sets of related elements and that there are vast differences in systems from very general to highly particular. For example, he noted that a single plant in a field is a system that might be a part of a cropping system and several cropping systems might be combined with animal production systems to form a farming system. He argues that the farm household or family is the center of farming system because families can act to change the output of farming systems by making decisions about the inputs or technical factors of the farming systems. Decisions about the input elements can have important impact on systems' performance (Spencer, 1991).

This research process has been considered to have "upstream" and "downstream" aspects. Upstream FSR addresses macro-political and socio-economic issues and basic physical and biological issues for the development of agriculture. Downstream FSR addresses the activities designed to identify and test possible innovations which can be immediately adopted by farmers (Norman, 1980) and that can be considered to imply the diffusion of the innovation actively undertaken by extension (E) activities. So the possible link between FSR/E and the adoption/diffusion model can be in the fact that both are interested in the adoption of innovations. The adoption/diffusion approach may assume that generated technologies should closely fit the needs of implementors conceived as receivers who did not participate in the generation process.
of the new technologies (Nonu, 1983). In contrast, Molnar et al. (1984) argue that in the FSR approach, the farmer as a receiver is treated as an active participant in the generation process of the new technology. Incorporating factors such as socio-cultural background, experience, knowledge, and family imperatives can suggest otherwise unanticipated ways of developing new technologies that would better fit the needs of farmers in developing countries.

It is generally recognized that FSR involves the three interlinked multidisciplinary activities of 1) basedata analysis, 2) on-station research and 3) on-farm studies (Gilbert et al., 1980; Simmonds, 1986; Plucknett et al., 1986). The ex-ante and post-hoc evaluations of technology adoption and impact in relation to the farm family are important sociological aspects of on-farm research and studies (Spencer, 1991). This relationship is why sociological research can be of importance in FSR/E approach.

The sociological interest in farming families as subsystems of society that can influence their individual members' decisions and activities has been expressed by many authors. Small farmers operate in complex systems that result from the interdependence of physical, biological, economic and social environmental factors. Therefore, the rationality of their farming systems lies in how farmers develop their own ideas and experience in response to the set of factors that they confront (Loomis, 1962). Rogers (1971) explained how individual characteristics influence the adoption of new technologies already generated and being diffused. Blau (1975) stated that individuals' social networks influence their decisions. This relationship means that the classical diffusion model that emphasizes the individual characteristics of adopter categories may not have enough explanatory power in a social context with important networks of social relationships. Anderson and Carter (1984) stated that the
family is a unit of intensive interactions where the action of any member affects all the others and functions as a group that can decisively have an impact on its individual members in their decision making process. This finding implies that family structural factors may help to explain family members' decisions. Wilkening (1954) stated that the prevalence of family interests over individual members' interests is expressed in the maintenance of family social contacts, properties and occupational status. He argues that family decision making about the adoption of innovations can be subject to kinship ties. According to Goffman (1971), individuals are related to collectivities through membership and to each other through social relationships in a way that makes the network of society. Hurrelman (1988) affirms that each family functions for its members as a dynamic and relatively autonomous mediator of external reality. He argues that there is a social interaction within families and informal social institutions that provide specific modes of interpretation and problem solving strategies that can be adopted and carried out by individual members of the group.

According to Burt (1980), social structure also accounts for individuals perceptions of the advantages and disadvantages of the adoption of innovations. This effect can justify an investigation on how family social structural factors are associated with decisions like the adoption of innovations (Finley, 1968). The extent to which individuals' subjective motivations toward free will action can be set a part from their action under pressures insinuated somehow by social structures has been debated since Durkheim (Porpora, 1987)

When Rogers and Shoemaker (1971) decomposed the adoption process into the stages of awareness about an innovation, the information about it, its evaluation and trial stages, and finally its sustained acceptance, they found that social norms of tar-
get groups are important factors to the adoption of innovations. But most empirical research about adoption, especially in developing countries, has not investigated the direct relationship between the social norms of target groups and the adoption of innovations (Bangura, 1983).

Many of the studies have analyzed the relationships of individual characteristics to the adoption of innovations. Most of these studies emphasized either the characteristics of the new technologies for their adoptability or the individual characteristics for their personal ability to adopt innovations. But this direct influence of social structure on the attitudes of potential adopters of innovations has been much less addressed in the studies about adoption and diffusion of new technologies, especially in developing countries.
CHAPTER 3. THEORETICAL PERSPECTIVE

Introduction

This chapter presents the theoretical perspective used for this research. It presents also the hypotheses derived to test the relationships of farm family structural and operation characteristics to the adoption of new farming practices.

Theoretical Framework

The well-being of farmers in the OHV area depends largely on their ability to produce enough subsistence food for their fast growing families. The goal of the agricultural research and development projects under way is to help farmers to achieve this objective by convincing them to apply new and/or improved agricultural technologies and to adopt new information processing technologies. But it rests upon the farm families of concern to make the decision to implement the proposed more production technologies to obtain their subsistence needs.

The family has been portrayed as a subsystem that can be a physical factor for agricultural production but organized on the basis of role performance toward the satisfaction of goals and needs in relation to land and resources (Drame, 1986). In the low productivity conditions of arable tropical lands of sub-Saharan Africa, the principal goal of farm families is to provide basic subsistence for all family members. In
this regard, family farming is essentially adaptive and large families are advantageous as productivity of rudimentary agriculture depends largely on labor and increases directly with the number of workers (Lee and Whitbeck, 1990). As such, farm families can be considered as social sub-systems striving for survival in an interaction process with the environment.

From the system theory perspective, Wilson (1983) stated that in social life, systems' operation is an input and output process by which families perform interchanges with the environment to achieve survival and attain set goals. Parsons and Smelser (1969) recognize that the adaptation of a system implies its adjustment to the situation lying outside the system. The use of structural networks and elements to explain behavior and the formation of norms and attitudes have been described by Wellman (1988) in the following terms: Structural analysis first seeks explanations in the regularities of how people and collectivities actually behave rather than regularities of their beliefs about how they ought to behave. Structuralists interpret behavior in terms of structural constraints on activity instead of assuming that inner forces such as internalized norms impel the actor in voluntaristic behavior toward desired goals, that is, "structuralists treat norms as effects of structural locations, not causes" (Erikson 1988, Wellman and Berkowitz, 1988: 32-5).

Many mainstream sociologists use the structural location of persons to explain how individuals acquire norms and values. Therefore, persons are treated as individuals acting in response to their internalized norms and values. This more psychological perspective neglects the argument of the structural approach, which contends that norms emerge from locations in structured systems of social relationships. Variations in structured access to resources determine opportunities and constraints for behavior
(Wellman and Berkowitz, 1988). Wellman (1988) stated that normative studies argue that rural Third World people change their attitudes to become more modern, but structural studies suggest that rural villagers act under the influence of kin, friend or neighbor communication networks. This distinction suggests that structural characteristics of kin groups may explain behavior toward set goals. Berkowitz (1988) affirmed that focusing on relations among units rather than on individual attributes forces structural sociologists to think sociologically (i.e., to make inferences about the behavior of the element of the overall structure of system). "Systemic effects are an explicit part of the real world that structural sociologists attempt to model" (Wellman and Berkowitz, 1988: 483).

The external environment of the farm family systems in the OHV may be defined as the active intervention of research and extension services using scientific methods such as field demonstrations, visit and training approaches, on and off farm trials and literacy programs to convince farmers that their well being or successful adaptation depends on their adopting new agricultural technologies. Farmers' are exposed to new technologies in a constant appeal to set goals and make decisions that may give them more stability in their adaptive process. The need for a social system to adjust to its external environment or situation has been expressed by Parsons (1969) when he noted that a goal stated for the social system is a relation between the system and one or more situational objects which maximizes the stability of the system.

Adaptation is performed through the exchange process in which the FPU is engaged in interacting with its natural and institutional environment. The natural environment is composed of geographical and climatic factors and the institutional factors are extension, research and marketing institutions and networks. The ex-
change activity consists of the evaluation and selection process by the FPUs of new agricultural information and technologies promoted by the research and extension services. Social structural and farm operation characteristics influence farmers' decisions about the adoption of adaptive innovations on the basis of perceived innovation characteristics and farmers' value orientation and beliefs concerning the fields system organization (Shaner et al., 1982).

Testing the influence of structural opportunities and constraints on behavior is in agreement with the structuralists' perspective that contends that accounting for behavior through motives is a more psychological explanation. Structuralists suggest that sociologists should explain behavior by looking at the social distribution of possible unequal availability of resources and the processes through which people may access them (White et al., 1988). Mayhew (1982) supports the view held by Parsons (1968) that a system is any set of interdependent elements that are naturally connected into a self-regulating whole and maintained by drawing resources from an environment and using its resources by mobilizing them. He agrees with Parsons that the process of using, consuming or mobilizing resources is the process of adaptation of systems. In this case, adaptation would involve the relation of systems to their external conditions and environment, and adaptation is instrumental in developing and creating means for the pursuit of systems' goals. In this sense, Mayhew (1982: 24) affirms that "human groups can be said to form systems when interaction between members come to have stable patterns of organizations which are maintained by drawing upon resources that nourish the groups' life."
Theoretical Framework and Hypotheses

The main resource in African rural economies is labor produced and constantly renewed through extended family systems and sub-systems. Hyden (1986) explained that the "economy of affection" refers to a network of support, communication and interaction among structurally defined groups that are connected by kin, blood, community and others affinities. He affirmed that in most African countries production and reproduction at the household level are much embedded in "economy of affection."

Social Structure and Adoption

The allocation of labor resources in terms of number of days per worker to the fields of different statuses influences farmers' capacity to produce, innovate and perform a better adaptive strategies. The importance of labor resource generation and its use for adaptive production through family systems in African agrarian societies have been recognized by many authors. Shaner et al. (1982) recognize that family labor includes not only household members who are active workers, but also family cooperative efforts that allow them to get help from other families in the form of external labor. In this case, external labor would help reduce the dependency rate in farm families with fewer members actually capable of working because they have many more infants than reliable workers. Indeed, Cernea (1985, 1986) noted that the structural characteristics of family-based production units often composed of mini-sub-households can affect tremendously the process of resource allocation to different crops in a farming system. He argues that many unexpected effects of agricultural projects were due to insufficient appreciation of the structure, role and function of
the internal mechanisms of the family-based production units in Africa.

**Hypothesis 1.** The number of persons in the FPU is positively related to the adoption of innovations.

**Hypothesis 2.** The number of households in the FPU is positively related to the adoption of innovations.

**Hypothesis 3.** The dependency rate (dependent per worker) of the FPU is negatively related to the adoption of innovations.

Koenig (1980) reported in her findings that most households with traditional family structure of polygyny were more likely to adopt new technologies in the area of Kita in Mali. This finding contrasted with Lewis' (1978) findings that households more integrated in traditional social relationships, (i.e., polygyny or extended family) systems, were least likely to adopt new equipment in the area of Segu in the same country. Koenig (1980) observed that women in Mali constitute a labor power as workers on communal fields and on their own fields, and by producing children, they increase the labor power potential of households. He also affirms that collateral branches and polygynous relationships contribute to the adoption of new agricultural techniques. In this context, farmers' innovativeness may be the consequence of their decision to adopt techniques for more output to meet the survival needs of their increasing farm family members due to high birth rates and the extensive practice of polygyny.

**Hypothesis 4.** The higher the wife rate (Wives per married man) the higher the adoption of innovations.

Another characteristic of family farm labor is the division of family members' efforts according to land use and individual profits from individual versus common
fields. This division or distribution of labor can create incentives for higher productivity. In his effort to conceptualize the household in Africa, Otite (1984) came to consider the household as a field of social relations involving various categories of dependents and as structural growth-poles that interconnect individuals. In the same perspective, the complexity of African farming systems have been reported by Okibo (1986) when he stated that they can be composed of many types of common and individual field systems where there may be important variations in the types of commodities produced, in the number of workers and their motivation, and in the intensity and timing of the farming activities. He affirms that this complexity is largely due to the close ties that exist among family members and extended family systems. Also, Pollet and Winter (1978) noticed about Soninke farmers in Mali that the organization of labor groups is performed according to the traditional principle that junior members of the family owe prestations to senior members of the same generation. The extended family may split into reduced groups when juniors' participation in surplus production becomes marginal.

**Hypothesis 5.** The importance accorded to individual fields is positively related to the adoption of innovations.

Barrows and Roth (1989) defined tenure security or land ownership in the African context as the land holders' perception of having some specific rights on land, such as the right to cultivate or fallow and graze, the right to transfer or mortgage. They reported also that individualization and freehold of land increase land tenure security and are likely to have positive benefits when new technological options are offered to land owners.

**Hypothesis 6.** FPUs with family owned lands are more likely to adopt innovation
than FPUs who were attributed land by land owner families or by village chiefs.

According to Willard and Shaudys (1967), the relationships between farm and family in farming families are interdependent in the sense that the farm is the means by which the family as a whole fulfills its survival needs, and therefore, farming decisions are family decisions. This interrelation between farm and family influences not only the structure of familial roles but also the structure of decision making processes about the production activities that provide basic resources for living (Anderson and Carter, 1978; Abd-Ella et al., 1981). Rogers and Kincaid (1981) recognized that social systems' structure can influence individuals' attitudes for the adoption of innovations.

Rogers (1969) noted that one partial indicator of success in farming is the farm size measured in either land units or labor inputs. He measured labor input as the number of days of family or hired labor utilized on farm. Shaner et al. (1982) recognizes that the household social organization may or may not be a joint family that consists of two or more linearly related kinfolk with their spouses and offsprings. They state that the specific social factors that influence farmers' acceptance of new technologies are societal norms related to land ownership and use, division of labor, family obligations according to sex, age groups and different cooperative efforts. Cooperative efforts include exchanges with other families in the form of external labor and collaborative discussions about decisions within the family, especially with other men in the FPU. Indeed, according to Cloud (1986), husbands and groups of brothers are most often perceived as those who control the grain crop fields and their outputs. She reports that despite the important implication of women in the food production systems, mainly as labor force in Africa, men generally control the decision making
about most farming activities.

**Hypotheses 7.** The more discussion of the household head with other men in the FPU about decisions, the higher the adoption of innovations.

**Farm Operation Characteristics and Adoption**

Smelser and Lipset (1966) stated that social structures can be classified only in two sets of concepts: (1) The directional tendencies of social systems and (2) the resources of social systems. They defined social structure as recurrent interactions among two or more persons that are regulated by values, norms and sanctions. In other words, they referred to social structure as organized sets of human activities that are institutionalized to perform functional exigencies such as the production and consumption of commodities and the creation and transmission of cultural values. These exigencies are the directional tendencies of the social system. They noted, for example, that the nuclear family is a set of institutionalized roles that may function to perform several needs of the social system. Indeed, Parsons and Smelser (1969) noted that the household and the productive unit constitute one single collectivity or the same social system in classical peasant agriculture. Smelser and Lipset (1966) affirmed that these institutions use resources available to socials systems to perform functional exigencies. They stated also that resources available in terms of land, capital, labor, organization and level of information available for action and education are always relevant to structured social action and are a second set of variables that enter propositions about the social system.

**Hypothesis 8.** A higher technical level of farm equipment is positively related to the adoption of innovations.
Hypothesis 9. The perceived importance of radio and research and extension agents as source of information is positively related to the adoption of innovations.

Hypothesis 10. The number of visits received from research and extension agents is positively related to the adoption of innovations.

The “Division de Recherche sur les Systemes de Production Rurales” (DRSPR) conducted a rapid reconnaissance survey in 1986. The research found that most of the farmers in the OHV area live in large farm families with an average of five to six households and a population of ten to twenty members. As Olsen (1968) stated, the systems approach requires the designation of a focal system, and when the family is identified as the focal system, attention must be given to both its members and its significant environment. The significant environment of the FPUs in the present research can be considered to be the formal research, extension and marketing services that are actively intervening in the rural communities to rapidly increase agricultural production by generating and providing new techniques to be adopted by farmers.

Since the 1920s, the French Colonial government began to implement “agricultural advertisement” programs in its West African colonies in order to diffuse technical information that would promote the production of agricultural products most needed, such as cotton, coffee, peanuts, fibers etc. (Sarraut, 1931 The development of these programs since the 1920s gave way to the creation of the actual research, extension and development projects and intervention programs and services that constitute the most dominant feature of the environment of rural farm families. These services have been specialized in the generation and/or extension of so many new agricultural technologies during decades that the survival and adaptation of traditional farm families depends largely on their ability to process and make decisions
about the adoption of the new information.

As the fundamental goal common to farmers in rural societies is ensuring enough food for the family (Harwood, 1979), their decision making process is influenced by households needs and objectives and by resources such as land, water, labor, credit systems (Peggy, 1980).

**Hypothesis 11**. The use of credit is positively related to the adoption of innovations.

The rapid reconnaissance survey of DRSPR showed that historically, powerful families have maintained a hold on better quality lands such as lands near villages, flood recession lands and lands near possible irrigation water. This finding contrasts with the accepted idea of equal access to land for all farmers in Africa. Most semi-arid African farmers practice domestic grazing of animals to compensate the high risks of possible crop failures due to inadequate soil and climate conditions. Therefore, livestock ownership is an investment that gives more security: Animals can be transacted in labor exchanges. They can be used to increase labor and land productivity when used respectively as draft animals and to produce manure (McCown et al., 1979). The productive and reproductive capacity of livestock can be an important potential resource that may be mobilized to meet adaptive needs and functions.

**Hypotheses 12**. The amount of external labor used in the farms of the FPU is positively related to the adoption of innovations.

**Hypothesis 13**. The number of cattle owned is positively related to the adoption of innovations.

**Hypothesis 14**. Livestock ownership (sheep and goats) is positively related to the adoption of innovations.
CHAPTER 4. METHODOLOGY

Research Setting

Geographic Area

The “Operation Haute Vallee” (OHV) area covers 31,530 square kilometers which constitutes 11 percent of the total cultivated land in Mali. It stretches out from a Sahelian climate with 600 mm of rainfall per year to a Sudanian climate with 120 mm of rainfall. The main crops grown are sorghum, millet, corn and rice as food crops and cotton, tobacco and peanuts as cash crops. The population of OHV is composed of Malinke, Bambara, Sarakolle, Marka, Peul and Bozo. The population is generally organized in clans and extended families and has farming as its main occupation. There is a large diversity among farmers, especially with respect to their social structural characteristics. The zone of operation of OHV is divided into six administrative sectors that are subdivided into thirty “Zones d’Expansion Rurales” (ZERs). The ZERs are divided into one hundred and sixty “Secteurs de Base” (SBs) comprising about nine hundred and forty villages and settlements.

Institutional Framework

Since the 1960s the efforts of the extension offices of the government to promote new agricultural techniques in the area of OHV have led to nearly 35 percent of
the farmers adopting some form of animal traction. In general, the use of animal traction is the highest level of capital intensive agriculture in the area. In the late 1980s, a Farming System Research and Extension Project was implemented in the area of the Development Project of OHV. The project was designed to investigate the appropriateness of proposed new technologies to farmers’ specific farming needs in relation to socio-economic and sociological factors that may account for the slow participation of farmers in the project. The proposed new farming technologies were the use of plows and different seed bed preparation methods, the use of chemical fertilizers, new seed varieties and new sowing methods.

The research has been conducted in the OHV area consisting of four homogeneous agro-climatic zones defined by the DRSPR on the basis of the results of a rapid reconnaissance survey in 1986. This survey was conducted by a multidisciplinary team of agronomists, sociologists, agro-economists, and animal scientists in forty-four villages. It consisted of interviews with 160 heads of farm production units (see methodology in Appendix A) This research was conducted in the five villages chosen and maintained as representatives of the OHV area by the ongoing research team. The villages are Deguela, Balanzan, Tenguele, Kominta and Kanika. These villages are considered to cover the diversity in the social structural and farm operation characteristics of farmers practicing both traditional and new farming.

**Sampling Procedure**

**Selection of Sample**

The sampling frame consists of farmers in the villages already chosen by the DRSPR as representative villages of the different technical levels of farming systems in
the OHV area. The villages were chosen by the DRSPR in order to implement farming research activities directly on farmers' fields in these villages in cooperation with the development project in the area. A large part of the farming research activities consist of trials on farmers' fields of some agricultural practices and technologies already known to have been successful on agronomic research stations.

For this research, 100 farmers were interviewed. The sample used for this research is the one used by the researchers of the DRSPR for agronomic trials and socio-economic studies. It consists of 20 FPUs chosen by stratified random sample method in each of the 5 villages representing the area of OHV. This stratification was based on data from an exhaustive survey in each of the 5 villages. These data concerned the socio-demographic elements, the equipment and the animal resources of each FPU that were used to elaborate a typology of the FPUs and to define three homogenous categories of FPUs. These categories represented the strata from which were drawn the FPUs for this research. The heads of the FPUs chosen were the respondents of the interviews.

Development of Questionnaire

The questionnaire was developed in English and translated into French. After discussions with the researchers of the DRSPR, the new questionnaire adopted was tested in one village used for tests in the OHV area. This village was not one of the 5 research villages where the interviews were conducted. The questionnaire (see appendix B) was designed to collect data on farm social structural characteristics based on the demography of each FPU and the relationships between family members in the FPU. The farm operation characteristic elements collected were the material
and educational resources available in the FPUs.

**Data Collection**

In each village where the interviews were conducted, three full time interviewers were present as research agents of the DRSPR. They were assisted with three controllers. The training of these professional interviewers for the data collection consisted of completing 2 or 3 questionnaires with each interviewer after a general explanation of the questionnaire. The researcher was assisted in the data collection by an assistant sociologist working at the headquarters of the DRSPR and by a sociologist expatriate, the coordinator of the project. Each interview took about 40 minutes and was conducted in the local dialect of "Bambara."

**Definition and Operationalization of Variables**

In this section the methods used to measure the variables and their frequency distributions are presented.

**The Dependent Variable and Adoption**

The dependent variable is the adoption of innovations. Two methods are used to measure adoption of innovations. In the first method, the number of new practices adopted by respondents is measured by giving a score of (1) to each of the new practices selected for the survey. From this method, the measure of adoption is obtained by adding the scores given to each new practice adopted and is referred to as the number of new practices adopted or adoption scores in the analysis.

The second method takes into account the period of adoption, as time of adoption
is an important indicator of innovativeness (Rogers, 1971). A scale of 3 periods of 10 years each was developed beginning in 1960, as this date is the beginning of the implementation of agricultural extension programs for the adoption of new practices. The first period is from 1960 to 1969, the second period is from 1970 to 1979, the third period is from 1980 to 1989 and the last is from 1990 or later. The score of (1) is given to the respondents who adopted new practices from 1960 to 1969, the score of .66 is given to the total score of those who adopted new practices from 1970 to 1979, the score of .33 to the adoptions from 1980 to 1989 and 0 to the late adoptions from 1990 or later.

The second method used to measure adoption is a composite score of the number of adoptions and the time of adoption as a measure of innovativeness computed by adding the number of adoptions to the scores given for each period of adoption. The final score obtained indicates at the same time the number of innovations adopted and the time of adoption. It is referred to as innovativeness in the analysis.

The list of new technologies used for the study was determined by an interdisciplinary team of sociologists, animal scientists, economists, and agronomists of DRSPR, and by extension agents in OHV area. The new technologies considered for adoption are divided into crop-related, non crop-related technologies and household technologies as follows:

**Crop related farming technologies**

Partitioned ridges, which is a method used to keep rain water from streaming.

Stone bands, which is an anti-erosion technique.

New seeds, which is the use of improved cereal seeds.

Guided sowing method, which consists of sowing on a drawn line parallel to a
first straight line.

Alternated lines, which consists of sowing different crops on different sowing lines.

The use of natural phosphate of Tilemsi (PNT), which is locally produced fertilizer used to compensate the lack of phosphate in the soil

Cereal and peanut chemical fertilizers, which are different from fertilizers usually used for cotton.

Ammoniac phosphate and urea, which are chemical fertilizers.

Non crop related farming technologies

Manure from improved corral, which consists of producing manure in a more systematic way.

Cattle finishing, which consists of fattening cattle to sell them for profit.

Animal and poultry treatment, which consists of the use of vaccines.

Household Technologies

Local condiment made with soya bean, which is usually made out of the fruits of a local tree, “neré”.

Local soap made with soya oil, which is usually made with “karite” oil. “Karite” is a local tree.

Table 4.1 and Table 4.2 respectively present the percentage of farmers’ adoption of crop and non-related new farming practices that were considered to measure adoption. In general, a higher percentage of farmers have adopted crop related innovations than non-crop related ones. That may be an indication that the majority of farmers still have subsistence food as their priority in farming. Among non-crop related innovations, farmers have adopted more animal related new practices (25 percent and
22 percent) than household new practices (12 percent and 9 percent) as shown on Table 4.2. This may be due to the fact that farmers may perceive animal care as secondary in their farming activities. It may indicate also that farmers have much less interest in non-agricultural innovations because they are less important. The high percentage reported for the use of new seeds (47 percent) on Table 4.1 may be due to the low satisfaction of farmers with the seed varieties they have been using and their willingness to try new seeds. It may be also that new seed are easier or less costly to adopt than the other practices. Table 4.1 indicates also a very low percentage of farmers who have adopted fertilizers for soil reconstitution (3 percent) compared to the use of fertilizers for plants. That is consistent with the findings of previous research that less visible effects of innovations like the use of fertilizer to correct the soil structure are less likely to be adopted.

Table 4.1: Percentage of adoption of crop related new farming practices by farmers

<table>
<thead>
<tr>
<th>Farming practices</th>
<th>% of Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Seeds</td>
<td>47</td>
</tr>
<tr>
<td>2 Urea for cotton</td>
<td>43</td>
</tr>
<tr>
<td>3 Ammoniac phosphate(fertilizer for plants)</td>
<td>36</td>
</tr>
<tr>
<td>4 Pesticides</td>
<td>35</td>
</tr>
<tr>
<td>5 Guided sowing.</td>
<td>24</td>
</tr>
<tr>
<td>6 Alternate cropping</td>
<td>13</td>
</tr>
<tr>
<td>7 Stone bands (Soil conservation)</td>
<td>11</td>
</tr>
<tr>
<td>8 Cereal fertilizer</td>
<td>10</td>
</tr>
<tr>
<td>9 Peanut fertilizer</td>
<td>8</td>
</tr>
<tr>
<td>10 PNT (Natural Phosphate of Tilemsi); fertilizer to build soil</td>
<td>3</td>
</tr>
<tr>
<td>11 Herbicide</td>
<td>3</td>
</tr>
</tbody>
</table>

In Table 4.3 and Table 4.4 are presented the frequencies of the number of new practices adopted respectively for crop related and non-crop related practices that are being promoted with farmers. For crop related new practices, Table 4.3 shows that
only 1 percent of farmers have adopted 6 new practices and only 3 percent of farmers have adopted 5 of 11 new practices being promoted. Also only 3 percent of farmers report having adopted 3 of the 6 non-crop technologies being promoted (Table 4.4). This low adoption of new technologies may be a result of the promoted technologies being unsuited to farmers needs. The FSR approach is to solve this possible problem by bringing farmers into the process of generating new technologies.

<table>
<thead>
<tr>
<th>New technologies</th>
<th>% of Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedlot</td>
<td>25</td>
</tr>
<tr>
<td>Vaccination for small ruminants</td>
<td>22</td>
</tr>
<tr>
<td>Local food made with soya beans</td>
<td>12</td>
</tr>
<tr>
<td>Poultry treatment</td>
<td>10</td>
</tr>
<tr>
<td>Local soap made with soya oil</td>
<td>9</td>
</tr>
<tr>
<td>Corral manure</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4.3: Extent of adoption of crop related new practices

<table>
<thead>
<tr>
<th>Adoption scores</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4.4: Extent of adoption of non crop related new practices

<table>
<thead>
<tr>
<th>Adoption scores</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Independent Variables and Sample Descriptive Elements

The independent variables consist of family social structural variables presented on Table 4.5 and farm operation variables.

Social Structural Variables

1. The number of person in the FPU is measured by the total number persons in the FPU classified in the four following age categories: 1) Infants: from birth to two years old. 2) Children over two up to seven years old consist one category. 3) Children over seven up to fifteen years old constitute the second category of children. 4) All remaining persons over 15 in the FPU are classified in the category of adults. The last two categories are considered as the main source of labor for farming activities in the FPU.

2. The number of households is measured by the number of married males, as the head of household is defined as a married man living with at least one wife or with dependent child or parent.

3. The number of wives is measured by the number of females married by the male workers in the FPU.

4. The wife rate is measured by dividing the total number of wives by the total number of married males in the FPU. This measure is computed to get a standard
measure for FPUs with many married males and FPUs having few males married to many women.

5. The dependency rate is based on the assumption that the more non productive children to be fed are present in families, the less they can save resources required as investment for the adoption of new practices. It is measured by dividing the sum of male and female children (over 2 up to 7 years old) and infants (from birth to 2 years old) by the total number of person in each FPU.

Table 4.5: Demographic structure of farm families

<table>
<thead>
<tr>
<th>Age category</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Range</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1-9</td>
<td>1.73</td>
</tr>
<tr>
<td>Number of wives</td>
<td>4.85</td>
<td>4</td>
<td>2</td>
<td>1-14</td>
<td>2.85</td>
</tr>
<tr>
<td>Male infants</td>
<td>0-2</td>
<td>.84</td>
<td>1</td>
<td>0</td>
<td>.96</td>
</tr>
<tr>
<td>Female infants</td>
<td>0-2</td>
<td>.86</td>
<td>1</td>
<td>0</td>
<td>.93</td>
</tr>
<tr>
<td>Male children</td>
<td>3-7</td>
<td>1.92</td>
<td>1</td>
<td>0</td>
<td>1.94</td>
</tr>
<tr>
<td>Female children</td>
<td>3-7</td>
<td>2</td>
<td>2</td>
<td>0-8</td>
<td>1.84</td>
</tr>
<tr>
<td>Male adolescent</td>
<td>8-15</td>
<td>2.4</td>
<td>2</td>
<td>1</td>
<td>2.16</td>
</tr>
<tr>
<td>Female adolescent</td>
<td>8-15</td>
<td>1.7</td>
<td>1</td>
<td>0</td>
<td>1.55</td>
</tr>
<tr>
<td>Adult males</td>
<td>&gt; 15</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2.89</td>
</tr>
<tr>
<td>Adult females</td>
<td>&gt; 15</td>
<td>5.92</td>
<td>5</td>
<td>7</td>
<td>3.22</td>
</tr>
<tr>
<td>Number of persons</td>
<td>21.61</td>
<td>20</td>
<td>19</td>
<td>5-47</td>
<td>10.12</td>
</tr>
<tr>
<td>Work rate</td>
<td>.25</td>
<td>.01</td>
<td>.2</td>
<td>0-.54</td>
<td>.11</td>
</tr>
<tr>
<td>Wife rate</td>
<td>1.5</td>
<td>1.5</td>
<td>1</td>
<td>.33-.4</td>
<td>6.1</td>
</tr>
</tbody>
</table>

The number of households in the FPUs has a mean of 3, a mode of 3 and ranges from 1 to 9, while the number of wives by FPU has a mean over 4 with a mode of 2 and ranges from 1 to 14 (Table 4.5). The FPUs are extended family units with many women and children. On one hand, the smaller number of female than male adolescent on average may be due to the practice of female early marriage. On the other hand, the smaller number of male adolescents than female and male adults may
be due to migration of young adolescents to urban areas.

6. Importance accorded to individual fields is measured by asking respondents to answer yes or no to 3 questions. The first question is whether they prefer individual fields to common fields in general. The second question is whether they prefer individual to common fields with food crops, and the third question is their preference for individual to common fields with cash crops. The score of 1 is given to each positive answer, and the variable importance given to individual fields is computed by the positive answers to the 3 questions.

It appears as shown in table 4.6 that a large majority of farmers still accord a big importance to common fields: 85 percent prefer common fields and 96 percent would prefer to have food crops on common fields. Common fields may be considered more secure than individual fields. Given the uncertain health and climatic conditions related to farming, it easily can be more harmful to isolated individuals than to farmers working together.

<table>
<thead>
<tr>
<th>Importance of type of field</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More importance to common fields</td>
<td>85</td>
</tr>
<tr>
<td>Preference to have food crops on common fields instead of on individual fields</td>
<td>96</td>
</tr>
</tbody>
</table>

7. Land Status was considered for each new farming practice adopted. Respondents were asked to indicate the status of the land were they applied the new practice adopted. The score of (1) was given to owned lands, the score of (2) was given to attributed lands and the score of (3) was given for borrowed lands. Owned lands are family inherited owned lands. Attributed lands are lifelong attributed lands by fam-
ily land owners to non land owner families. Borrowed lands are lands attributed for a definite known period of time. The measure of the land status in relation with the adoption of new practices is obtained by multiplying the score of the adopted practice by the score of land status, dividing that result by the total number of adopted new practices and then summing across all adopted practices. It ranges from 0 to 3 with a mean of 1.04, a median of 1 and a standard deviation of .75.

8. Discussion about decision making was measured by asking the respondents whether they discussed with their family male members the decisions about seven agricultural practices. These practices are the use of new seeds, the use of a new equipment, the use of credit, hiring external labor, selling farm products, sowing dates and harvest dates. The score of 1 is given for the decision about each of the 7 agricultural practices that has been discussed. Each decision is coded 0 when not discussed. Discussion with men about decision making is the sum of the scores for the 7 agricultural practices for each respondent.

More than a total of 60 percent of farmers have discussed at least 4 of the 7 decisions they were asked about (Table 4.7).

Table 4.7: Extent of discussion of decision with men

<table>
<thead>
<tr>
<th>Number of decisions discussed</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>41</td>
</tr>
</tbody>
</table>
9. Importance accorded to information was measured by summing two variables. The variables are the importance to farmers of radio as a mass media source, and of agricultural research and extension agents. These sources are chosen because they are the most available in rural areas in Mali and accessible to farmers. For the first measure, respondents were asked to indicate how important is radio as a source of information. The second measure was the importance of research and extension agents as a source of information. The score of 1 is given when they give a big importance to a source of information. The score of 2 when they are neutral and the score of 3 is given when they don't give any importance to a source of information. The variable importance accorded to information has a mean of 2.4, a median of 2, a standard deviation of .66 and ranges from 2 to 6.

10. Level of education is measured by the number of years respondents attended either French school, Arabic or literacy school. Only 6 percent of respondents have attended French school; 20 percent have attended Arabic school and 8 percent have attended literacy school. The number of years of education for the few who have attended school ranges from 1 to 10 with a mean of 5.33 and a mode of 1 for French school; for Arabic school, the range is from 1 to 17 with a mean of 6.35, a mode of 3; for literacy school, the number of years ranges from 1 to 11 with a mean of 2.88 and a mode of 1 (Table 4.8). The literacy school is more oriented toward improving farming activities but is still less attended than Arabic school. This variable is not used in the analysis because these figures show that the large majority of farmers are illiterate and thus insufficient variation.
Table 4.8: Number of years of types of school attended by farmers

<table>
<thead>
<tr>
<th></th>
<th>French school</th>
<th>Arabic school</th>
<th>Literacy school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.33</td>
<td>6.35</td>
<td>2.88</td>
</tr>
<tr>
<td>Mode</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Median</td>
<td>4.5</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>Range</td>
<td>1-10</td>
<td>1-17</td>
<td>1-11</td>
</tr>
<tr>
<td>Standard deviation.</td>
<td>3.5</td>
<td>4.95</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Farm operation variables

1. The level of equipment is measured by considering three categories of farmers.

   The score of 1 is given to the first category which is the well-equipped of farmers having at least one complete set of one simple plow, one multi-purpose plow, one seeder, one cart, and at least two pairs of draft oxen. The second category consists of intermediate or semi-equipped farmers that are missing at least one element of the complete set of equipment and do not have more than one complete pair of draft oxen. The score of 2 is given to that category. The score of 3 is given to the third category consisting of the non-equipped or manual farmers who have none or one oxen and only one or two of the elements of the equipment set.

Table 4.9: Percentage of farmers owning at least one of each type of equipment

<table>
<thead>
<tr>
<th>Type of equipment owned</th>
<th>% of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plow</td>
<td>83</td>
</tr>
<tr>
<td>Chisel plow</td>
<td>34</td>
</tr>
<tr>
<td>Seeder</td>
<td>32</td>
</tr>
<tr>
<td>Cart</td>
<td>61</td>
</tr>
<tr>
<td>Harrow</td>
<td>17</td>
</tr>
</tbody>
</table>

Although 83 percent of farmers own at least one plow and 68 percent own at least an ox and one cattle (Table 4.9) and (Table 4.10), only about half of the farmers can be considered as semi-equipped or well-equipped (Table 4.11).
The low percentage of well equipped farmers contrasts with the high percentage of ownership of equipment and animals, especially oxen and cattle. That may mean that farmers do not have the proper combination or sets of equipment necessary for improved farming. There may exist other reasons or conditions that enable farmers to own animals that cannot directly use for farming activities.

2. **Number of cattle** is measured by adding the number cattle and oxen the respondent reportedly own. It ranges from 0 to 92, with a mean of 7.39, a median of 4 and a standard deviation of 11.63.

3. **Livestock ownership** is measured by the sum of the number of sheep and the number of goats. It ranges from 0 to 66, with a mean of 6.4, a median of 3 and a standard deviation of 10.79.

<table>
<thead>
<tr>
<th>Type of animal owned</th>
<th>% of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxen</td>
<td>69</td>
</tr>
<tr>
<td>Cattle</td>
<td>68</td>
</tr>
<tr>
<td>Sheep</td>
<td>44</td>
</tr>
<tr>
<td>Goat</td>
<td>54</td>
</tr>
<tr>
<td>Donkey</td>
<td>56</td>
</tr>
<tr>
<td>Horse</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-equipped</td>
<td>11</td>
</tr>
<tr>
<td>Semi-equipped</td>
<td>39</td>
</tr>
<tr>
<td>Non-equipped</td>
<td>50</td>
</tr>
</tbody>
</table>
4. The use of credit is measured by the sum of the score of 1 given to the use of credit for the purchase of each of the following elements: seeds, pesticides, herbicides, fertilizers, plows, multipurpose plow, seeders, harrow, motor-pumps, oxen, donkeys and horses.

Only 38 percent of farmers reported to have used credit in the 5 last years to purchase one of the following inputs and equipment: Seeds, fertilizers, herbicides, plows, seeders, harrow, irrigation pump, carts and draft animals. The remaining 62 percent of farmers gave different reasons for not having used credit in the same period (Table 4.12).

Table 4.12: Reasons why farmers did not use credit in the last five years

<table>
<thead>
<tr>
<th>Reason for not use of credit</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to credit is difficult</td>
<td>13</td>
</tr>
<tr>
<td>Access to credit is conditional to growing cotton</td>
<td>13</td>
</tr>
<tr>
<td>Cannot get credit</td>
<td>12</td>
</tr>
<tr>
<td>There is no village cooperative</td>
<td>10</td>
</tr>
<tr>
<td>Cannot pay back credit</td>
<td>7</td>
</tr>
<tr>
<td>There is no supplier</td>
<td>5</td>
</tr>
<tr>
<td>Don’t know</td>
<td>2</td>
</tr>
</tbody>
</table>

A large majority of farmers (85 percent to 99 percent) reported that they would like to get credit to buy at least one or more of the inputs or equipment cited in Table 4.9. But 41 percent affirmed that they can get credit when they want it. Those who reported that they could not get credit when they wanted gave the reasons presented in Table 4.13. The main reasons for not being able to obtain credit were difficulty to obtain credit and lack of collateral.
Table 4.13: Reasons why farmers could not get credit when they want it

<table>
<thead>
<tr>
<th>Reasons for inability to get credit</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonavailability of money</td>
<td>2</td>
</tr>
<tr>
<td>Lack of collateral</td>
<td>17</td>
</tr>
<tr>
<td>Difficult to obtain</td>
<td>29</td>
</tr>
<tr>
<td>Lack of confidence</td>
<td>6</td>
</tr>
<tr>
<td>Don’t know</td>
<td>5</td>
</tr>
</tbody>
</table>

5. *Visits received* was measured by asking farmers how often they received counseling visits from research or extension agents. The score of 1 is given when the respondent did not receive any visit. The score of 2 is given for several visits received in a year, the score of 3 is given for visits received at least once a month, the score of 4 is given for visits received at least once a week and the score of 5 is given for more than one visit received per week. A total of 61 percent of farmers receive at least one visit a month from research or extension agents (Table 4.14). But only about one third of farmers report to have received a visit at least once a week. This relatively low frequency of visits received by farmers may be due either to their unavailability to cooperate with research and extension agents or to the unavailability of enough organizational means and/or incentives for agents to visit farmers more regularly.

Table 4.14: Frequency of visits received

<table>
<thead>
<tr>
<th>Frequency of visits</th>
<th>% of visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least once a week</td>
<td>28</td>
</tr>
<tr>
<td>More than once week</td>
<td>23</td>
</tr>
<tr>
<td>At least once a month</td>
<td>20</td>
</tr>
<tr>
<td>Several times a year</td>
<td>18</td>
</tr>
<tr>
<td>Never</td>
<td>11</td>
</tr>
</tbody>
</table>
6. The external work is measured first by adding the number of external workers who have been paid and not paid to work on the respondent's farm, and second, by multiplying that number by the number of days they worked on the respondent's farm. It has mean of 3.96, a median of 0, a standard deviation of 21.19 and ranges from 0 to 184.

Intervening Variables

Intervening variables are variables that may be associated with the independent variables in a chain causation. In this case, the independent variables would affect indirectly the dependent variable (Agrasti and Finlay, 1986). Four attitude and value orientation variables have been included in the research as intervening variables to determine their relationship to the independent variables considered for the study and to determine the extent of their effect on farmers' behavior for the adoption of new farming practices.

1. Attitude toward women for the adoption of new practices is measured by asking the respondents whether they agree or disagree with the following items: women may participate in farming activities, have their own cash and food crop fields, use new practices before their husbands and grow only crops allowed by their husbands. A score of 1 is given for disagreement, 2 for neutral attitude and 3 for agreement. The reliability test resulted in ALPHA of .44. This low reliability test score may be due to farmers' tendency to agree that women have their own farming fields and also participate in their husbands' farming activities. But farmers disagreed with letting women adopt new technologies before their husbands. That likely inconsistency may explain the low reliability test result.
In general farmers have favorable attitudes for women involvement in farming activities but they tend to be more skeptical about women adopting farming innovations before their husbands. Farmers appear also less favorable to women independence based on having their own subsistence crop fields (Table 4.15).

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Women should participate in farming activities of the common fields of the FPU.</td>
<td>35</td>
<td>8</td>
<td>57</td>
</tr>
<tr>
<td>2. Women should have their own cash crop fields</td>
<td>31</td>
<td>4</td>
<td>65</td>
</tr>
<tr>
<td>3. Women should not use new practices on their own fields before their husbands use them $^a$</td>
<td>34</td>
<td>10</td>
<td>56</td>
</tr>
<tr>
<td>4. Women should grow only the crops their husbands want them to grow $^a$</td>
<td>38</td>
<td>6</td>
<td>56</td>
</tr>
<tr>
<td>5. Women should have their own subsistence crop fields</td>
<td>12</td>
<td>3</td>
<td>85</td>
</tr>
</tbody>
</table>

$^a$Statements 3 and 4 are recoded (1=3; 3=1) to indicate favorable attitude toward women.

2. The fatalistic attitude of respondents was measured by asking them whether they agreed or disagreed with the following items: they don’t master their fate, they cannot change their economic situation, their progress depends on their personal efforts and their success depends on forces beyond their control. A score of 1 is maintained for disagreement, 2 for neutral and 3 for agreement. The reliability test have resulted in an ALPHA of .66.

Table 4.16 show that farmers are rather fatalistic. Even if the neutral scores are added to the disagreement scores, the agreement to fatalism remains high.
Table 4.16: Distribution of fatalistic attitude

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your fate for farming is beyond your control.</td>
<td>23</td>
<td>13</td>
<td>64</td>
</tr>
<tr>
<td>2. You cannot change your economic status</td>
<td>37</td>
<td>12</td>
<td>51</td>
</tr>
<tr>
<td>3. Your progress depends on your personal efforts¹</td>
<td>37</td>
<td>11</td>
<td>52</td>
</tr>
<tr>
<td>4. Your success depends on forces beyond your control</td>
<td>29</td>
<td>11</td>
<td>60</td>
</tr>
</tbody>
</table>

¹Statement 3 is recoded (1=3; 3=1) to indicate fatalistic attitude.

3. Risk taking attitude for adopting new technologies is measured by asking respondents to indicate their agreement with the statements that there is too much risk of loss in the use of new agricultural techniques, gaining a small yield is preferable to losing a big one, it is better not to use new techniques until neighbors have used it, it is better to use old successful techniques than to use new ones, the use of new techniques is generally better and farmers should learn about new agricultural methods to get better yields. The score of 1 is given for disagreement. 2 for neutral and 3 for agreement. A reliability test resulted in an ALPHA of .65.

Farmers also appear to have positive attitudes toward new farming practices and toward credit as shown in Table 4.17. This apparent openness of traditional farmers may indicate their willingness to change.

4. Attitude toward credit was measured by asking respondents to indicate their agreement with the three statement that they should wait until they can accumulate their own money rather than borrow money for farming purposes, borrowing money from someone they know is preferable to borrowing money from the government, and
Table 4.17: Distribution of attitudes toward new farming practices

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There is too much danger of loss in using new farming methods</td>
<td>46</td>
<td>17</td>
<td>37</td>
</tr>
<tr>
<td>2. It is better to have a small yield than to take a chance of losing a large yield</td>
<td>52</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>3. In general, it is better not to try new farming practices until other farmers in your area have tried them a</td>
<td>64</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>4. In general, it is better to the old method that have been successful in the past years, rather than trying new ones</td>
<td>57</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td>5. In general, it is better to use new farming practices a</td>
<td>11</td>
<td>9</td>
<td>80</td>
</tr>
<tr>
<td>6. In general, it is better for a farmer learn about new farming methods if he wants to have better yields a</td>
<td>10</td>
<td>9</td>
<td>81</td>
</tr>
</tbody>
</table>

aStatements 5 and 6 are recoded (1=3; 3=1) to indicate favorable attitude toward new farming practices.

using credit is a good action. The score of 1 is given for disagreement, 2 for neutral and 3 for agreement. A reliability test resulted in an ALPHA of .37. This low test result may be due to farmers’ tendency to put themselves in a situation of credit need, while the majority (59 percent) don’t think that using credit is a good action as shown in Table 4.18.

The greater disparity among farmers about their attitude toward women compared to their fatalistic attitude and to their attitude toward new farming practices (Table 4.19), may be due to their inconsistency about women as the low reliability test result indicated and is explained on page 35.
Table 4.18: Distribution of attitudes toward credit

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. You should wait until you can you can accumulate your own money rather than borrow money for farming purposes</td>
<td>74</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>2. Borrowing money from some one you know is preferable than borrowing money from the government</td>
<td>74</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>3. Using credit is a good action&lt;sup&gt;a&lt;/sup&gt;</td>
<td>59</td>
<td>7</td>
<td>34</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statement 3 is recoded (1=3; 3=1) to indicate unfavorable attitude towards credit.

Table 4.19: Attitude scale statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Range</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude toward women</td>
<td>10.8</td>
<td>11</td>
<td>4-15</td>
<td>6.4</td>
</tr>
<tr>
<td>Fatalistic attitude</td>
<td>8.0</td>
<td>8</td>
<td>4-12</td>
<td>4.3</td>
</tr>
<tr>
<td>Attitude toward new farming practices</td>
<td>9.8</td>
<td>9</td>
<td>6-16</td>
<td>3.2</td>
</tr>
<tr>
<td>Attitude toward credit</td>
<td>4.8</td>
<td>5</td>
<td>3-9</td>
<td>1.8</td>
</tr>
</tbody>
</table>
CHAPTER 5. ANALYSIS AND DISCUSSION

The objective of this chapter is to present and discuss the findings of the research. Pearson correlations are used to test the relationships postulated in the hypotheses and multiple regression with stepwise method is used to determine the variables explaining the adoption of new practices. The level of significance used is .05. Analysis and discussion are presented in the following order.

(1) The relationship between farm social structural characteristics and adoption is presented.

(2) The relationship between farm social structural characteristics and the intervening variables is presented.

(3) The relationship between farm operation characteristics and adoption is presented.

(4) The relationship between farm operation characteristics and the intervening variables is presented.

(5) The relationship between the intervening variables and adoption is presented.

Finally, a summary of the results and discussion is presented.

Two measures of adoption as independent variable were defined in the methods chapter: The first measure is the total number of new practices adopted referred to as adoption scores, and the second measure is the same number to which is added
the scores of the time of adoption and is referred in this section as innovativeness. The correlation between adoption scores and innovativeness is .91 and is significant at .05 level. Each of these two variables will be considered separately in the analysis.

**Family Social Structural Characteristics and Adoption**

The pearson correlations are first presented to determine whether the postulated hypotheses are supported (Table 5.1). Then, to identify how much each individual social structural variable accounted for in explaining the number of adopted new practices and innovativeness, a stepwise multiple regression analysis is used. It consists of regressing (a) the number of new practices adopted, and (b) innovativeness on the social structural variables (number of persons in the FPU, number of households, dependency rate, wife rate, importance accorded to common fields versus individual fields, land ownership, discussion of decisions with men in the FPU, and importance accorded to information) (Table 5.2 and Table 5.3). The hypotheses tested are the following:

1. The number of persons in the FPU is positively related to the adoption of innovations.
2. The number of households in the FPU is positively related to the adoption of innovations
3. The higher the wife rate (Wife per married man) the higher the adoption of innovations
4. The dependency rate (dependent per worker) of the FPU is negatively related to the adoption of innovations
5. The importance accorded to individual fields is positively related to the
adoption of innovations.

6. FPUs with family owned lands are more likely to adopt innovation than households who were attributed land by land owner families or by village chiefs.

7. The more discussion of the household head with other men in the FPU about decisions, the higher the adoption score.

8. The perceived importance of radio and research and extension agents as source of information is positively related to the adoption of innovations.

The correlations on table 5.1 shows that three hypotheses (number of households, number of persons in the FPU, and land ownership) are supported at .05 level of significance with both measures of adoption. The five other hypotheses (Dependency rate, wife rate, discussion with other men of decisions, importance of individual fields and importance accorded to information) are not supported.

Table 5.1: Pearson correlations among social structural variables and adoption scores and innovativeness

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adoption score</th>
<th>Innovativeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Number of households</td>
<td>.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.26&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 Number of persons in the FPU</td>
<td>.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.25&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 Dependency rate</td>
<td>.02</td>
<td>-.03</td>
</tr>
<tr>
<td>4 Wife rate</td>
<td>.00</td>
<td>.03</td>
</tr>
<tr>
<td>5 Importance of individual fields</td>
<td>.02</td>
<td>.00</td>
</tr>
<tr>
<td>6 Land status</td>
<td>.47&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.40&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 Discussion with men in FPU</td>
<td>-.11</td>
<td>-.15</td>
</tr>
<tr>
<td>8 Importance accorded to</td>
<td>-.19</td>
<td>-.10</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at prob. > .05.

From the regression of the number of new practices adopted (adoption score) on family farm social structural characteristics, land ownership was the first variable
Table 5.2: Regression of the number of new practices adopted on farm social structural characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimate</th>
<th>( R^2 ) adjusted</th>
<th>( R^2 ) change</th>
<th>T value</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Land ownership</td>
<td>.52</td>
<td>.21</td>
<td>.21</td>
<td>6.25</td>
<td>.00</td>
</tr>
<tr>
<td>2 Number of households</td>
<td>.31</td>
<td>.29</td>
<td>.08</td>
<td>3.79</td>
<td>.00</td>
</tr>
<tr>
<td>3 Discussion with men</td>
<td>-.24</td>
<td>.33</td>
<td>.04</td>
<td>-2.82</td>
<td>.01</td>
</tr>
</tbody>
</table>

...to enter the equation and explained 21 percent of the variation in the number of adopted new practices. The number of households is the second variable to enter the equation, explaining an additional 8 percent and discussions with other men was the third variable to enter and explained 4 percent of the variation. But the negative relationship instead of the positive relationship predicted may be due to generation conflicts or lack of confidence among family members. The 3 variables that entered the equation explained together 33 percent of the variation and each of them was statistically significant. All the other 5 variables did not pass the tolerance level test to enter the equation.

Table 5.3 displays the summary of the regression of the second measure of adoption referred to as innovativeness on farm social structural variables. The same variables that entered the equation with the first measure of adoption, land ownership, the number of households and discussion with other men entered the equation and respectively explained 15 percent, 7 percent and 6 percent of the variation. The 6 other variable did not reach the tolerance level. Land ownership appears more important in explaining the variation in adoption contrary to the usual assumptions that...
land ownership is not important in Africa. Discussion with men negatively related contrary to the positive predicted relation may be to generation conflicts or lack of confidence among family members.

Table 5.3: Regression of innovativeness on farm social structural characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Adjusted</th>
<th>$R^2$ change</th>
<th>$R^2$ value</th>
<th>$T$</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Land ownership</td>
<td>.46</td>
<td>.15</td>
<td>.15</td>
<td>5.27</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>2 Number of</td>
<td>.30</td>
<td>.22</td>
<td>.07</td>
<td>3.53</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>households</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Discussion</td>
<td>-.27</td>
<td>.28</td>
<td>.06</td>
<td>-3.08</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>with men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Family Social Structural Characteristics and Intervening Variables

The correlation between family social structural variables and 4 intervening variables in Table 5.4 indicates that most social structural variables are not related to the intervening variables. Only the number of households and the importance given to information are significantly related to fatalistic attitude, and dependency rate and importance of information are related to attitude toward credit.

Each one of 4 attitudes and value orientation variables defined as intervening variables (attitude toward women, fatalistic attitudes, risk taking attitude toward new farming practices and attitude toward credit) was regressed on farm social structural variables and on farm operation variables to determine their contribution in explaining the intervening variables.

In the first regression of attitude toward women on farm social structural characteristics no variable entered the equation. In the second regression of fatalism on
Table 5.4: Pearson correlations among social structural variables and the four intervening variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Attitude toward women</th>
<th>Fatalistic attitude</th>
<th>Attitude toward innovations</th>
<th>Attitude toward credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Number of households</td>
<td>-.05</td>
<td>.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.15</td>
<td>-.09</td>
</tr>
<tr>
<td>2 Number of persons</td>
<td>.08</td>
<td>.04</td>
<td>-.09</td>
<td>-.04</td>
</tr>
<tr>
<td>3 Dependency rate</td>
<td>.05</td>
<td>.04</td>
<td>.01</td>
<td>.17&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 Wife rate</td>
<td>.05</td>
<td>-.10</td>
<td>-.11</td>
<td>.06</td>
</tr>
<tr>
<td>5 Importance of individual fields</td>
<td>-.03</td>
<td>-.02</td>
<td>-.14</td>
<td>-.10</td>
</tr>
<tr>
<td>6 Land ownership</td>
<td>.01</td>
<td>.06</td>
<td>.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.01</td>
</tr>
<tr>
<td>7 Discussion with men</td>
<td>.11</td>
<td>.04</td>
<td>-.02</td>
<td>-.13</td>
</tr>
<tr>
<td>8 Importance accorded to information</td>
<td>.07</td>
<td>-.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.14</td>
<td>.22</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at prob. > .05.

Family social structural variables summarized in Table 5.5, only 1 variable (importance accorded to information) entered the equation and explained only 5 percent of the variation in fatalism.

Only one variable, land ownership, entered the third the equation in the regression of risk attitude toward new farming practices on farm social structural characteristics and explained 3 percent of the variation (Table 5.6).

On Table 5.7 only level of information entered the equation and explained 4 percent of the variation in attitude toward credit.
Table 5.5: Regression of fatalist attitude on farm social structural characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>( R^2 )</th>
<th>( R^2 ).</th>
<th>( T )</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance accorded to information</td>
<td>-.24</td>
<td>.05</td>
<td>.05</td>
<td>-2.47</td>
</tr>
</tbody>
</table>

Table 5.6: Regression of risk attitude toward new farming practices on farm social structural characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>( R^2 )</th>
<th>( R^2 ).</th>
<th>( T )</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land ownership</td>
<td>-.21</td>
<td>.03</td>
<td>.03</td>
<td>-2.15</td>
</tr>
</tbody>
</table>

Table 5.7: Regression of attitude toward credit on farm social structural characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>( R^2 )</th>
<th>( R^2 ).</th>
<th>( T )</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance accorded to information</td>
<td>.22</td>
<td>.04</td>
<td>.04</td>
<td>2.23</td>
</tr>
</tbody>
</table>

Farm Operation Characteristics and Adoption

To determine the contribution of each farm operation variable in explaining adoption, a stepwise multiple regression of adoption score and innovativeness on farm operation variables (number of cattle owned, number of visits received, level of equipment, external labor used and number of sheep and goats owned) was performed. The empirical hypotheses relating farm operation characteristics to the adoption of new farming practices were the following ones:

1. A higher technical level of farm equipment is positively related to the adoption
of innovations

2. The number of cattle owned is positively related to the adoption of innovations.

3. Livestock ownership in general is positively related to the adoption of innovations.

4. The use of credit is positively related to the adoption of innovation

5. The number of visits received from research and extension agents is positively related to the adoption of innovations

6. The amount of external labor used in the farms of the FPU is positively related to the adoption of innovations.

In Table 5.8, the Pearson correlations between farm operation variables and the number of new practices adopted and innovativeness indicates that only external labor use is not supported with the number of new practices adopted or adoption scores. That might be due to the fact that farmers who adopt less new practices may be hampered by the continuous use of old practices that need more labor to be performed.

In the regression of adoption scores (Number of adopted new practices) on farm operation variables, only the variable level of equipment entered the equation and explained only 11 percent of the variation in adoption scores (Table 5.9). The negative relationship is due to the lowest score given to the well equipped and vice versa.
Table 5.8: Pearson correlations between farm operation characteristic variables and adoption scores and innovativeness

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adoption score</th>
<th>Innovativeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Number of cattle owned</td>
<td>.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.33&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 Number of visits received</td>
<td>.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.19&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 Level of equipment</td>
<td>-.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.34&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 Use of credit</td>
<td>.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.18&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 External labor used</td>
<td>.10</td>
<td>.13&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>6 Number of sheep and goats</td>
<td>.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.33&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at prob. > .05.

Table 5.9: Regression of adoption scores on farm operation characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>R&lt;sup&gt;2&lt;/sup&gt;</th>
<th>R&lt;sup&gt;2&lt;/sup&gt; Adjusted</th>
<th>T</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of equipment</td>
<td>-.34</td>
<td>.11</td>
<td>-3.56</td>
<td>.00</td>
</tr>
</tbody>
</table>
But, in the regression of innovativeness on farm operation characteristics, 3 variables (level of equipment, the number of sheep and goats owned and the number of visits received) entered the equation and explained respectively 11 percent, 5 percent and 3 percent of the variation in innovativeness as shown on Table 5.10.

Table 5.10: Regression of innovativeness on farm operation characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Adjusted</th>
<th>$R^2$ change</th>
<th>T value</th>
<th>Prob I T I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Level of equipment</td>
<td>-.28</td>
<td>.11</td>
<td>.11</td>
<td>-3.02</td>
<td>.00</td>
</tr>
<tr>
<td>2 Sheep and goats owned</td>
<td>.26</td>
<td>.16</td>
<td>.05</td>
<td>2.74</td>
<td>.00</td>
</tr>
<tr>
<td>3 Number of visits received</td>
<td>.21</td>
<td>.19</td>
<td>.03</td>
<td>2.34</td>
<td>.00</td>
</tr>
</tbody>
</table>

**Farm Operation Characteristics and Intervening Variables**

The correlation between farm operation characteristics and the intervening variables show that the number of visits is significantly correlated to risk attitude toward innovations and to attitude toward credit. The use of external labor is supported with attitude toward women and fatalism (Table 5.11).

For the 3 regressions of 3 intervening variables (risk attitude toward new farming practices, fatalism and attitude toward credit), on farm operation variables, none of the variables passed the tolerance level to enter the equation. Only the use of credit entered the equation regressing risk attitude toward new farming practices on farm operation characteristic variables. It explained 6 percent of the variation in risk attitude as shown on Table 5.12.
Table 5.11: Pearson correlations between farm operation variables and the four intervening variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Attitude toward women</th>
<th>Fatalistic attitude</th>
<th>Attitude toward innovations</th>
<th>Attitude toward credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Number of cattle owned</td>
<td>.02</td>
<td>-.01</td>
<td>-.03</td>
<td>-.03</td>
</tr>
<tr>
<td>2 Number of visits received</td>
<td>.02</td>
<td>-.06</td>
<td>-.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.13</td>
</tr>
<tr>
<td>3 Level of equipment</td>
<td>-.10</td>
<td>.04</td>
<td>.07</td>
<td>.01</td>
</tr>
<tr>
<td>4 Use of credit</td>
<td>-.05</td>
<td>.15</td>
<td>-.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.04</td>
</tr>
<tr>
<td>5 Use of external labor</td>
<td>.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.12</td>
<td>.10</td>
<td>.16&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>6 Number of sheep and goats</td>
<td>.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.07</td>
<td>-.09</td>
<td>-.13</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at prob. > .05.

Table 5.12: Regression of risk attitude toward new farming practices on farm operation characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>$R^2$ Adjusted</th>
<th>$R^2$ change</th>
<th>T value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of credit</td>
<td>-.27</td>
<td>.06</td>
<td>.06</td>
<td>-2.81</td>
<td>.00</td>
</tr>
</tbody>
</table>
Intervening Variables and Adoption Scores and Innovativeness

The correlations on Table 5.13 show that only risk attitude is significantly related to both independent variables. The other 3 intervening variables did not therefore intervene in explaining the variation in the adoption of new technologies.

The regression of adoption scores and innovativeness on the 4 intervening variables (attitude toward women, fatalistic attitude, risk attitude toward new farming practices, and attitude toward credit) is summarized on Table 5.14 and Table 5.15. Only risk attitude toward new farming practices entered both equations and explained respectively 8 percent in the variation in adoption scores and 6 percent in innovativeness.

Table 5.13: Pearson correlations between intervening variables and adoption scores and innovativeness

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adoption scores</th>
<th>Innovativeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Attitude toward women</td>
<td>.03</td>
<td>.10</td>
</tr>
<tr>
<td>2 Fatalistic attitude</td>
<td>.05</td>
<td>.01</td>
</tr>
<tr>
<td>3 Attitude toward new farming practices</td>
<td>-.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.28&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 Attitude toward credit</td>
<td>.00</td>
<td>.00</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at prob. > .05.

Table 5.14: Regression of adoption scores on four intervening variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>$R^2$ Estimate</th>
<th>Adjusted $R^2$</th>
<th>T</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk attitude toward new farming practices</td>
<td>.28</td>
<td>.08</td>
<td>.08</td>
<td>-2.88</td>
<td>.00</td>
</tr>
</tbody>
</table>
Table 5.15: Regression of innovativeness on the four intervening variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Adjusted change</th>
<th>$R^2$</th>
<th>$R^2$</th>
<th>T</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk attitude toward new farming practices</td>
<td>-.27</td>
<td>.06</td>
<td>.06</td>
<td>-2.77</td>
<td>.00</td>
<td></td>
</tr>
</tbody>
</table>

Farm Social Structure and Farm Operation and Adoption

In this section is presented the results of the regression of adoption scores and innovativeness on both family social structural and farm operation characteristic variables that were considered separately in the previous sections. These regressions are to show how much family social structural variables versus farm operation variables account for the variation in adoption scores and innovativeness when these variables are considered together. From the regression of adoption scores on all variables considered, it appears on Table 5.16 that a total of 33 percent of the variation in adoption score is explained by 3 farm social structural characteristics among which, land ownership explains 21 percent of the variation. No farm operation variable entered the equation.

But from the regression of innovativeness on family social structural and farm

Table 5.16: Regression of adoption scores on farm social structural and farm operation characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Adjusted change $R^2$</th>
<th>$R^2$</th>
<th>T</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Land ownership</td>
<td>.52</td>
<td>.21</td>
<td>.21</td>
<td>6.25</td>
<td>.00</td>
</tr>
<tr>
<td>2 Number of households</td>
<td>.31</td>
<td>.29</td>
<td>.08</td>
<td>3.79</td>
<td>.00</td>
</tr>
<tr>
<td>3 Discussion with men</td>
<td>-.24</td>
<td>.33</td>
<td>.04</td>
<td>-2.82</td>
<td>.00</td>
</tr>
</tbody>
</table>
operation variables, a total of 35 percent of the variation in innovativeness is explained by land ownership accounting for 15 percent and by 4 farm operation characteristics as follows: The number of sheep and goats accounts for 8 percent, the number of visits received 7 percent, discussion with men 2 percent and level of equipment 3 percent. (Table 5.17). In both cases, land ownership was the first variable to enter the equation and explained a fairly important amount of variation in adoption. This may be the indication that land ownership is important in the adoption process of new farming practices even though land has virtually no price in the traditional land tenure systems in Africa as reported in the literature.

Table 5.17: Regression of innovativeness on farm social structural and farm operation characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>$R^2$</th>
<th>$R^2_{\text{Adjusted}}$</th>
<th>$R^2_{\text{change}}$</th>
<th>T value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Land ownership</td>
<td>.40</td>
<td>.15</td>
<td>.15</td>
<td>4.66</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>2 Number of sheep and goats</td>
<td>.24</td>
<td>.23</td>
<td>.08</td>
<td>2.88</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>3 Number of visits received</td>
<td>.25</td>
<td>.30</td>
<td>.07</td>
<td>2.95</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>4 Discussion with men</td>
<td>-.20</td>
<td>.32</td>
<td>.02</td>
<td>-2.32</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>5 Level of equipment</td>
<td>-.27</td>
<td>.35</td>
<td>.03</td>
<td>-2.20</td>
<td>.03</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Results

The descriptive elements of family structure of the sample suggest that farming communities in the OHV area are composed of extended families with more wives and adult men than adolescents. Farmers have a preference for common over individual fields although the theory reviewed indicates that individuals may be more motivated to work individually for personal rewards.

The majority of farmers reported a need for credit. In general, they consider that their lack of using credit is due to external and institutional factors rather than to their inability to repay the loans. A lower percentage of the adoption of fertilizer-related innovations was reported with the exception of fertilizers use with cotton. That may be due to the fact that cotton growers are supplied each farming season with fertilizers to be paid by the sale of cotton. Of the respondents, 50 percent were poorly equipped, and only 11 percent are well equipped.

The relative availability of resources such as cattle, sheep, goats and plows are consistent with the explanations of the variations in innovativeness by farm operation characteristics and with the theory on the importance of available resources on farmers’ decisions about innovations.

From the regression of adoption scores and innovativeness on the 9 family social structural characteristic variables, 3 (Land ownership, number of households and discussion of farming decisions) explained together 33 percent of the variation in adoption scores and 28 percent of innovativeness. Land ownership explained 22 percent of adoption scores and 15 percent of innovativeness. The number of households explained respectively 8 percent and 7 percent of adoption scores and innovativeness. Discussion of farming decisions explained respectively 3 percent and 6 percent of
adoption scores and innovativeness.

The regressions of attitude variables on family social structural and farm operation characteristics show that farmers' attitudes in general are not explained by those variables. Only importance accorded to information explained 5 percent of fatalism, and 4 percent of attitude toward credit. Also, only land ownership explained 3 percent of attitude toward credit. Furthermore, farmers' attitudes appear neither related to farm operation characteristics as 3 of the four attitudinal variables are not explained by any farm operation variables. Only the use of credit explained 6 percent of risk attitude.

The regression of adoption scores and innovativeness on farm operation variables showed that only the level of equipment used Farmers' attitudes appear neither related to farm operation characteristics as 3 of the four attitudinal variables are not explained by any farm operation variables. Only the use of credit explained 6 percent of risk attitude. To define 3 categories of farmers explained 11 percent of adoption scores. Also, level of equipment, sheep and goats owned and the number of visits received explained a total of 19 percent of the variation in innovativeness.

The regression of adoption scores and innovativeness on the attitudinal variables used as intervening variables showed that only risk attitude toward new farming practices entered both equations and explained 8 percent of adoption scores and 6 percent of innovativeness. This suggest that adoption of new farming practices by traditional farmers may be explained by family social structural and farm operation characteristics rather than by farmers' value orientations on women, fatalism and credit.
Hypotheses Supported

1. The number of households in the FPU is positively related to the adoption of innovations.

2. FPUs with family owned lands are more likely to adopt innovation than FPUs who were attributed land by land owner families or by village chiefs.

3. A higher technical level of farm equipment is positively related to the adoption of innovations.

4. Livestock ownership (sheep and goats) is positively related to the adoption of innovations.

5. The number of visits received from research and extension agents is positively related to the adoption of innovations.
CHAPTER 6. CONCLUSIONS AND PERSPECTIVES

The results presented in chapter 3 and 4 are discussed in relation to the objectives and the theoretical framework of the study in this final chapter. Then, the implications of the findings for the adoption of innovations are presented. Finally, the limitations of the research, suggestions for future research and a general conclusion are presented.

Sample Characteristics

Socio-demographic Elements

The socio-demographic elements of the sample indicate that farming communities in the OHV area are generally composed of extended families with many households living and farming the same fields. The average number of persons is 21 and the average number of households is 3. But the distribution of age categories indicate that FPUs are composed of a greater number of female adults and male adolescents.

This finding is consistent with the theoretical framework of the study that large families are advantageous in rudimentary or subsistence agriculture. They can provide sufficient labor for greater productivity of collective efforts to fulfill survival needs through interactive exchanges with the external environment. The implications of this finding for the adoption of innovations is that labor intensive technologies may
be more likely to interest farmers for the maximization of the productivity of the labor force available to them.

Farmers have a preference for common fields over individual fields in general and almost all farmers (96 percent) prefer to grow food crops on common fields. However, the literature reviewed indicates that farm level individualization is rather more likely than common fields to be an incentive for the adoption of new technologies for higher production. This means that educational efforts to convince farmers of the advantages of individual entrepreneurship may be useful to increase the adoption of new farming practices for higher production.

Availability of Resources

The percentage of farmers who have used credit is low (38 percent). Reasons for not using credit are related to lack of access and imposition of conditions such as growing cotton, participation in cooperative institutions or having collateral. The low frequency of visits from research and extension agents may be a limiting factor for the adoption of innovations. The data indicate positive relationship between visits and adoption of innovation. These observations are consistent with theory that available resource such as credit, capital or information influence decisions concerning the adoption of innovations. The findings suggest that credit policies should be implemented on the basis of farmers resources instead of conditions that cannot be met easily by farmers.
Adoption of Innovations

In general, more farmers have adopted crop related innovations than non-crop related innovations. A lower percentage of the adoption of fertilizer-related innovation was reported, with the exception of fertilizer use with cotton. Cotton growers are supplied each farming season with fertilizers to be paid with the sale of cotton. Also, a higher percentage of farmers have adopted new practices related to animals compared with the percentage of farmers having adopted new household technologies.

The total number of new practices adopted is small. About 80 percent of farmers have adopted between 1 and 4 crop related innovations out of 11 being promoted. The maximum number of innovations adopted is 6. Only 1 percent of respondents have adopted that number and half of the respondents did not adopt any non-crop related innovation. These findings imply that there may be a need to promote a limited number of technologies that are likely to be adopted rather than a large number of innovations of which few are likely to be adopted. Greater effort to generate technologies that suit best the needs of respondents would also help to overcome the this low adoption rate.

Farmers Attitudes and Value Orientations

Farmers have mixed attitudes toward women. They are favorable to women participation in farming activities but less favorable to let women grow their own food crops or to let them adopt innovations before their husbands. In general, farmers are fatalistic, but have positive attitudes toward the adoption of new farming practices. Their attitudes toward credit is also mixed. They expressed a need for credit but they reported that using credit is not a good action. Farmers attitudes are in general
not significantly related to family structural characteristics. Less than 5 percent of the variation in farmers attitudes toward women, credit, risks and fatalism is explained by family social structural characteristics. There is also a weak correlation between farmers attitudes or value orientation and adoption. Only attitude toward risk of adopting new farming practices explained any variation in the adoption of innovations.

**Relationship Between Variables**

The major objective of this study was to test hypothesized relationships of both farm family social structural and farm operation characteristic variables to farmers' adoption of new farming practices. Tests were performed by using correlation and regression analyses methods.

The Farm family social structural characteristics variables considered in the analysis were number of household, number of wives, total number of persons, the dependency rate, the wife rate, the importance accorded to individual fields, land status and the importance accorded to information.

The correlation analysis (Table 5.1) indicated mixed support of the hypotheses tested. Three hypotheses were supported at .05 level of significance. In addition, the regression analysis revealed that 33 percent and 28 percent respectively of the variation of the two measures of adoption are explained by three variables among which land status accounted for 21 percent and 15 percent respectively. This finding partially supports the theoretical perspective used in this research. First, the theoretical implication of this finding for adoption of innovations by farmers, is that family social structural characteristics variables should considered in complement to
the individual characteristic variables traditionally included in adoption/diffusion research. Secondly, the importance of land status in explaining most of the variation in adoption implies that lack of private land resources can be a constraint for farmers. This is anomalous in that land has virtually no price in the traditional land tenure systems in developing countries.

The correlation and regression analyses also revealed that decisions about the adoption of innovations are discussed with other family members by the household head, but such discussions have a negative relationship to adoption. This finding supports the theoretical perspective used in this study arguing that social systems process new information to be used for their objectives. Theoretically, this suggest that empirical generalizations about the relationship of interpersonal interactions and their effect on the adoption of innovations can be generated and tested for extended farm families in developing societies such as those in Africa. The practical implication of the negative relationship of discussing decisions with adoption is the need to be aware of potential disagreements among farm family members about the use of new technologies. Given these types of interpersonal relationships found in the farm families, efforts should be made to obtain consensus or compromises about technologies before and during their implementation.

Five of the six farm operation hypotheses used to test the relationship with adoption were supported by the correlation analysis. Only the relationship with external labor was not supported. The regression of adoption on farm operation variables indicate that the level of equipment is the most important variable explaining adoption (11 percent of the variation). This finding also is consistent with the literature on the importance of resources for the adoption of innovations.
Implications for Farming System Research and Extension

There are several policy implications of these findings. First, the generation of farming innovations should be designed according to different categories of resource ownership so that innovations better suit potential adopters' resource capabilities. Next, farming system research should make more effort to understand to what extent different land statuses can affect farmers' decisions to adopt innovations. This implies also that farming research and extension institutions should develop intervention strategies that can ensure more security in land use related to farming innovations.

For the generation of new technologies that suit farmers' labor resource potentials, research and extension agencies should pay more attention to the possibilities of using labor intensive technologies.

A program of extension work based on the specific needs of each farmer should be developed in consultation with farming system research agents and used to organize visits of farmers. On the basis of the finding that needed credit is not accessible to most farmers because of institutional factors, farming research and extension agencies should exert more efforts not only on the generation of suitable farming technologies, but also on ways to create and/or to improve credit systems. This implies that more efforts can be placed on the efficient use of resources available such as cattle and sheep and goats.

Limitations of the Research

Limitations of this research may be due to different measurements of adoption that resulted in different number of variables that entered regression equations in some cases. For example, only 3 variables entered the equation regressing adoption
scores on family social structural and farm operation characteristics while 5 variables entered the same equation using innovativeness as dependent variable (Table 5.16 and Table 5.17).

The survey did not include an investigation of farmers’ perceptions about the new farming practices of concern because the interviews of farmers about their perception of innovation characteristics during the test of the questionnaire did not give valid results. This may be due to the general tendency of farmers to be favorable toward all new technologies because of the introductory statement. They were told at the beginning of the interview that the information from the survey would be used to help farmers in their farming practices. This confusion of needs and perceptions of new technologies may be addressed in future research by developing a detailed explanation in the questionnaire about why questions on each technology are asked.

The fact that some independent variables did not relate to adoption may be due to inadequate measurement or operationalization. For example, from the regression of the number of new farming practices on farm social structural characteristics, 5 variables (number of persons in the FPU, dependency rate, wife rate, importance of individual fields and importance accorded to information) did not relate to the independent variable. In such cases the use of other measurements to be defined may be useful to explain whether the lack of a relationship of independent variables to adoption are due to inadequate measurement or not. Some of these variables such as number of persons and dependency rate may not have been related to the independent variable because the way they are measured may not have reflected adequately the farmers’ actual situation. To address this limitation these variables may be redefined by considering for example the farmers’ own definition of family members and
workers.

Another possible source of unreliable data can be the translation of the questionnaire from English to French and from French to the local dialect used by respondents who are mostly illiterate. This possible source of error may be better addressed by developing more effort to conceive the questionnaire as closely as possible in the local dialect used by respondents for future research. A methodological limitation of this research is the small number of independent variables that could have been expanded by an informal short survey on the subject before the final conception of the study.

Suggestions for Future Research

Future research is needed to investigate new technologies that can be more easily used by women and older workers in farming activities, as the results of the research indicate that farm families are composed of larger numbers of women and old members than adolescents.

Research is needed to determine why available resources such as cattle or sheep and goats are not be mobilized toward the purchase of farming equipment for quick improvements in farming systems. Farmers may have other strategies for the use of their resources that should be investigated to determine better assistance strategies.

The importance of land status in explaining the variation in adoption suggest that further research may be needed to find ways of giving more security in land use to farmers who are not direct land owners in the traditional land tenure systems.
General Conclusion

In general, the results of the research indicate that family social structure and farm operation characteristics have some effect on the adoption of farming innovations. This suggests some specific grounded theories can be developed and tested to help the transfer of new farming technologies in developing countries. Such approaches can help address the food crisis in the third world where the majority of the population has agriculture as principal occupation. For example, as the results of this research indicated some significant relationship between family interpersonal relations such as the number of households, and possible disagreements between large farm family members in the decision making process for the adoption of new farming practices. Grounded theories developed on these finding may help overcome some limitations in the technology transfer that are not explained by the classical individualist adoption/diffusion perspectives.
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APPENDIX A. METHODOLOGY USED IN THE RAPID RECONNAISSANCE SURVEY

The first step of the survey consisted of series of meetings and documentation at the level of all the OHV sectors with the OHV extension staff, the forestry, livestock and agricultural research agency commissions and with present agricultural or development services. The information collected at the sector level was to state the diversity of the farming systems in the sector and to determine which “Zones d’expansion Rurales” (ZERs) and “Secteurs de Base” (SBs) are the most representative of the sector. This information concerned data on the total population of ethnic groups represented, the food and cash crops grown, the use of agricultural equipment and the transhumant or sedentary livestock management system. In all the SBs chosen as representative of the diversity of the farming systems in the ZERs that were chosen as representative of the sector, two accessible villages have been finally selected for a more indepth survey.

The second step consisted of a group interview of the head of farmers’ families in the chosen villages to collect the same information collected at the ZER and SB levels. The last step of the survey was an interview of three categories of farmers sampled by a systematic method in each chosen village. The three categories were the well-equipped farmers composed of those who have at least two complete draft
pairs of oxen, the semi-equipped farmers who have one complete pair of draft oxen, and the manual farmers have one complete set of animal traction equipment.
APPENDIX B. QUESTIONNAIRE

Family Social structure, Farm Operation characteristics
and the adoption of new technology for
sustainable farming systems in Mali.

QUESTIONNAIRE

Good morning/Afternoon. I am_____________. We are working with a program that has been in this area since 1986 to help farmers with new farming practices. We want to collect some information on how you and your family carry out your farming activities. The information will be used to help farmers in their farming practices. Your participation in this interview is voluntary: This means that you may refuse to answer any question that you don’t like for personal reasons. All the information you may provide us will be confidential. It should take only about 30 minutes to answer the questions. We will be happy to answer any question of your concerns about the interview at any time. Thank you for your cooperation.
I. FAMILIAL LABOR RESOURCE

First, I would like some information about you and your family.

1. Is farming your main occupation? Yes 1 / No 2 If no
   What is your main occupation? .................

Education:

2. Have you attended French school? Yes 1 / No 2
   If yes, how many years did you attend ............

3. Have you attended Arab school? Yes 1 / No 2
   If yes, how many years did you attend ............

4. How old are you? Years. ..............

5. Are you married? Yes 1 / No 2
if yes, I would like you to tell me

1. the number of your wives and the age of each of them.
2. the number, gender and age of the non married children of each of your wives.

Age is to be estimated by using local historical events.

<table>
<thead>
<tr>
<th>Wife</th>
<th>Age of wife</th>
<th># / Gender of children</th>
<th>Age of children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 / .... 1 / 2</td>
<td></td>
</tr>
<tr>
<td># 1</td>
<td>...........</td>
<td>2 / .... 1 / 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 / .... 1 / 2</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4 / .... 1 / 2</td>
<td></td>
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<td>.... 1 / 2</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>.... 1 / 2</td>
<td></td>
</tr>
</tbody>
</table>

II. EXTERNAL LABOR

I would like to ask you about the external non family labor you used for farming during last season.

6. Did you use external labor for your farming activities?
   (Field activities, market gardening, breeding)

1. -Paid

   Yes 1 / No 2  If yes,
(a) How many persons have you used last season?
Number of persons used.  

(b) How many days did they work on your farm last season?
Number of days.  

2. Non paid

Yes 1 / No 2  If yes,

(a) How many persons have you used last season?
Number of persons used.  

(b) How many days did they work on your farm last season?
Number of days.  

7. Do you call for local work associations to assist you in your farming activities?

Yes 1 / No 2  If yes,

Would you tell me how many times did you call for work associations last season, how many persons were present each time and the number of days they worked on your fields?

<table>
<thead>
<tr>
<th>Number of time</th>
<th>Number of persons</th>
<th>Number of days</th>
</tr>
</thead>
<tbody>
<tr>
<td>...............</td>
<td>1st time...........</td>
<td>...............</td>
</tr>
<tr>
<td></td>
<td>2nd time...........</td>
<td>...............</td>
</tr>
<tr>
<td></td>
<td>3rd time...........</td>
<td>...............</td>
</tr>
</tbody>
</table>

III. CREDIT AVAILABILITY AND USE.

8. Have you ever used credit to purchase one of the following items for farming?
Yes 1 / No 2  If Yes, how many times?

How much was it?

1. Agricultural inputs 1 / 2

(Seeds, Pesticides, Fertilizers, Herbicides)

2. Agricultural equipments 1 / 2

(Plows, Multipurpose plows, Seeders, Harrows, Motor-pumps)

3. Draught animals 1 / 2

(Oxen, Donkeys, Horses)

If no, why? -----------------------------------------------

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

9. Would you like to have credit to purchase the following elements?

1. Agricultural inputs 1 / 2

(Seeds, Pesticides, Fertilizers, Herbicides)

2. Agricultural equipments 1 / 2

(Plows, Multipurpose plows, Seeders, Harrows, Motor-pumps)
3. Draught animals 1 / 2

(Oxen, Donkeys, Horses)

If no, why? 

10. Can you get credit when you need it? Yes 1 / No 2

If no, why can you not get credit?

IV. LEVEL OF EQUIPMENT AND LIVESTOCK OWNERSHIP

11. Do you own the following equipments.
<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Number owned</th>
<th>Did you use it last season</th>
<th>Yes 1 / No 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Simple plow.</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td></td>
</tr>
<tr>
<td>1. Multipurpose plow.</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td></td>
</tr>
<tr>
<td>1. Seeder.</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td></td>
</tr>
<tr>
<td>1. Cart.</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td></td>
</tr>
<tr>
<td>1. Mini Tractor</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td></td>
</tr>
<tr>
<td>6. Other.(If yes)</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td></td>
</tr>
</tbody>
</table>

Specify:

- Type._________  1 / 2
- _____________  1 / 2
- _____________  1 / 2

12. Do you own oxen  Yes 1 / No 2  If no, go to 13.

If yes,

1. How many oxen do you have? Number._________

2. Do you produce manure? Yes 1 / No 2

3. How do you feed them?

   (a) In corral Yes 1 / No 2

   (b) Grazing Yes 1 / No 2

   (c) Mixed grazing/corral Yes 1 / No 2
13. What additives do you give them in their feed?

14. Do you own any other than oxen animals? Yes 1 / No 2

If yes, how many of each of the following animals do you own?

Number: ......... ......... ......... ......... ......... ......... .........

V. LAND OWNERSHIP, AND NEW PRACTICES ON FARM FIELDS.

15. Did you use the following new practices on your fields but not on trial fields last season?

Yes 1 / No 2. if yes,

1. On what crops did you use them during last season?

2. When did you use them for the first time?

3. Are you the owner of your farm fields?

Yes 1 / No 2 If no,

(a) Were they attributed to you? Yes 1 / No 2

If yes, how?

(b) Did you borrow them? Yes 1 / No 2
### TECHNOLOGIES RELATED TO CROPS.

<table>
<thead>
<tr>
<th>C.1</th>
<th>C.2</th>
<th>C.3</th>
<th>C.4</th>
<th>C.5</th>
<th>C.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Practices</td>
<td>Use</td>
<td>Crop</td>
<td>Year</td>
<td>Land status</td>
<td>Satisfaction</td>
</tr>
<tr>
<td>1. Partitioned ridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Seeds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Guided sowing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Alternated crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PNT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Cereal fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Peanut fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Urea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Herbicide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Pesticide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NB: C.2: 1 Yes / 2 No

C.3: 1 Millet, 2 Sorghum, 3 Rice, 4 Corn, 5 Beans, 9 Cotton,

10 Peanuts, 47 "Sesame", 53 Soya.

C.4: Year the technology is used for the first time.


C.6: Satisfaction 1 = Yes, 2 = No.
## TECHNOLOGIES NOT RELATED TO CROPS.

<table>
<thead>
<tr>
<th>C.1</th>
<th>C.2</th>
<th>C.3</th>
<th>C.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies</td>
<td>Use</td>
<td>First year</td>
<td>Satisfaction</td>
</tr>
<tr>
<td>Manure from improved corral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Soumbala&quot; of soya</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local soap made with soya</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone bands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poultry treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NB: C.2 Yes 1 / No 2  
C.3 Year the technology is used for the first time.  
C.4 Satisfaction 1=Yes, 2=No

### VI. FIELD SYSTEM

I would like to ask about your feelings on the different statuses of your crop field.

16. Which fields do you feel are better for the good of the farming family, individual fields or common field?

Common 1 / Individual 2
17. Do you feel that it is more important to have food crops in common fields or individual fields?

Common 1 / Individual 2

Why?

18. Do you feel that it is more important to have cash crops in common fields or individual fields?

Common 1 / Individual 2

Why?

VII. ATTITUDES TOWARD FARMING.

I would like to ask how you feel about some aspects of agriculture and the use of new farming practices.

19. For each following statement, please tell me whether you

1. Disagree (D),

2. Are neutral (N), (Don't agree or disagree)

3. Agree (A)
1. Women should participate in farming activities of the common fields of the FPU.

2. Your fate for farming is beyond your control.

3. Women should have their own cash crop fields?

4. You cannot change your economic status.

5. Women should not use new practices on their own fields before their husbands use them?

6. Your progress depends on your personal efforts?

7. Women should grow only the crops their husbands want them to grow?

8. Your success depends on forces beyond your control?

9. Women should have their own subsistence crop fields?
I would like to ask you about your feelings on new farming practices.

20. Do you agree that:

1. There is too much danger of loss in using new farming methods?  
   1 2 3

2. It is better to have a small yield than to take a chance of losing a large yield?  
   1 2 3

3. In general, it is better not to try new farming practices until other farmers in your area have tried them?  
   1 2 3

4. In general, it is better to use the old method that have been successful in the past years, rather than trying new ones?  
   1 2 3

5. In general, it is better to use new farming practices?  
   1 2 3

6. In general, it is better for a farmer learn about new farming methods if he wants to have better yields?  
   1 2 3

7. You should wait until you can accumulate
your own money rather than to borrow money for farming purposes.

8. Borrowing money from someone you know is preferable to borrowing money from the government.

9. Using credit is a good action.

VIII. LEVEL OF INFORMATION.

I would like to ask you about sources of information for new farming practices.

21. How important to you are each of the following sources of information in the decision you make to use new farming practices.

1. Very important (VI),
2. Neither important nor unimportant (NINU)
Radio.  1  2  3
Extension and research officers  1  2  3
Friends and neighbors  1  2  3
Male members of FPU  1  2  3
Farm demonstration  1  2  3
Wives in the FPU  1  2  3

22. Do you get visits for counseling about farming practices from agricultural re-
search or extension officers?

1. Never.

2. Several times a year

3. At least once a month,

4. At least once a week

5. More than once week.

6. How many times a week? .......... 

23. Do the agricultural extension or research officers give you information that is
useful in your farming activities?

24. Are the agricultural extension or research officers available when you need them?


IX. DECISION MAKING.

25. When decisions are made about the following farming activities, are they usually made

1. by the head of the FPU,

2. by wives, or

3. by other males in the FPU?

26. Are the decision discussed with other family members?
   If yes, With whom?
<table>
<thead>
<tr>
<th>Decisions are made by</th>
<th>Decision is discussed</th>
<th>With whom is it discussed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of household</td>
<td>Wife</td>
<td>Other males</td>
</tr>
<tr>
<td>Yes / No</td>
<td>Head of household</td>
<td>Other males</td>
</tr>
<tr>
<td>1. New varieties</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. Use of new equipment</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3. Use of credit</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. Labor hiring</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. Marketing</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>of crops</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. Sowing dates</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. Harvesting dates</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
APPENDIX C. HUMAN SUBJECTS APPROVAL FORM
Checklist for Attachments and Time Schedule

The following are attached (please check):

12. ☐ Letter or written statement to subjects indicating clearly:
   a) purpose of the research
   b) the use of any identifier codes (names, #’s), how they will be used, and when they will be
      removed (see item 17)
   c) an estimate of time needed for participation in the research and the place
   d) if applicable, location of the research activity
   e) how you will ensure confidentiality
   f) in a longitudinal study, note when and how you will contact subjects later
   g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. ☐ Consent form (if applicable)

14. ☐ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. ☒ Data-gathering instruments

<table>
<thead>
<tr>
<th>16. Anticipated dates for contact with subjects:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First Contact</td>
<td>Last Contact</td>
</tr>
<tr>
<td>03/05/81</td>
<td>06/20/81</td>
</tr>
<tr>
<td>Month / Day / Year</td>
<td>Month / Day / Year</td>
</tr>
</tbody>
</table>

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

   12/31/91
   Month / Day / Year

18. Signature of Departmental Executive Officer | Date | Department or Administrative Unit
   Patricia M. Keith | 3/18/91 | Sociology

19. Decision of the University Human Subjects Review Committee:
   ☒ Project Approved | Project Not Approved | No Action Required
   Patricia M. Keith | 3/17/91 | Signature of Committee Chairperson
   Name of Committee Chairperson | Date | Signature of Committee Chairperson

GC: 1/90