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# The comparative influence of intervening variables in the adoption behaviour of maize and dairy farmers in Shashemene and Debrezeit, Ethiopia

by

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# Dedication

*This thesis is dedicated to my brother Berhanu Abate (1946-1998).*

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Habtemariam Abate Gorfe

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# ACRONYMS

| | |
|---|---|
| AEZ | Agro ecological Zone |
| AI | Artificial insemination |
| ALWDDPMA | Ada Liben Woreda Dairy and Dairy Products Marketing Association |
| ANOVA | Analysis of variance |
| ANRS | Amhara National Regional State |
| AKS | Agricultural knowledge system |
| AKIS | Agricultural knowledge and information system |
| B | Behavior |
| BH | Bacco hybrid |
| BoA | Bureau of Agriculture |
| CBO | Community based organizations |
| CSA | Central Statistics Authority |
| CSG | Controlled selective grazing |
| DAP | Diamonium phosphate |
| DA | Development agent |
| EARO | Ethiopian Agricultural Research Organization |
| EMTP | Extension management training plot |
| F | Function |
| F2 | Second generation crossbred |
| E | Environment |
| GDP | Gross domestic product |
| GNP | Gross national product |
| GWE | Growth with equity |
| ILRI | International Livestock Research Institute |
| ITK | Indigenous technical knowledge |
| LSP | Life space |
| masl | Meters above see level |
| MoA | Ministry of Agriculture |
| NC | Need compatibility |
| NGO | Non Governmental Organization |
| NI | National income |
| NT | Need tension |
| OLS | Ordinary least squares |
| OM scale | Overall modernity scale |
| P | Person |
| PA | Peasant Association |
| PADC | Peasant Association Development Committee |
| PADEP | Peasant Agriculture Development Project |
| PADETES | Participatory Demonstration and Training Extension System |
| PCE | Perceived current efficiency |
| PHB | Pioneer hybrid |
| PTA | Perceived total attributes |
| SAA | Sasakawa Africa Association |
| SD | Standard deviation |
| SG2000 | Sasakawa Global 2000 |
| SPSS | Statistical package for social sciences |
| TV | Television |
| TVET | Technical Vocational Education and Training |
| UP | University of Pretoria |
| WAC | Woreda Administrative Council |

## Abstract

The impact of the package based extension program in Ethiopia in terms of its influence on yield improvement is not well known. The objectives of this study have been to assess the relationships and determine the factors responsible for behavior change and production efficiency of farmers participating in the program. Identification and analysis of the critical factors affecting adoption or non-adoption is believed to assist in the formulation of policy in the areas of research and extension aimed at alleviating production constraints of small-scale farmers and thereby improves agricultural productivity.

It was hypothesized that there is a significant difference among participant farmers in their technology use and production efficiency. Based on this assumption, it was also hypothesized that adoption behavior is determined by independent and intervening variables, of which, the influence of the former is indirect and only becomes manifested in behavior via intervening variables, which are the immediate and direct precursors of decision making and adoption behavior.

Independent variables included in this study are age, education, gender, farming experience, attitudinal modernity, organizational participation, contact with extension, media contact, farm size, and agro ecology. The intervening variables, on the other hand, refer to the farm operators' needs as manifested in their problem perception, and the need compatibility of the production practices and the perception regarding advantages and disadvantages of the recommended practices.

In order to test the hypotheses, the Ordinary Least Squares (OLS) method i.e. standard and hierarchical multiple regression analyses were employed on data from a survey of 200 maize and 200 dairy farming households in the Southern and Central Ethiopia.

The study reveals that, in general, maize farmers using recommended technologies are more efficient than those who do not use them. In dairy, clear differences are found only

with regard to breeding practices suggesting that the rest of the practices included in dairy package were not very important for dairy farmers.

Independent factors responsible for the difference in the adoption behavior of maize farmers include agro ecology, media exposure, education, age, farm size, extension contact, and attitudinal modernity. As far as dairy farming is concerned, education, farm size, farming experience, and media exposure are found to be significant predictors of adoption behavior. While all of the need related factors are significantly related with adoption behavior, perceptions of farmers towards production practices included in both of the maize and dairy packages are not found to be significantly associated with adoption behavior.

In general, although both the independent and intervening variables are significant predictors of the adoption behavior of farmers in the study area, the latter are much more prominent. In support of the hypothesized association, the contribution of intervening variables to the variance in the adoption behavior of maize and dairy farmers is as high as 87.2 percent in maize and 68.3 percent in dairy compared to the significantly lower contribution of independent variables, which is 32.4 percent in maize and 17.8 percent in dairy. The contribution of intervening variables is significantly higher even after the possible effect of independent variables is controlled, which is 56.6 percent in maize and 55.9 percent in dairy as opposed to 32.4 percent and 17.8 percent respectively in the case of independent variables.

Finally, this study raises issues that call for immediate policy interventions and have implications for further research.

# CHAPTER 1

# INTRODUCTION

## 1.1 BACKGROUND TO THE STUDY

Up until 1957, when three successive five-year development plans were launched, there has been no definite development strategy aimed at improving the socio economic condition of the rural population of the country (Abebe 2000:63).

Agriculture is recognized as an important sector of the economy but only received the attention of the central government during the third five-year development plan, which outmoded from 1968 to 1974. It was during this time that the various extension projects such as the Chilalo Agricultural Development Unit, The Wolaitta Agricultural Development Unit, the Minimum Package Projects, and etc. were designed and implemented.

Although some extension activities are reported to have existed prior to this period, formal and organized extension programs with the objective of addressing the problem of the agricultural sector were only launched during this period.

Following the comprehensive and minimum package projects approach, a World Bank funded, Training and Visit approach projects referred to as Peasant Agriculture Development Project (PADEPs) were launched in seven of the eight agro ecologically delimited zones of the country.

However, owing to the limited success gained by these extension programs in improving the livelihood condition of the farming community (Elias, 1993:3), the government of Ethiopia was obliged to draft and implement a new extension strategy named the Participatory Demonstration and Training Extension System (PADETES). This was implemented in 1995 and was developed mainly by drawing some positive elements from the previously tested extension approaches, the participatory, cost sharing and the Sasakawa Global 2000 Extension Approach (Habtemariam, 1995:42).

The objectives of PADETES are focused on improving the income and the standard of living of the rural people mainly by raising their participation in the development process along with attaining national food self-sufficiency by increasing the productivity per animal or per hectare of land (ANRS/Sida 1996: 32).

With regard to its technology promotion strategy, PADETES is characterized by the introduction of recommended agricultural technologies commonly presented in a form of a package, a strategy borrowed from the Sasakawa Global 2000 Approach. A cereal package, for instance, comprises the use of the best available commercial cultivars or hybrids, improved agronomic practices that insure proper spacing and method of planting and proper application/method and use of recommended level of plant nutrients in the soil (Elias, 1999:7).

With the introduction of these packages, the productivity of program participant farmers has been doubled, tripled and in some cases quadrupled in some major crops. For example maize, wheat, teff, and sorghum averaged 5.2, 2.8, 1.5 and 4.5 tons per hectare respectively in the 1994 season (SG 2000:1994). These yields are about 2-3 times higher than the national averages.

Encouraged by the promising results, the Government of Ethiopia ambitiously increased the number of participating farmers to about 4 million in 1999 from it's very modest beginning of 166 farmers of the 1993 when the project began its first operation in Ethiopia. However, some groups claim that the results were rather negative and do not share this positive impression. They argue that when the technology adoption and yield improvement attained by farmers is not significant, the higher input price and unavailability of credit, the bureaucratic input and credit administration system, low prices for agricultural produce and poor marketing services, land fragmentation caused by government land ownership policy, inefficient research and extension services, etc. become barrier for technology adoption and offsets the minimum improvements attained. This empirical study is, therefore, aimed at determining the level of adoption and efficiency attained by the introduction of agricultural technologies promoted through PADETES. More specifically the study aims at disproving the claim that "there is no significant difference in behavior change and production efficiency among participant farmers or that all participant farmers are equally poor in technology adoption and yield". The assessment is also believed to refute the claim that significant proportion of participant farmers have rejected or withdrawn using the technologies promoted through PADETES. In connection to this, factors, which facilitate or hinder technology adoption, will be assessed to shed some light on possible improvement potentials.

For the purpose of providing a better perspective of the background problem, a brief overview of Ethiopian agriculture is presented here.

## 1.2 BACKGROUND INFORMATION ON THE ETHIOPIAN AGRICULTURE

Ethiopia is a large country with a total land area of 111,811, 000 hectare. However, only 30 percent of this can be used for rain-fed cultivation. The total arable land could only be increased to a merely 38 percent even when vertisols that have drainage problem and steeper land (over 30 percent slope) are included (Tesfaye 2003: in press).

Despite the higher rate of population growth from 23 million in 1960 to 37 million in 1980 and to 65.5 in 2001(CSA, 2000/01), the rate of growth in the agricultural GDP has according to Abebe (2000:68), declined at an alarming rate. It declined from 2.63 percent in 1961-65 to 1.85 in 1966-70 and to 1.39 percent in 1971-74. The annual growth rate of the agricultural GDP continued to decline and even plunges below zero in seven of (1975, 1978, 1981, 1982, 1984, 1985, & 1988) the sixteen successive years (ibid: 79).

Despite the deteriorating situations, agriculture continues to play an important role in the economy employing 85 percent of the labor force and accounting for 50 percent of the GDP and 90 percent of the national export earning (Zegeye *et al,* 2001:4). According to a report by ELU, quoted by Brons (1992:1) two thirds of export earnings come from coffee exports. Other export commodities include hides and skins, oilseeds, pulses, live animal, fruit and vegetables. For the last three to four decades, domestic food production has not been sufficient. From 1980/1981 to 1986/1987 food imports have increased by 260 percent (UNDP, 1991).

About 95 percent of the cultivated (7 million hectare) land is under smallholder farming where crop and animal production is undertaken mainly for subsistence. Cereals, pulses, oil and some tree crops constitute the major portion of crop production while the contribution of livestock and small ruminants as source of food, draught and income cannot be underestimated.

Maize is grown in many parts of Ethiopia and is the second most important crop next to teff (eragrostis teff) in area coverage. It covers 1.3 million hectare (CSA, 1996/97) and is the staple food crop for millions of people.

According to Abay *et al,* quoted by Moges and Baars (1998:170), the country is endowed with large cattle population but like in the case of crop production; the benefit derived from this sector does not satisfy the demand of the ever-growing population.

Livestock are used for a multitude of purposes such as draught, meat, milk and financial income. Although milk is mainly produced under smallholder production systems in rural Ethiopia, the recent change in government policies featured by liberalization and encouragement of the private sector, has led to the emergence of commercial dairy farms in urban and peri-urban areas. The Ada Liben Woreda Dairy and Dairy products Marketing Association (ALWDDPMA) is one among the many associations established during this period (ALWDDPMA, 2001).

## 1.3 PROBLEM STATEMENT

Although numerous packages have been developed and promoted in the areas of crop and livestock production and environmental conservation with the implementation of PADETES, formal and scientific studies conducted to determine the level of adoption and production efficiency attained are scanty.

Available studies (Howard *et al,* 1999; Elias, 1999; Alene *et al,* 2001; Zegeye *et al,* 2001; Zegye and Tesfaye, 2001) have focused mainly on the investigation of the effects of some personal, socioeconomic, communication and environmental factors on behavior but have failed to explain much of the variation in behavior (practice adoption) and the resulting production efficiency. This study endeavors to shed more light on the critical behaviour determinants, which are, according to Lewin, (1951) and Düvel, (1991), associated to the cognitive field.

## 1.4 OBJECTIVES

The overall objective of this study is to identify and compare the different categories of variables in regard to their influence on the adoption behavior and production efficiency as it pertains to maize growers in the Shashemene District and members of ALWDADPMA. The specific objectives of the research were:

- To review past development theories and behavior change models with a view to assess their potential use as conceptual models appropriate for behavior analysis and intervention,
- To assess the difference in technology use among program participant farmers compared against the different efficiency classes,
- To provide a description of the maize and dairy farmers in the study area regarding their profile or characteristics,

- To identify the most important factors responsible for the adoption of the technology packages promoted through PADETES and the production efficiency thereof, and finally,

- To highlight the implication of the findings for future policy, research and extension interventions.

## 1.5 SIGNIFICANCE OF THE STUDY

As it is explained in section 1.2 above, maize is one of the most important crops in Ethiopia. Dairy farming is also gaining importance and starts to flourish around urban and peri-urban areas of the country along with the scattered and traditional rural dairy farming. Both commodities are, therefore, the priority and focal points of research, extension and the overall agricultural development programs. It is believed that the findings of this study will contribute towards narrowing the knowledge gap regarding adoption behavior and in terms of contribution towards a more efficient overall policy and research and extension systems and the creation of a more enabling environment for the generation and promotion of agricultural technologies and enhancement of food production, which are the primary goal and focus of the government.

The study aims to attain its objectives through evaluating various models and approaches to behavior change with special emphasis to the model developed by Düvel (1991) and testing it's relevance in cross-cultural settings, different conditions and different innovations and where possible, contribute to its refinement.

## 1.6 SCOPE OF THE STUDY

As indicated in section 1.2 above, maize is adapted to a wider agro-ecology and many parts of the country covering more than 1.3 million hectare of land. Due to financial and time constraints, this study was conducted only in one district. However, the results are expected to be reasonably representative of the wider maize growing areas as most parts of the maize growing regions of the country are found under similar geographical (Low and medium agro ecological zones) and socio-economic (similar input and output marketing system, similar technology and technology promotion services, similar land ownership policy etc.) conditions. Similar assumptions apply in the case of dairy farming. However, also when considering the fact that this study is the first of its kind conducted under Ethiopian condition, replication may well be necessary to further verify its findings.

## 1.7 THESIS OVERVIEW

After having introduced the study by relating to the background problem and the general objectives, a literature overview and theoretical exposition is presented leading to the research hypotheses. In chapter three the research methodology is discussed with special reference to the research design.

Findings of the research are presented in three chapters; chapter four provides the current production efficiency and adoption status of farmers under investigation. Chapters five and six summarize the factors responsible for affecting production efficiency and the adoption behavior and compares between the two sets of variables (the independent and the intervening variables) with the aim of identifying the most important variables contributing to the variance in production efficiency and the adoption behavior of farmers in the Shashemene and ALWDADPMA.

Finally a summary of the findings and their implication for policy, research and future extension intervention is given in chapter seven.

# CHAPTER 2

# REVIEW OF LITEARTURE

## 2.1 INTRODUCTION

The literature review is interested in two major areas. In section one, a short summary of the various development theories is made with a view to identify the most important variables associated with change and development. Section two proceeds with the investigation of the various behavior change models with the aim of identifying the conceptual model or approach appropriate for behavior analysis for the study. Section three reviews empirical studies conducted in the area of behavior change (adoption), which finally led to the formulation of the research hypotheses.

## 2.2 THEORIES OF DEVELOPMENT AS VIEWED FROM THE PERSPECTIVE OF AGRICULTURE

The ultimate objective or motivation of any behavior change model or construct is to provide the framework of how social change takes place both at the micro and macro (individual and society) level. Behavior change at the individual farm operator level is believed to bring changes at the society level (development). It may be argued here that the origin of behavior change models is partly associated with our present understanding and concept of development. The origins of the classical five-stage adoption process (1961), the Campbell model (1966), and the innovation decision-making process model of Rogers's and Shoemaker (1971), for example, is the well-known modernization theory of development whereas recent behavior change models such as AKIS (agricultural knowledge and information system) are more associated with current theories like growth with equity and human resource development.

The concept of other behavior change models, such as the Tolman model (1951), and Lewin's psychological field theory, on the other hand, is purely associated with psychological constructs or the cognitive map of the individual at that given period and do not have to do much with development theories. A brief overview of the various development theories is made here inter alia show the relations between development and behavior change and the major changes that occurred over time so as to be in a position to identify the more appropriate behavior change model to guide the study and identify the respective key variables.

### 2.2.1 Historical overview

Melkote (1991:13-14) has divided the history of world development into three major epochs namely:

(1) The period of great development (350BC-1700AD). Mention is given to ancient civilization of Mesopotamia, Egypt, Indus valley, Shang, Han, Ming, Axum, Ghana, Mali, Songhai, Zimbabwe, Mayan, Aztec and Inca in order of chronology,

(2) Period of colonization; emergence of the Third World ($16^{th}$–$20^{th}$ century). A period of change from a state of development to underdevelopment where slave trade, protectionism, mercantilism, and imperialism were the major phenomena of the day,

(3) Period of decolonization (late $19^{th}$ century).

The period from the emancipation of underdeveloped nations (decolonization) up to our present day is characterized by:

(1) Genesis of organized development assistance involving the birth of multi-lateral development assistance (1945) and the emergence of bilateral development assistance (1949),

(2) Development of emerging Third World (1950s) involving fostering self-help by capital infusion and diffusion of modern innovations from the west and

industrialization, urbanization, westernization, considered critical for development,

(3) First decade development: - Period of great optimism (1960s). The dominance of modernization paradigm of development characterized by industrialization, urbanization, capital-intensive technology, centralized economic planning, etc.

(4) Second decade of development: - Period of pessimism (1970s). Top down flow of message and decisions, authority driven models, widening socioeconomic gaps were scrutinized as features of the dominant paradigm which ultimately led to its down fall,

(5) Alternative conceptions of development (1970s). Growth with equity models, self determination and self reliance of local communities, freedom from external dependency and integrated rural development considered critical,

(6) Third development decade (1980s). Participatory decision making, knowledge sharing on a co-equal basis, use of pluralistic culture sensitive models of development were considered to be important to bring about the desired change in development (ibid. 15-18).

Perret *et al,* (2003:19), however, summarize this period into three major development eras; the fifties and sixties that was characterized by the belief in trickle down development and technology transfer, the seventies and early eighties by equity considerations and the latter eighties and nineties by participatory people driven development.

Agunga (1997:138) also abridges the history of development interventions of the 2nd half of the 20th Century into four major periods each characterized by its own distinguishing development theory namely:

(1) The modernization theory of the late 1940s to mid 1960s,
(2) The dependency theory of the late 1960s,
(3) Growth with equity of the 1970s, and
(4) The human development theory - an emergent theory since the mid 1980s.

The above stratifications on the episode of the various development strategies is some how similar and consistent with other classifications and can serve as a base for our present objective of looking at the factors considered to be the key for development with changes in our thinking from time to time.

### 2.2.2 Modernization Theory (The Orthodox Approach)

Modernization is the process by which individuals change from a traditional way of life to a more complex, technologically advanced, and rapidly changing style of life (Rogers 1969:14). According to Little, quoted by Eicher & Staatz (1998:9), leading development economists of the 1950s knew little about the nature of tropical agriculture and rural life when they designed the so-called modernization theory of development. This theory saw development as an evolutionary, uni-linear and uni-directional path through which all nations must move (Agunga, 1997:140).

Modernization places the developed western values and culture in the center and puts that of the developing nations' in the periphery. Development was therefore thought to be brought about by the transfer of technology, expertise, and training from the center to the periphery, the same way that the economy of the war victim European countries was reconstructed through the Marshal Plan after the termination of the 2nd world war. But according to Perret *et al,* (2000:21), it was not possible and fair to compare the then Europe to the present developing countries, which lack the structural, institutional, and attitudinal conditions to efficiently use the new capital input. Rogers (1969:10) was also convinced in the claim and said that our error was one of equating redevelopment with development; the technical know how, and basic education for and the aspiration to higher levels of development which were lacking in the present developing countries were already present to bring the war-torn Europe back on its feet through the Marshall plan.

It was for this reason that agricultural development programs of the 1950s placed heavy emphasis on the American style of agricultural extension and the diffusion model of agricultural development which assumed that farmers could substantially increase their agricultural productivity by allocating existing resources more efficiently and by adopting agricultural practices and technologies from the industrial countries (Eicher & Staatz, 1998:12).

For Alex Inkeles, as quoted by Melkote (1991:47), the transformation of individuals was both a means and an end in itself of the development process. Inkeles (1983:35) used nine attitudinal items to construct what he call the analytical standard scales of modernity, which he later used to identify the character of the modern person viz.:

(1) Readiness for new experiences and the openness to innovation and change,
(2) Growth of opinion, disposition to form and hold opinions and democratic orientation
(3) Planning habits,
(4) Belief in human and personal efficiency,
(5) Belief that the world is calculable, trust, optimism
(6) Awareness of, and respect for, personal and human dignity,
(7) Educational and occupational aspirations and faith in science, technology and new learning,
(8) Belief in technical skill and distributive justice against particularism
(9) Time (orientation to the present or to the future rather than the past, punctuality, regularity and orderliness).

Other modernization theorists, Kahl (1968); Motoitwitz (1970); Schnaiberg (1970) and Porters (1974) are reported to have supported his idea and prepared an exhaustive list of the social psychological attributes of modernity, viz.:

(1) Desire for geographical mobility,
(2) High participation in organizations,
(3) Secularism,
(4) Appetite for national and international information,
(5) Achievement motivation,
(6) Desire for consumption of new goods and technology,

(7) Preference for urban areas (cosmopolites)
(8) New attitudes to wealth, work, savings, and possibility of change,
(9) Socio economic and political discipline and deferral gratifications (Melkote 1991:47).

A leading exponent and modernization theorist, Everett M. Rogers (1969:23), asserts that for a country to develop or modernize it was necessary that the peasants were persuaded to change their traditional way of life (subculture) characterized by:

(1) Mutual distrust, suspiciousness and evasiveness in interpersonal relations,
(2) Perceived limited goods (the image of limited good) - a notion that all desirables in life (including land, wealth, health, love, power, and safety) exist in finite quantity, are always in short quantity and cannot be increased in quantity by any means with in the peasant's power,
(3) Dependence and hostility toward government authority (their interpersonal distrust carries over into their attitudes toward government leading to a relation of distance, reserve, resignation, and cheating). A long history of exploitation at the hands of outsiders has conditioned the villager to this hostile view. They also tend to regard most village improvements as the job of the government rather than their own,
(4) Familism (the subordination of individual goals to those of the family caused by mutual distrust in interpersonal relations, which leads to greater dependence on one's own family to insure protection against aggression and humiliation),
(5) Lack of innovativeness (the tendency for villagers to follow the prescribed ways of their ancestors attributable to lack or inappropriateness of knowledge about available alternatives or generations of negative cultural conditioning- an accumulation of which discourages adoption of innovations),
(6) Fatalism (the degree to which an individual recognizes a lack of ability to control his future and ultimately leading to failure to see relationship between work and one's economic condition),

(7) Limited aspirations (Low desired future states of being such as social status, education and occupation caused by perceptions of blocked opportunities), lack of achievement motivation and inconspicuous consumption,

(8) Lack of differed gratification (postponement of immediate satisfaction in anticipation of future rewards),

(9) Limited view of the world or localiteness caused by low geographical mobility and low mass media exposure,

(10) Low empathy (the ability of an individual to project himself into the role of another person)

In general all the modernization theorists believe that factors associated with personal characteristics of the traditional man were the precondition for traditional societies to improve their situation. These factors include readiness for change, perceived limited good, belief in human and personal efficiency and distributive justice, time, planning habit, secularism, fatalism, deferral gratification, cosmopolitness, empathy and innovativeness. Smith & Inkeles (1966: 353-377) summarized and captured these factors in a 33-item attitudinal scale and formed a composite variable, attitudinal modernity. Organizational participation and mass media exposure were also included to this variable list. Rogers (1969:50) expanded the number of variables by adding literacy and extension contact as some of the antecedent variables, innovativeness being the consequent variable. Attitudinal modernity, literacy, organizational participation, media exposure and extension contact are, therefore, considered in this study as some of the key variables to be looked into.

Development strategies designed and based on theories of modernization paradigm, however, did not work and it became clear that the model had practically failed to replicate western style of development over the so-called third worlds when the expected trickle down effect of the diffusion of innovations did not occur. Experience of the comprehensive and minimum package projects, which were outmoded from 1968 to 1974 in Ethiopia, is a practical example. In fact, the disparity between the developed and the developing and the rich and the poor appeared to widen. Paul Streeten, as cited by

Agunga (1997:146), criticized modernization theory on what he called logical, moral, political, historical and economic grounds.

According to Dudley Seers, as quoted to by Melkote (1991:125), the neo-classical economic model started loosing its credibility in the seventies and gave way to its successor for the following major reasons, namely:

(1) The social problems of developed nations were spreading concern about environmental costs of economic growth,
(2) Despite substantial transfer of capital and technology from the developed nations to the third world, the gap in per capita income between the two blocks was growing,
(3) Third world nations with impressive rates of growth did not achieve either political status or social equity expected of them,
(4) Income inequality was increasing all over the third world countries,
(5) Unemployment rates were refusing to go down in spite of impressive growth rates,
(6) Power was being concentrated among the elite who benefited from the growth, who then used that power to preserve the inequality in their societies,

### 2.2.3 Dependency Theory (The Radical Approach)

The dependency paradigm of development places the cause of under development on institutional and structural barriers rather than on the individual peasant and advocates for undertaking political and economical reforms to break down the barriers.

Arguments of the radical scholars or promoters of the theory is that economic growth, the major element of modernization theory, was more than just a technocratic matter of determining how best to raise per capita GNP as was believed by modernization scholars. They rather believe that development involves the restructuring of institutional and political relationships (Staatz & Eicher, 1998:15). The Ujamaa villages in Tanzania, different forms of organizational societies (peasant associations, service co-operatives and producers co-operatives) in Ethiopia, and several other forms of peasant institutions in many eastern European and developing countries were established for this purpose. These organizations were established with the aim of restructuring existing traditional rural institutions and enable the broad majority of peasant population to control their development endeavor and be in a position to administer land reform programs, which were critical under rural settings.

Agunga (1997:150) argues that, whilst modernization theorist's focus on the role of western educated elites in guiding their nations in the new era, Marxists (dependency theorists) give more attention to pressure from below - to the working class and peasant basis of revolutionary and nationalist movements and to the economic exploitation that causes such uprisings. However, dependency theory has also been criticized on three grounds, namely rigidity of its central planning principle, the suppression of individual liberties and its large government bureaucracy (Seitz, 1998:7-8). Staatz & Eicher (1998:15) further remark that the paradigm suffered form its

(1) inadequate attention to the need for technical changes in agriculture,
(2) lack of attention to the biological and location specific nature of agricultural production processes and
(3) lack of a solid micro foundation based on empirical research at the farm and village level.

As properly put by Statz & Eacher above, the paradigm lacks a theoretical foundation and failed to formulate propositions about how human behavior changes in a way that generalizations and hypothesis testing are possible. Consequently, it was not possible to extract variables that could be considered for behavior analysis in this study.

### 2.2.4 Growth With Equity (GWE)

Since the development experience with modernization strategies of the 1960s showed that the gap between the rich and the poor countries was growing wider and that dependency theorists had no solutions to narrowing this gap, a new thinking was required, which came in the form of "*growth-with-equity*" theory (Agunga, 1997:151). He listed the main distinguishing features of this theory to be the following:

(1) its recognition that traditional reliance on growth of GNP will not benefit the poor in today's less developed countries or won't benefit them, at least not over the short term,

(2) its recognition that social revolution is not possible or even advisable in many countries,

(3) its assumption that peasants in developing countries are not lazy, they simply lack economic opportunities and incentives and finally,

(4) GWE theorists noted that both modernization and dependency theorists tend to treat the third world as a homogeneous group of countries rather than as a conglomeration of heterogeneous states with different needs and priorities.

Melkote (1991:194) summarized the main elements and philosophy of this theory of development in what he calls alternative pluralistic conceptions of development namely:

(1) Equity in distribution of information and other benefits of development,
(2) Active participation of people at the grass roots,
(3) Independence of local communities (or nations) to tailor development projects to their own objectives,
(4) Integration of the old and new ideas, the traditional and modern systems, and the endogenous and exogenous elements to constitute a unique blend suited to the needs of a particular community,

Due to its pluralistic (blend of the old and new concepts) nature, this model of development was engaged in running combined intervention strategies in agriculture including:

(1) Expansion of extension services, provision of credit, agrochemical and high vigor cultivators to small-scale farmers,

(2) Capacity building like the provision of market centers, feeder roads, drinking water, and organization of the peasant community for the promotion of popular participation in decision-making and planning,

(3) Promotion of social, economic, political and human development aspects in integrated way,

(4) Acceleration of land and tenancy reform,

(5) Decentralization of authority to rural communities,

However, although this approach to development seems to be meaningful on several grounds, it couldn't escape criticisms and later rejection. According to Lele, quoted by Staatz & Eicher (1998:17), many integrated rural development projects expanded social services faster than the economic base needed to support them, and the projects often proved to be extra-ordinarily complex and difficult to implement and replicate over broader areas.

Binswanger, as cited by Staatz & Eicher (1998:17), has also assessed that the rise and decline of integrated rural development approach of the GWE theory was very similar to that of the community development approach of the 1950s. Still another criticism of GWE theory is that it failed to teach people how to do things for themselves. Instead, it continued with the top-down approach like in the case of the modernization paradigm whereby foreigners assumed direct control of development and decision-making. Donor agencies continued to preach local participation, but firmly held control of projects, never delegating these to third world development ministries (Agunga, 1997:154).

Like in the case of its preceding development theory, GWE is also lacking the theoretical foundation and the conceptual framework and not formulated in a way that cause and effects can be statistically tested. It would be difficult to postulate any proposition or deduce any conclusion in the absence of such conditions, which forms the pillar of any scientific enquiry. Some factors associated with development that can be used for behavior analysis can, however, be summarized as access to credit and markets, extension contact, organizational participation, and provision of agricultural technologies. Some of these factors like access toward credit and markets are addressed in the 33-item attitudinal modernity scale as mentioned previously while extension contact, organizational or social participation and provision of agricultural technologies stand on their own and are included in the variable list of this study.

### 2.2.5 Human Development Theory

Over time there has been an increased realization that development is about people and that, they, the beneficiaries are the principal actors. Agunga (1997:158) reported "As disappointment with development aid mounted in the late 1970s and early 1980s, many writers, analysts, thinkers, and policy makers began to accept the reality that development is not something that can be forced on people by outsiders, particularly foreign experts. In the final analysis, development is about people". He further argues that economic pressures, national and international, have led to the neglect of the human dimension in development and unless remedied, the neglect could lead to the destruction of billions of poor people.

The human development theory implies that any development program aimed at human development must be based on the perceived needs and problems of the people themselves. Servaes, Mowlama and Wilson as cited by Melkote (1991:234) also pointed out that in this paradigm, priorities are more contextual to the needs and problems of individual countries (or communities) than the universal applicability of earlier paradigms. According to Perret, *et al,* (2003:38), two fundamental principles of participatory development, which is the main aspect of human development theory, are:

- Communities are knowledgeable, possessing indigenous technical knowledge (ITK). Interventions should not be planned on the basis of exogenous analysis, which may be unrelated to the local situation,
- The participants in rural development and technical change in agriculture are the farmers themselves, and the communities to which they belong. These farmers are rational decision makers, in the context of their constraints and opportunities. They have good reasons for doing what they do. Their practices reflect the information available to them, the resources they can mobilize, their technical

skills, and their physical and institutional environment. To express a value judgment on these practices according to some "external expertise" or "standard criteria" is incorrect, although it may be easier than to figure out the context of these practices.

The dimensions and intervention strategies of human development theory (Agunga, 1997:165) include:

(1) Sustainability – natural resource oriented,
(2) Capacity building – training oriented,
(3) Emancipation – education and organization oriented and
(4) Development support communication making people at the center of development.

Some of the factors considered critical for development like capacity building in the form of training and extension, emancipation such as literacy and education, organization and communication are well provided for in the former growth-with-equity theory and are included as behavior determinants in this present study. But the other factors that are emphasized in human resource development theory such as participation, sustainability etc. were not found to be easily quantified. According to Oakley (1990:32), evaluation of the social aspects of development, such as the above, requires different indicators and methods. Suggested methods, like participant observation, and in-depth study demand a fairly longer period of time of more than one season. This is beyond the scope of this present study, thesis research, and might be areas of future investigation.

### 2.2.6 Conclusion

Where considering the various theories and approaches and how they have evolved over time the following shifts in tendency become evident.

(1) Single factor determinism which focuses either to economical, social or communication causes to contextual perspectives,

(2) External and intervention orientation to endogenous and sustainable strategies,

(3) Economic and material (NI, GDP) to social development indicators (income, education, literacy),

(4) Dependence on external expertise to management of programs by local people, and,

(5) Agendas as defined by outside experts to needs and problems, as perceived by the actors themselves,

(6) Individual blame for lack of change in behavior and growth to system blame.

Several factors such as backward tradition or lack of attitudinal modernity, lack of expertise and capital, lack of organizational participation, lack of access to technology, lack of education and training and access to information (Lack of access to extension and media) etc. appear to be important causes of behavior and justify further investigation. There are also new concepts (participation, emancipation, liberation, conscientization, sustainability, empowerment, etc.) that are considered to be legitimate causal factors. However, there is a lack of theoretical foundation, objectivity, and operational and scientifically acceptable method of enquiry. Proposed methods, also demand conducting continuous monitoring (data collection, and interpretation) over a longer period of time (Oakley, 1990: 32-35). Their main intent is to understand processes and not to measure outcomes, which is neither the objective nor the capacity of this study i.e. it is beyond the scope of the present study, which had to be completed in a given and limited time period.

## 2.3 MODELS OF BEHAVIOR CHANGE

Edward Tolman, quoted by Lee (1977:168), held that all behavior was intentional and governed by experience about the environment. It's intentional nature makes human behavior situation specific and therefore less predictable. The complexity is the fact that the same person at different situation may make different decisions and can therefore behave in different ways (Düvel, 1987:3). In connection to this, Albert Einstein is quoted by Jacobsen to have said, "it is hard to understand the behavior of human beings than to understand atoms" (Düvel, 1991:77).

Despite the dynamic nature of human behavior however, social scientists have managed to formulate conceptual constructs or behavior change models, which make provision as to how behavior can be acquired, modified or changed with the introduction of a new stimulus or experience. Düvel (1991:74-77) and Botha (1986:25), distinguished the following behavior or adoption models namely,

(1) The traditional approaches,
(2) The classical 5-stage adoption process,
(3) The Campbell model,
(4) The innovation decision-making process of Rogers and Shoemaker,
(5) The psychological field theory of Lewin,
(6) The Tolman model and
(7) Düvel's behavior analysis model, however, the more recent KIS (knowledge and information system) and Ajzan & Fishbein's attitudinal factors determining the individual's behavior can be regarded as another variations.

Most models or approaches of behavior change are based on processes or behavior determinants or a combination of the two (Habtemariam & Düvel, 1993:87-98). According to them, the classical 5-stage adoption process (North Central Rural Sociology Committee, 1961), the Campbell Model (1966), and the Innovation-decision model (1971) are typical processes. KIS can also be included under this category as it deals with system processes. The problem solving or behavior determinant approach is in a way also a process, but emphasizes perhaps more than others that the content is more important.

The following is a critical overview the different models and approaches for the purpose of assessing them regarding their usefulness as models of behavior analysis and intervention.

### 2.3.1 The Traditional Approaches

Albrecht (1969) quoted by Düvel (1991:74) enumerated the teaching method, the socio cultural, the atomic communication, the socio structural communication and situational-communication approaches in this category. Düvel (1991:74) has also emphasized the adequacy and contribution of the situational-functional approach (Albrecht, 1969) for its ability to address the problem of behavior from varied perspectives of situational factors as opposed to the other four which label either the teaching method, cultural ties, communication or any other single factor to be the cause of behavior.

### 2.3.2 The Classical 5-stage Adoption Process (NSRC, 1961)

According to Brown (1958:146) adoption of a farm practice is a bundle of related events emerging through time, not an instantaneous metamorphosis. He said that from first awareness to regular use, there must be a transformation in the orientations and behavior of the farm operator. Against this background, the North Central Rural Sociology Committee (1961) developed what is known as the classical adoption process model Campbell (1966:459). It assumes that the adoption of an innovation often is not an instantaneous act; rather, it is a process that develops over a period of time and is influenced by a sequence of actions. These actions consists of five- stages, namely:

(1) Awareness: The farm operator hears of the practice,
(2) Interest: The farm operator feels the practice is a workable solution for an existing problem,
(3) Evaluation: The farm operator carefully considers it together with alternatives and their consequences,
(4) Experimentation: The farm operator tries the practice on his farm and,
(5) Adoption: The farm operator uses the practice.

The assumption is that the process begins with awareness of an innovation, but, according to Campbell (1966:460), it may also start with a problem perception. He argues that many adoption sequences are problem oriented, whereby the individual becomes aware of a problem and then seeks out ideas or solutions and consequently becoming aware. The model is also criticized for disregarding non-rational decision-making. He argues that diffusion researchers have implied a reflective, carefully taught out decision of a rational nature (adoption follows careful evaluation), but it is a truism that not all decisions are rational

### 2.3.3 The Campbell Model

The individual adoption process model (NSRC, 1961) is a simplified heuristic device for describing a varied complex process and questioned for its adequacy to delineate the adoption process as it occurs in all of its variations (Campbell 1966: 459). Having scrutinized the weaknesses of the classical five-stages adoption model, Campbell (1966:465) came up with an alternative approach, which he claims, expands instead of refutes the predecessor. For Campbell, the individual decision- maker may take any of the proposed four types or paths of adoption namely:

(1) Rational-Problem Oriented. "Stages" (problem-awareness-evaluation-rejection or trial-adoption or rejection),

(2) Rational-Innovation Oriented. "Stages" (awareness-interest-evaluation, rejection or trial-adoption or rejection),

(3) Non-Rational-Problem Oriented. "Stages" (problem-awareness-adoption or rejection-resolution [including information seeking]),

(4) Non-Rational Innovation Oriented. "Stages" (awareness-adoption or rejection –resolution [including information seeking]) (Fig. 2.1).

"Rational" is defined here as a process in which the possible alternatives and consequences of the decision are considered before any action is taken, whereas, "non-rational" is any process that occurs without consideration of the alternatives or consequences including impulsive decisions (Campbell, 1966:461). He states that the majority of decisions undoubtedly fall between the two extremes, since they have elements of both rationality and non-rationality in them. Example was the reasons for the purchase of new automobile, where the purchase could be rational such as dependability, prestige, or achievement; and that it may also be non-rational such as the "desire" or "yearning" to have a new automobile and the impulse to buy one new without carefully assessing its social and economic desirability and comparing it against other priority needs and aspirations.

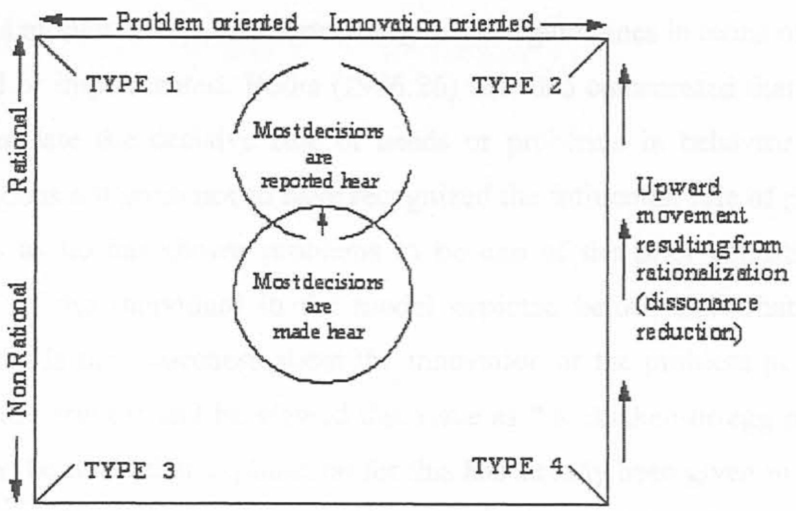


**Fig. 2.1 A paradigm of individual decision making and adoption (Campbell, 1966: 465)**

The model appears to offer an inclusive record of the possible pathways, which a farm operator may follow in the process of adopting new ideas. However, in common to the other process models, it focuses on explaining change and does not account on how change can be brought about.

## 2.3.4 The Innovation Decision-Making Process

At about 1968, when the generation of diffusion of knowledge that have reached to a watershed in the late 1960's, started to decline, Rogers and Shoemaker (1971) merged findings from several of the social sciences in both the United States and abroad into a single, integrated body of concepts and generalizations, which is called the classical diffusion model (Goss, 1979: 744).

According to the classical diffusion model (Fig. 2.2), the innovation decision process is the process through which an individual or other decision making unit, extension organization, for example, 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, and to confirmation of the decision (Rogers, 1983: 163).

Düvel (1991: 74) asserts that the model has successfully overcome the weakness of previous models except its shortcoming to offer guidelines in terms of how change can be directed or implemented. Botha (1986:26) has also commented that the model does not accommodate the decisive role of needs or problems in behavior analysis. However, Rogers does not seem not to have recognized the influential role of problems in behavior analysis as he has shown problems to be one of the prior conditions in the decision process of the individual in the model depicted below, but what he did question is whether it is the awareness about the innovation or the problem perception, that comes first in the process and he viewed this issue as " a chicken-or-egg problem". It should, however, be noted that explanation for this has already been given in the Campbell model of the individual adoption process. He gave the possibilities of both the rational (problem oriented) or non-rational (innovation oriented) processes depending on the type of the decision, the individual decision maker and the time. According to Campbell, an individual can make rational decisions at one time and can make non-rational decisions at another.

According to Singh (1997:19), although the model is not sufficient to explain the complete behavior of farmers and has been criticized severely, there has not been a better model, which has been developed by extension scientists and this has resulted into a theoretical vacuum in extension. Since traditional models are all heavily dependent on Roger's model, extension is faced with the paradigmatic crisis and extension researchers are still using the Roger's model as their bible though Roger himself has rejected his model and lamented that 'the child was thrown away with the bathwater' (Singh, 1997).

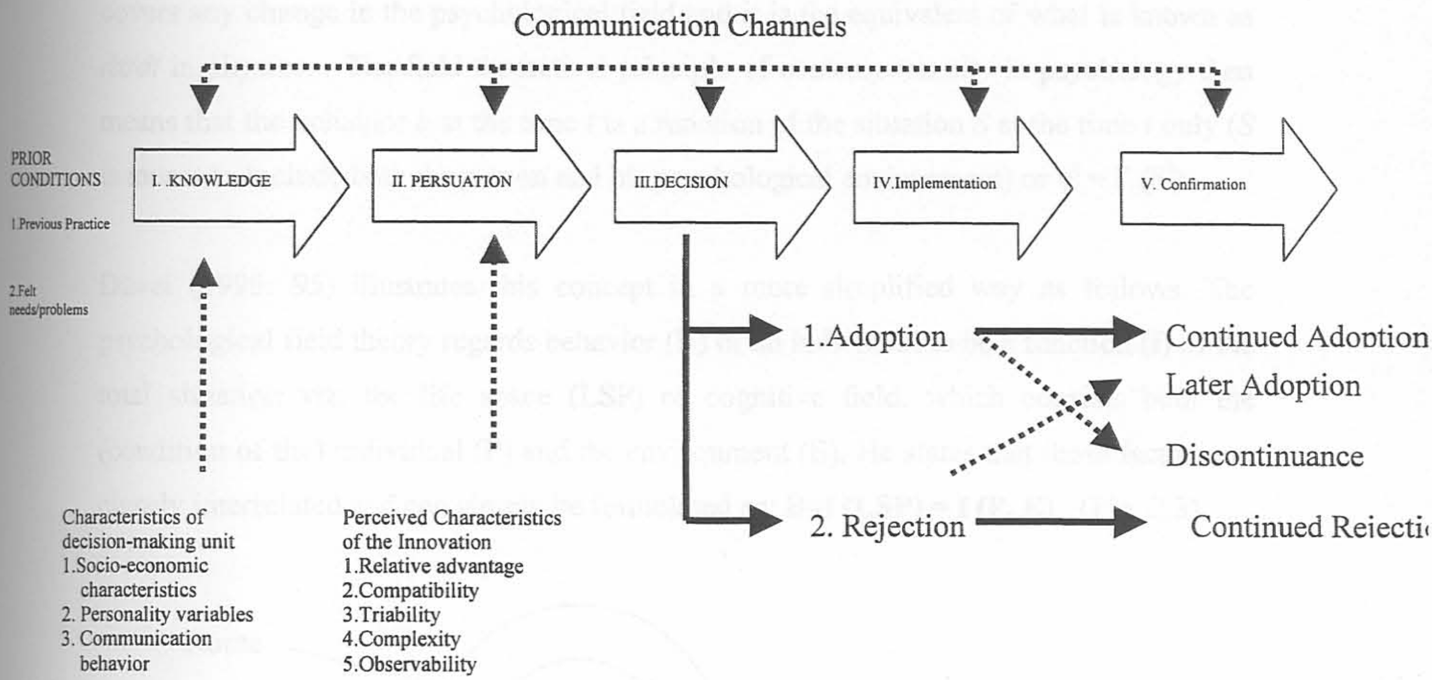


**Fig. 2.2 A model of stages in the innovation decision process (Rogers, 1983:165)**

### 2.3.6 The Psychological Field Theory of Lewin

The central element of Lewin's model, according to Neel (1977: 337), is a life space or psychological field in which the person moves. He states that this space is psychological, not physical (geographical concept), or it is not merely a spatial relationship but a hypothetical construct, an interface about what went on inside the human being or animal.

For Lewin (1951:299), the psychological field or the life space is synonymous to the physical space in physics, within which physical objects are moving. One of the basic principles of psychological field theory is the principle of contemporaneity, which states that any behavior or any other change in a psychological field depends only on the psychological field at that time (Lewin, 1951: 301). He elaborated this concept in saying that a change at the point $x$ in the physical world is customarily characterized as $dx/dt$; that is to say, as a differential changes in the position of $x$ during a differential time-period $dt$. Field theory states that the change $dx/dt$ at the time of $t$ depends only on the situation $S^t$ at the time $^t$ ($dx/dt = F(S^t)$). He further went on saying that the term behavior covers any change in the psychological field and it is the equivalent of what is known as *dx/dt* in physics. The field theoretical principle of contemporaneity in psychology then means that the behavior *b* at the time *t* is a function of the situation *S* at the time *t* only (*S* is meant to include both the person and his psychological environment) or $b^t = F(S^t)$.

Düvel (1995: 95) illustrates this concept in a more simplified way as follows. The psychological field theory regards behavior (B) of an individual to be a function (f) of the total situation viz. the life space (LSP) or cognitive field, which consists both the (condition of the) individual (P) and the environment (E). He states that these factors are closely interrelated and can simply be formulated as: **B=f (LSP) = f (P, E)** (Fig. 2.3).

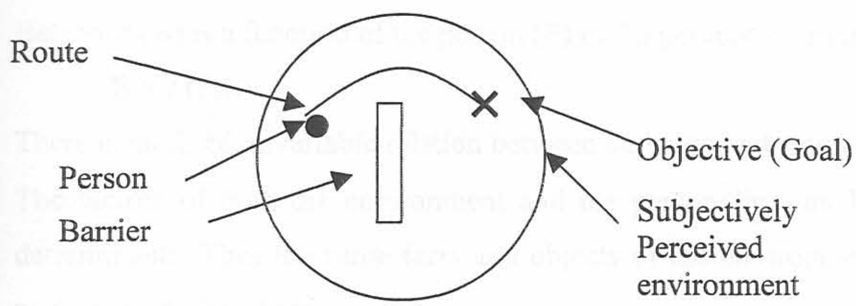


**Fig. 2.3 Model of the psychological field (Payer & Sulzer quoted in Düvel, 1987:3)**

The basic objective behind any psychological theory of behavior is to make provision for its accurate measurement and analysis. According to Lewin (1951: 301), field theory is best characterized by a method of analyzing causal relations and building scientific constructs. In the formula, B = F (P, E), B is the dependent variable while the "P" and "E" are the causal variables, which according to Lewin (1951:25) are interdependent.

Hruschka, quoted in Düvel (1991:75), states that the most relevant and important features of this theory making it useful as a conceptual framework for understanding behavior change are the following:

- The basic motivation of every organism is to maintain equilibrium.

- A disturbed equilibrium is experienced as a need tension, i.e. a felt need to reduce the tension. In this state the person tends to mobilize forces or energy to reduce the tension and re-establish a new equilibrium under the given conditions.
- The re-establishment of equilibrium takes the form of movement (locomotion), physical, or psychological, which continues until the equilibrium has been re-established. The effects of a felt tension on perception, cognition, and action are therefore such as to change the field in order to restore the tension-reduced situation.
- Anything in a situation that is perceived by the person as a goal, or as a path or barrier to a goal is understood as a force operating on the person's behavior. This force can be positive or negative.
- Behavior (B) is a function of the person (P) in the perceived environment (E)

  B = f (P.E)

  There is no fixed, invariable relation between stimulus and response.
- The factors of both the environment and the personality can become behavior determinants. Thus the same facts and objects of the environment or personality may cause different actions.
- The co-existing forces are dynamically interdependent constituting the so-called ' force field', which is subjective, time-specific and determines behavior.
- Change, or the lack thereof, is, in principle, explainable by the same concept: namely the constellation of interacting forces. Change can be brought about by changing the force field, i.e. by adding or strengthening "driving forces" (positive) forces and/or eliminating or weakening " restraining forces" (negative forces).

According to field theory, a person who finds himself in a relatively stable situation may assume a new behavior if and only if this seemingly stable situation (equilibrium) is disturbed and a need tension (dissonance situation) is created. In an attempt to eliminate or reduce the need tension and reestablish a new equilibrium, as the model in Fig. 2.4 below illustrates, the person starts locomotion from phase1 where the pressure of positive forces (driving forces) outweigh the opposite pressure from restraining forces (barriers or negative forces). The movement continues to a level or until a new equilibrium is formed

According to Düvel (1975:10) imbalance of positive and negative forces can be achieved in either one or combination of the following alternatives viz.:

(1) Addition or strengthening of positive or driving forces,
(2) Elimination or reduction of negative or restraining forces or
(3) Changing the direction of negative forces to positive.

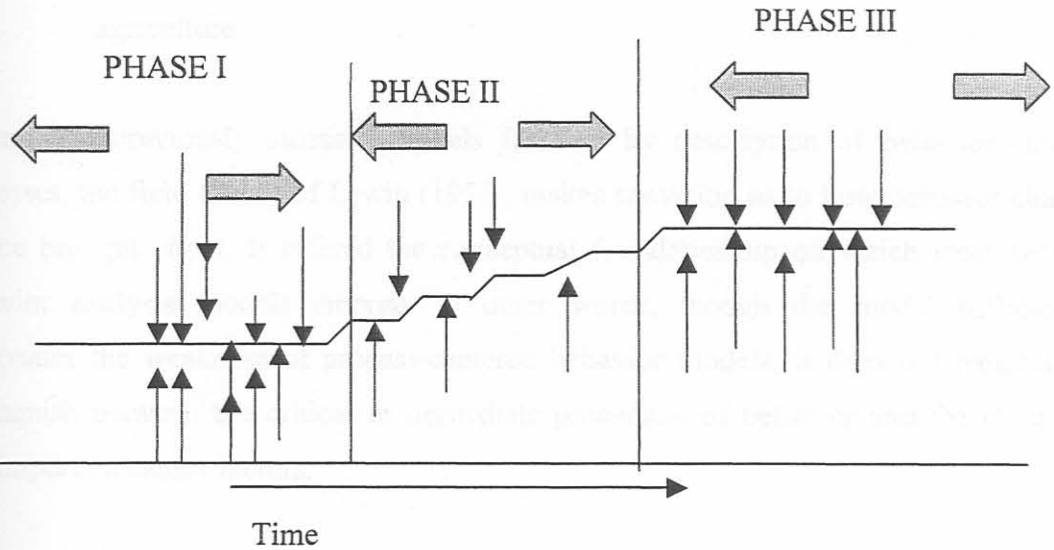


**Fig. 2.4 Behavior change model (Lewin, 1951, quoted in Düvel, 1987:3)**

As quoted by Düvel (1991:75) the field theory has originally been identified by Hruschaka (1969) and is regarded as the most appropriate for behavior analysis especially from extension point of view. According to Düvel (1991:75) the practical advantages of the model are,

(1) It provides a concept in terms of which the complexity of any real life situation, in respect of behavior relevant factors, can be analyzed,
(2) The theory is not limited to change but also explains non-change. It provides guidelines not only for situation analysis explaining behavior but also for planning change and for evaluation,
(3) It is also useful for the analysis of greater social units as groups of clients, organizations, and also for planning change with them,

(4) With the exception of its mathematical descriptions and quantifications it is easy to understand, mainly because of familiar principles or concepts relevant in other disciplines (e.g., the field concept of Einstein or the valence concept of chemistry),

(5) Regarded as an interdisciplinary theory that is not confined to any of the disciplines of the social sciences, which is inconsistence with the multidisciplinary nature of extension hence allowing it address all aspects in agriculture.

Contrary to previously assessed models featured by description of behavior change processes, the field theory of Lewin (1951), makes provision as to how behavior change can be brought about. It offered the conceptual foundation up on which more refined behavior analysis models emerge. In other words, though the model sufficiently overcomes the weakness of process-centered behavior models, it does not particularly distinguish between the critical or immediate precursors of behavior and the relatively less important causal factors.

### 2.3.6 The Tolman Model

Edward Tolman, according to Düvel (1995:46), is the one who introduced the concept of intervening variables. He is quoted by Düvel (1991:76) to have been differentiated three sets of variables, namely the independent, the dependent and the intervening variables (Fig. 2.5).

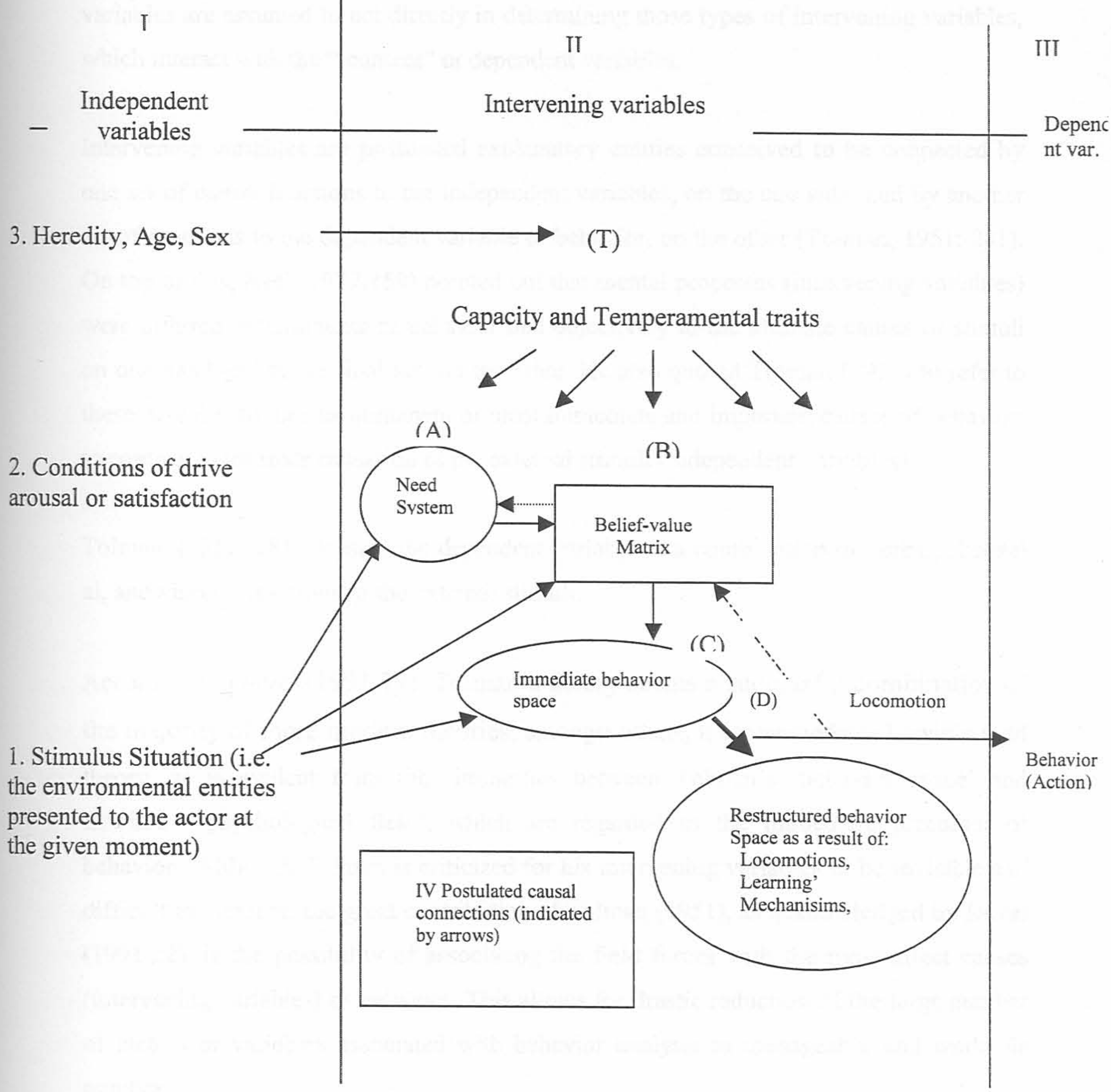


**Fig. 2.5 The Tolman Model (Tolman, 1951: 286)**

According to Tolman (1951:279), the independent variables are the initiating causes of the individual's action consisting of the environmental entities presented to the individual actor at the given moment (physical, social, and cultural objects and processes). He also enumerated conditions of drive arousal and such individual-difference-producing variables as heredity, age and sex to the category of independent variables. Independent variables are assumed to act directly in determining those types of intervening variables, which interact with the " content" or dependent variables.

Intervening variables are postulated explanatory entities conceived to be connected by one set of causal functions to the independent variables, on the one side, and by another set of functions to the dependent variable of behavior, on the other (Tolman, 1951: 281). On top of this, Neel (1977:159) pointed out that mental processes (intervening variables) were inferred determinants of behavior tied objectively to the ultimate causes or stimuli on one hand and to the final act, on the other. He also quoted Tolman (1951) to refer to these neural activities as immanent or most immediate and important causes of behavior, in contrast to ultimate causation of the external stimuli (independent variables).

Tolman, (1951: 281) defined the dependent variable as a combination of verbal, skeletal al, and visceral reactions to the external stimuli.

According to Düvel (1991:77), Tolman's theory seems a successful combination of the majority of more modern theories; amongst others, it accommodates Lewin's field theory, as is evident from the similarities between Tolman's 'behavior space' and Lewin's 'psychological field', which are regarded as the immediate precursor of behavior. Although Tolman is criticized for his intervening variables to be invisible and difficult to measure, the great contribution of Tolman (1951), as acknowledged by Düvel (1991:22), is the possibility of associating the field forces with the most direct causes (intervening variables) of behavior. This allows for drastic reduction of the large number of factors or variables associated with behavior analysis to manageable and workable number.

### 2.3.7 Fishbein & Ajzen's attitudinal determinants of behavior

Attitudes are viewed as complex systems comprising person's beliefs about an object, his feelings toward the object, and his action tendencies with respect to the object (Fishbein & Ajzen, 1975: 340). They elaborated that attitude is a learned predisposition to respond to an object in a consistently favorable or unfavorable manner and indicated the strong link that exists between attitude and behavior. They classified attitude into affective (e.g., I feel a strong liking for the church), cognitive (e.g., I believe that the church has extremely desirable qualities), and conative (e.g., I act supportive to the church).

According to Ajzen (1988:113) the important point about willful behaviors such as voting behavior, watching evening news over the Television, blood donation, etc. is that their occurrence is a direct result of deliberate attempts made by an individual i.e. people can easily perform these behaviors if they are so inclined, or refrain from performing them if they decide against it. This inclination or abstinence is termed as intention. Intensions are assumed to capture the motivational factors that have an impact on behavior. He argues that when dealing with volitional behavior, people can be expected to do when they intend to do. Expressions of behavioral intension should thus permit a highly accurate prediction of volitional action.

With an ultimate goal of understanding, predicting and explaining an individual's behavior, Ajzen & Fishbein (1980:8) tried to integrate diverse theories and lines of research in the attitude arena and came up with a complete list of behavior determinants (Fig. 2.6). Their theory is based on the assumption that human beings are usually quite rational (reasoned action) and they consider the implication of their action before deciding to engage or not to engage in a given behavior (Ajzen & Fishbein, 1980: 5). They assume that a person's intention to perform (or not to perform) a behavior is the immediate determinant of action. According to their theory of reasoned action, a person's intention is a function of two basic determinants, one personal in nature (the individual's positive or negative evaluation of performing the behavior), which they call 'attitude toward the behavior' and the other reflecting social influence, which is called subjective norm.

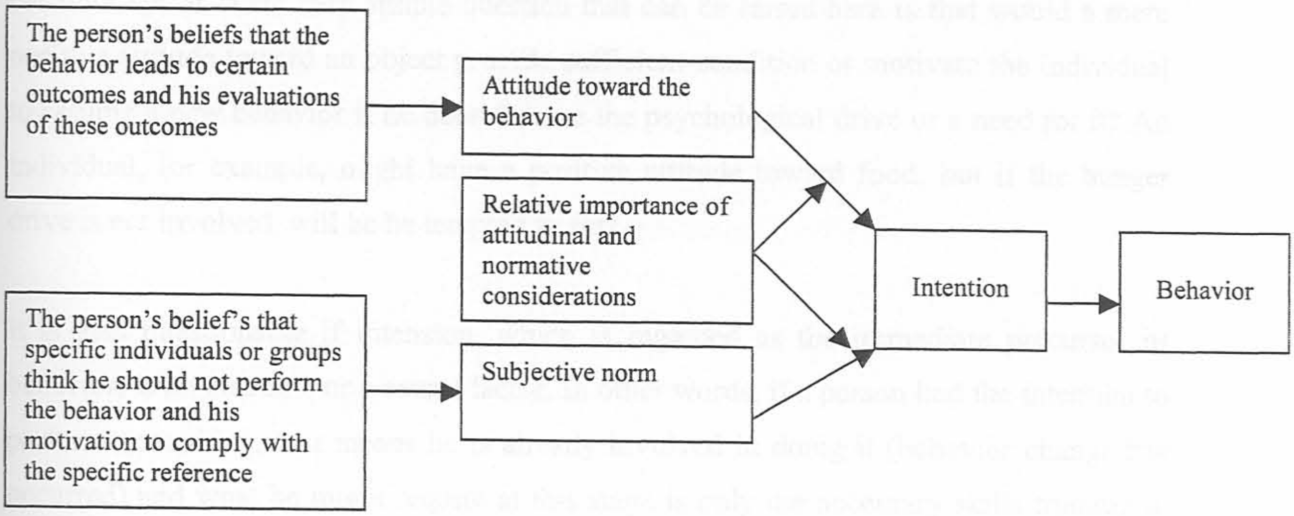


**Fig. 2.6 Factors determining a person's behavior (Ajzen & Fishbein 1980:8)**

One very important issue that can be noted here is that their analysis does not make reference to the various independent and intervening variables invoked to explain behavior by other behavior analysts. This is not, however, unintentional. They recognize that some of these factors such as personality characteristics (authoritarianism, achievement motivation), personal variables (age, sex, social class), status, kinship pattern, etc. may influence behavior but they classified them as 'external variables', whose influence is only indirect (Ajzen & Fishbein, 1980:82). They argue that external variables will have an effect on behavior only to the extent that it influences the determinants of that behavior and not directly the behavior itself.

Their association of independent variables to only an indirect influence is quite similar to that of Tolman's (1951) view. However, the fact that no mention is made neither to some of the salient features of Tolman's (1951) and Lewin's (1951) behavior space, nor to Düvel's (1975,1991) intervening variables (needs, perceptions and knowledge), which are assumed to be a direct precursor of behavior is not very clear. Of course, they assumed that there are different causes for different behaviors (Ajzen & Fishbein, 1980:4). Nonetheless it does not seem to be a sufficient explanation. It is difficult to expect changes in behavior without the presence of sufficient conditions for change like the creation of needs and favorable perceptions, which form the psychological field or behavior space. One very simple question that can be raised here is that would a mere positive attitude toward an object provide sufficient condition or motivate the individual to assume a new behavior if he doesn't have the psychological drive or a need for it? An individual, for example, might have a positive attitude toward food, but if the hunger drive is not involved, will he be tempted to eat?

It is also questionable if intension, which is regarded as the immediate precursor of behavior, is an outcome or a causal factor. In other words, if a person had the intention to perform something, that means he is already involved in doing it (behavior change has occurred) and what he might require at this stage is only the necessary skills training to implement the new behavior.

### 2.3.8 Agricultural Knowledge and Information System (AKIS)

The assumption and approach of AKIS is somewhat different from the other behavior analysis models. According to Blum (1997:2), the "classical" Transfer of Technology (ToT) models, that is to say NSRC, the Campbell model, Roger's and Shoemaker model, etc. assume that knowledge and technology are generated (only) through research and technological development, and these are then "transferred" (mainly) by an extension service to the knowledge and technology users, the farmers. He argues that the ToT models neglect the influence of policy decisions, the place of education, the media and farmers' role as knowledge providers and the potentials of indigenous knowledge, which should form part of the technology generation and utilization system. Singh (1997: 20) added that the study of consequences of innovations at the macro level was neglected and resulted in the shift of extension focus to systems perspectives. According to Rivera (1991:74), extension is afforded a quite broad purpose in AKIS, which goes beyond dissemination of agricultural information and technology to include education along with provision of information and innovations.

In the literature, Agricultural Knowledge System (AKS) and Agricultural Information System (AIS) and Agricultural Knowledge and Information System (AKIS) are interchangeably used. According to Röling (1988:33), AIS is a system in which agricultural information is generated, transformed, transferred, consolidated, received, and fed back in such a manner that these processes function synergistically to underpin knowledge utilization by agricultural producers. He defined AKS as a system of beliefs, cognitions, models, theories, concepts, and other products of the mind in which the (vicarious) experiences of a person or group with respect to agricultural production is accumulated. According to Van Den Ban & Hawkins (1988: 32), the sources of information about agriculture (the research, extension and utilizer sub systems) collectively are called the agricultural knowledge system. In this study the term AKIS is used to denote the whole process involved in the generation and utilization process of agricultural technology with the purpose of avoiding such confusion.

Röling (1988:188) holds that development of new knowledge and its utilization is a key survival strategy of the human species; it is a normal aspect of coping with the environment and not a specified function of researchers. He went on saying that the search for knowledge is a survival mechanism, in addition humans acquire a collective store of knowledge, which could be improved on the basis of their experience and inherited through cultural transmission by other generations. His argument here is that research is only a formal procedure for what is a normal human behavior, which follows that for a research output to be useable and be adaptable to the local situations, the research subsystem should not be the sole generator. The utilizer sub system, the extension, and policy sub systems have a role to play in the whole process of technology development. AKIS appreciates the system or bigger totality and dynamic interdependency of its subsystems rather than focusing on sub systems.

Features of a system's approach, as identified by Hurtubise (1984) and quoted by Röling (1988:188) are the following:

- It centers on interaction between elements instead of on the elements,
- It emphasizes the effects of interactions instead of their nature.
- It is based on global view, instead of on precision of details,
- It seeks to modify groups of variables at a time instead of a single variable,

- It seeks to validate facts by comparing model with reality instead of by experimental proof,
- It uses models which might not be very rigorous but can be used for decision and implementation,
- It is multi-disciplinary,
- It focuses on exact knowledge of objectives, and imprecise knowledge of details, instead of vice versa.

Fig. 2.7 provides a model of AKIS. AKIS consists of the knowledge policy, generation, development, exchange and utilization subsystems, which are assumed to be interdependent and dynamically interacting.

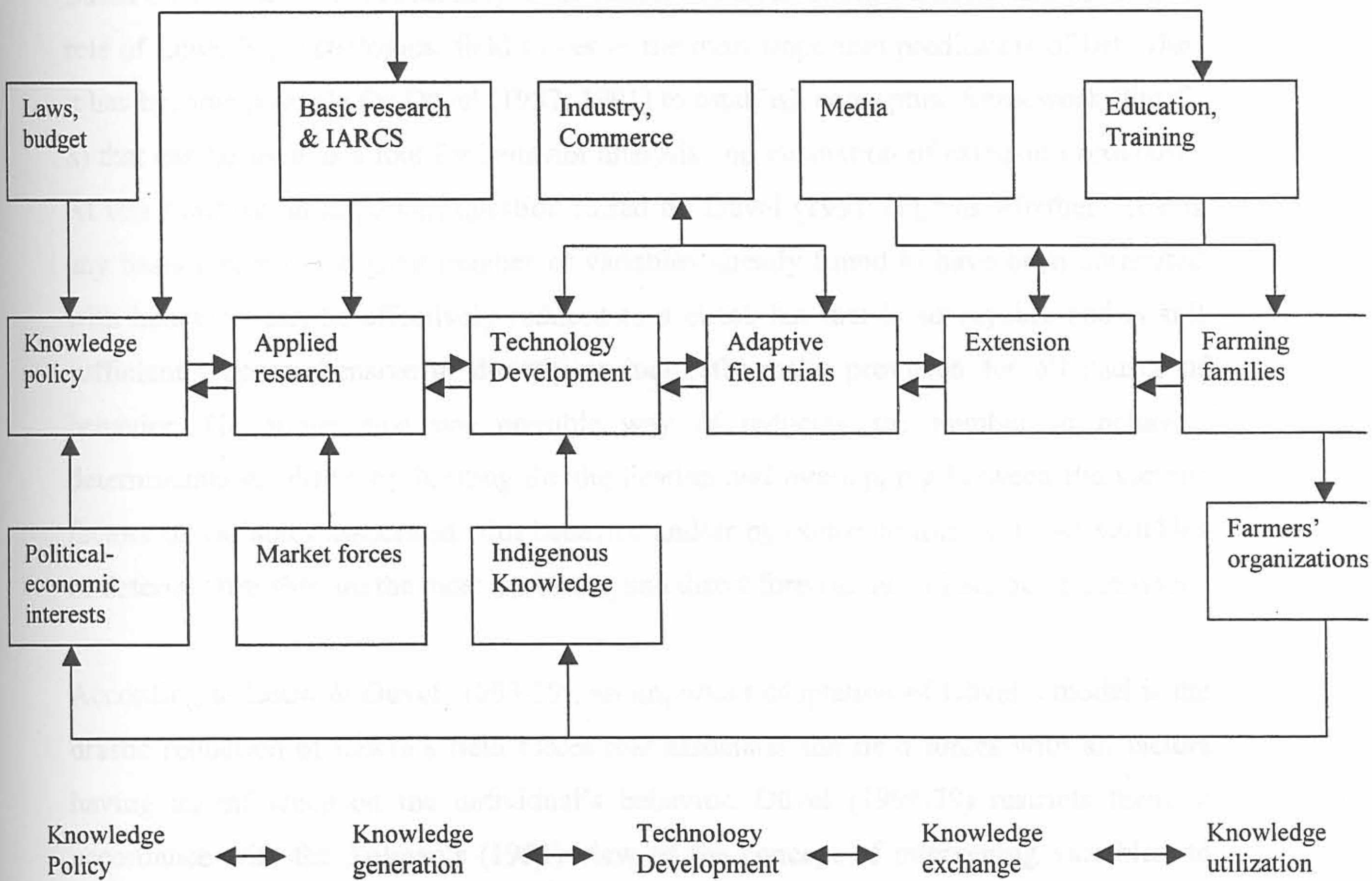


**Fig. 2.7 Schematic illustration of the Agricultural Knowledge System (Blum, 1977:6)**

According to Röling (1988:188), the word system is used for analytical, design, and simulation purposes but when used for analytical purpose, it seems difficult to analyze complex systems by conventional scientific analysis. It is also mentioned above that one of the features of the systems approach is that it seeks to validate facts by comparing model with reality instead of by experimental proof. In addition, systems approach is inappropriate for explaining individual behavior since the unit of decision-making is the individual and his perception of the system, which doesn't correspond with the objective system.

### 2.3.9 Düvel's Behavior Analysis Model

Based on Tolman's (1951) finding of the concept of intervening variables and the critical role of Lewin's psychological field forces as the most important predicators of behavior, it has become possible for Düvel (1987, 1991) to establish conceptual framework (Fig. 2. 8) that can be used as a tool for behavior analysis and evaluation of extension programs. At this juncture an important question raised by Düvel (1991:77) was whether there is any basis whereby the great number of variables already found to have been correlated with behavior, can be effectively reduced to a check-list that is surveyable and is still sufficiently comprehensive to directly or indirectly make provision for all causes of behavior. He argues that one possible way of reducing the number of behavior determinants would be by limiting the duplication and overlapping between the various factors or variables associated with behavior and/or by concentrating on those variables or determinants that are the most immanent and direct fore-runners of action or behavior.

According to Louw & Düvel (1993:29), an important adaptation of Düvel's model is the drastic reduction of Lewin's field forces that associates the field forces with all factors having an influence on the individual's behavior. Düvel (1991:79) restricts them in accordance with the Tolman's (1951) view of the concept of intervening variables, to only those variables (mediating variables) through which most causes of behavior (independent variables) become manifested in behavior. Louw & Düvel (1993:29) reported that the mediating variables represent a further selection of Tolman's (1967) intervening variables (mostly defined as invisible or covert constructs) to include only those that appear to be the immediate and direct precursor of decision-making or behavior, namely needs, perceptions and knowledge. This approach, namely the focus on the intervening variables has been implemented with success in numerous research projects as for example Düvel (1975), Louw and Düvel (1978), DeKlerk and Düvel (1982), Düvel and Scholtz (1986), Marincowitz and Düvel (1987), and Düvel and Botha (1990).

The salient features of Düvel's behavior analysis model (Figure2.8) are needs, perceptions, and knowledge, with the former two being the more basic or immediate determinants. Needs are the most important of all, because only through them can the process of behavior change come about or be triggered off, perceptions being regarded as an excellent means of determining psychological field forces as it indirectly comprises most, if not all, the factors determining behavior (Düvel, 1987:5). The independent variables or situational factors (personal, physical, economical, social, cultural, or communication) are not regarded to be part of the model because they are claimed to have only an indirect influence and thus play a less important role in the behavior determination process. The model is illustrated in Fig. 2. 8.

The advantages of using the intervening variables, which are an important feature of the model, for behavior analysis and behavior intervention, according to Düvel (1998:32), are as follows:

- They are, as direct determinants of behavior, the logical focus of intervention, and consequently also the logical criteria of evaluation,
- They will, if monitored, reveal why (or why not) change has occurred. Similarly, it is through these variables that progress (or the lack of it) can be monitored and that the extensionist can get an indication concerning the adaptations that need to be made in terms of message, method or approach,
- They allow for a fair and just merit assessment or recognition of performance. It is not uncommon for an extensionist to either get undue credit for change that can only be partially accredited to him, or - perhaps even more frequently - not to get

credit for what he has accomplished, simply because the change is of a covert nature.

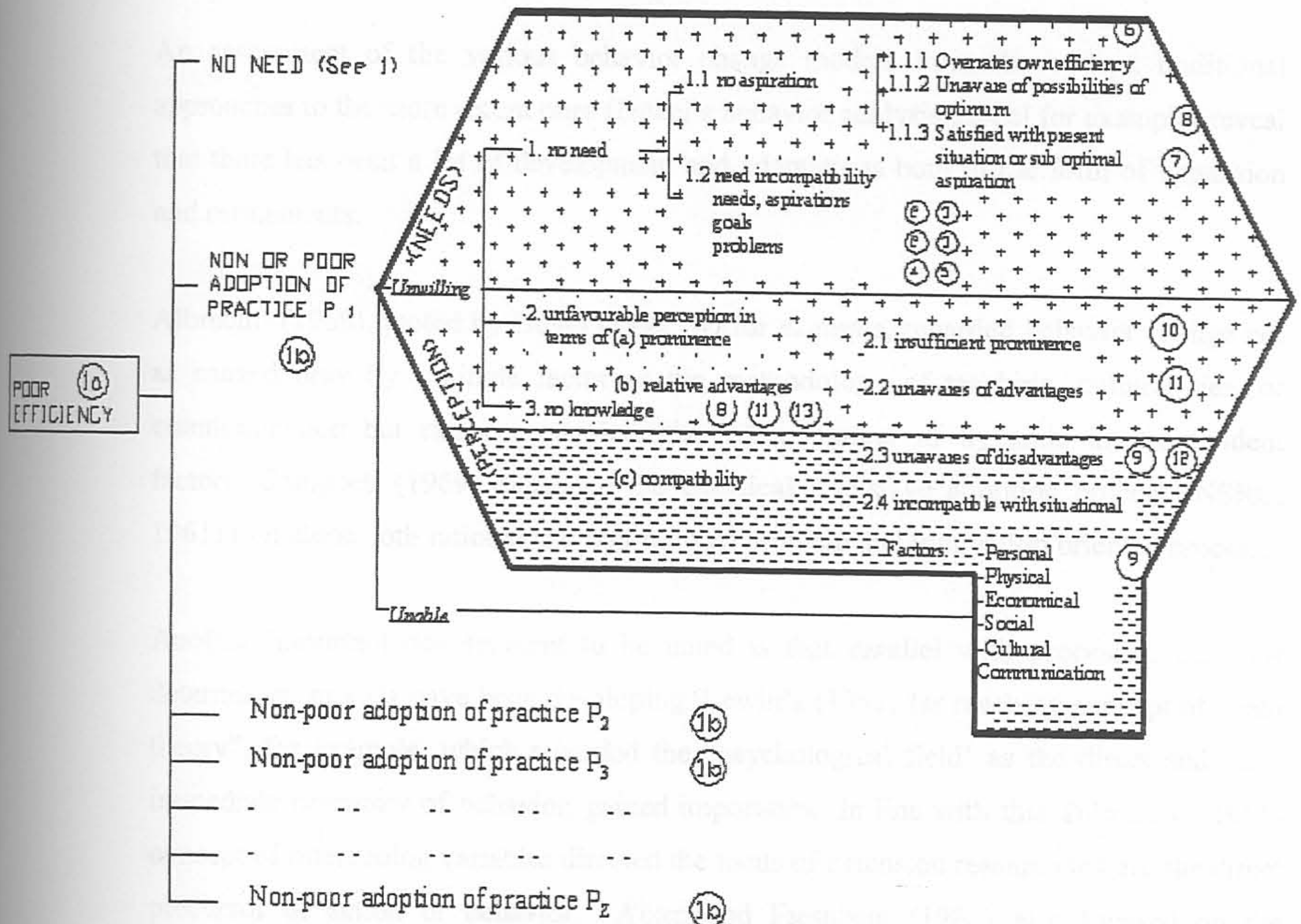


**Fig. 2.8** **Düvel's behavior analysis model**

Furthermore it is difficult, if not impossible, to expect change by concentrating efforts on independent variables such as age, status, education, which, have attracted the attention of past extension research, but are usually a given and cannot be changed. The intervening variables such as needs, perceptions and knowledge are, on the other hand more dynamic and can easily be changed by extension efforts. Beal (1956: 249) is of the same opinion to this line of argument. He suggests for an alternative research focus on dynamic factors such as satisfaction, having a say in decision making, and feeling of responsibility than on the independent factors. According to him it is possible for group members and leaders to easily change the former factors through group action than the latter, which are more static.

### 2.3.10 Conclusion

An assessment of the various behavior change models from the earliest traditional approaches to the more recent ones (Düvel's behavior analysis model for example) reveal that there has been a lot of development and adaptations both in the form of expansion and refinements.

Albrecht (1969) quoted by Düvel (1991:74) for example, regarded behavior change not as caused only by a single factor as the methodology of teaching, cultural ties, or communication but rather as an interplay of a number of dynamic inter-dependent factors. Campbell (1969) expanded the Classical five-stage adoption process (NSRC, 1961) to include both rational and non-rational problem and innovation oriented process.

Another important development to be noted is that parallel with processes, behavior determinant models have been developing. Lewin's (1951) far reaching concept of 'field theory", for example, which regarded the "psychological field' as the direct and most immediate precursor of behavior, gained importance. In line with this Tolman's (1951) concept of intervening variables directed the focus of extension research toward the direct precursor of action or behavior. Ajzen and Fieshbein (1980) also focused on the immediate precursors of behavior like attitudinal factors and indicted that the influence of independent variables is only indirect.

Based on the concepts of Lewin's psychological field and Tolman's intervening variables, Düvel (1987 and 1991) came up with his own model, which successfully reduced and refined the great many number of variables assumed to have been correlated with action or behavior and at the same time, appears to be so comprehensive and made provision for all causes of adoption behavior. A not worthy development when studying various behavior change models is the change in focus to the more direct forerunners of action or behavior (intervening variables) rather than the more independent (personal, physical, economical, social, cultural, or communication) factors.

## 2.4 Conceptual model of the study

Part one of the literature review showed that social development programs launched in the second half of the 20th century failed to change the traditional way of life of farmers. Factors or variables, that were considered most important or key for changes in behavior, were mainly associated with the personal characteristics (attitudinal modernity, literacy, organizational factors, communication, etc.). The individual peasant was, therefore, blamed for the lack in the change of behavior or lack of development. The most important development, however, was the recognition of the central role of people in the development process.

Part two of the review also concludes by underlining the decisive role of the intervening factors, (needs, perceptions, knowledge) in behavior determination. This change in focus of research and development tradition from the independent to more of the intervening variables is also an indication for the recognition of the important role of the people in development process. Moreover Düvel (1998:30) argues that if behavior evaluation has to produce meaningful results and answer the question "why change has/ has not occurred?" then it should not restrict itself with learning whether and to what extent the intended results have been achieved. Broadening the scope of the investigation from how (behavior processes) to why (behavior determinants) will enable evaluators to recognize alternative strategies in designing future programs. According to him, evidences to the why part of the question can be found only through an investigation of the influence of the intervening factors on behavior, which showed the focus of future extension research.

The compliance of the central ideas of part one and part two of the literature overview has motivated the researcher to focus on the investigation of the intervening factors in order to attain his objectives. It is noted that the main objective of the study is to determine the level of behavior change attained and the factors responsible for change in behavior of extension program participant farmers in Ethiopia.

Düvel's behavior analysis model is applied for the study. First proposed in 1975 and Introduced in 1987, the model has, over the years, been refined, developed and tested for its workability in behavior analysis especially in the area of agricultural development. It clarifies the main concepts, defines the dimensions and limits of technical factors or variables to be investigated in association with behavior change, sets forth crucial assumptions, and states the theoretical propositions and their operational hypotheses to be tested. The model, as clearly revealed with the review, is also presented in a more concise and simplified manner and has been able to capture the important aspects of past behavior analysis models and assumed to be more appropriate to meet the objectives of this study i.e. it provides a frame of reference and directives for the collection and analysis of data to answer the research questions raised in this study.

Based on his general behavior analysis model, Düvel (1991: 77) showed the relationship between behavior determining variables in agricultural development (Fig. 2.9), which gave the guideline and conceptual framework for this study. As clearly illustrated, the three categories of variables associated with behavioral change in agricultural development are the independent, the intervening, and the dependent variables. Based on the literature review, factors such as personal (e.g., age, education, literacy, organization, attitudinal modernity), socio-economic (e.g., farm size, capital, expertise) and communication aspects (e.g., extension, media), which were assumed to be important across all development theories and behavior change models reviewed, are considered in this study. Needs, perceptions and knowledge are found in the refined list of intervening variables. Distinction has even been made within the mediating variables in the degree to which they are assumed to predict behavior on the cause/effect continuum (Fig. 2.9). The model shows that needs are more closely associated with behavior or action among the intervening variables.

The content variables to be predicted are adoption behavior and the ultimate production efficiency. Based on the conceptual framework provided above, a comparative analysis will be made between the influence of selected independent and intervening variables on the adoption behavior and production efficiency of maize and dairy farmers.

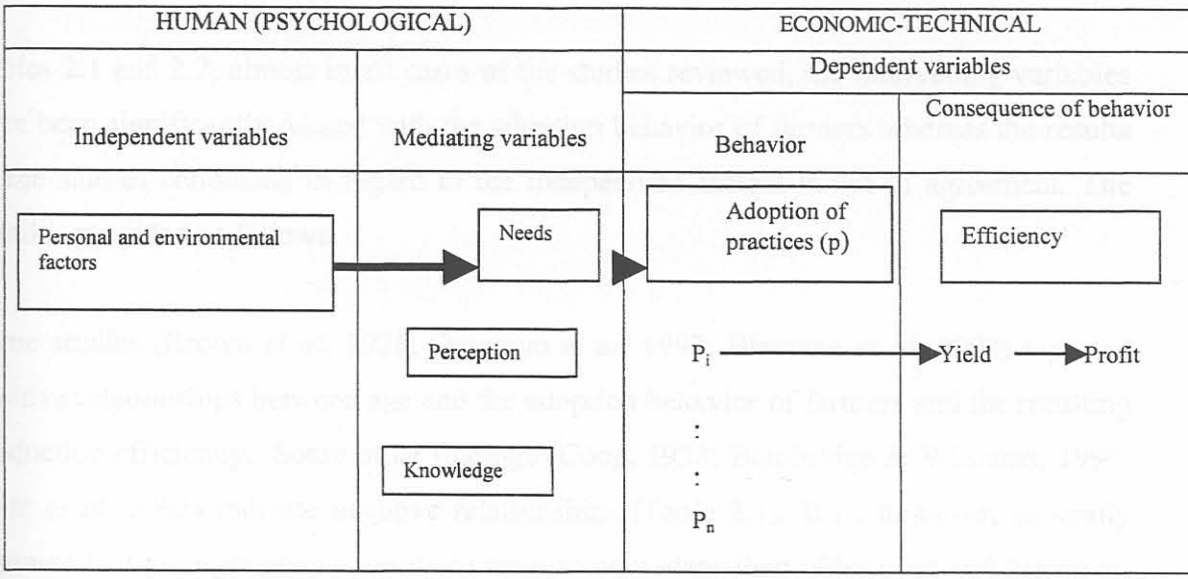


**Fig. 2.9 The relationship between behavior-determining variables in agricultural development, (Düvel, 1991:77)**

## 2.5 EMPIRICAL STUDIES ON THE EFFECT OF INDEPENDENT AND INTERVENING VARIABLES ON ADOPTION BEHAVIOR

A voluminous body of literature exists concerning the influence of situational factors on the adoption behavior of farm operators. The literature is too diversified to be reviewed here; therefore, only those studies that relate to the variables of this study will be reviewed. Relatively speaking only minorities of studies have been conducted on the influence of intervening variables. This could be attributed to the recentness of the models, which address the important role of intervening variables in behavior analysis. As a result studies conducted in this area are largely confined to Southern Africa and did not spread over a larger geographical area as yet (Table 2.1). This study, focusing on the investigation of these intervening human factors, is, therefore, believed to narrow this gap in the general body of knowledge.

In general, review of the literature indicates a greater degree of inconsistency of research results regarding the independent than the intervening variables. As clearly shown in

Tables 2.1 and 2.2, almost in all cases of the studies reviewed, the intervening variables have been significantly related with the adoption behavior of farmers whereas the results of the studies conducted in regard to the independent factors is not in agreement. The detail is provided as follows.

Some studies (Brown *et al*, 1976; Omotayo *et al,* 1997; Bizmana *et al,* 2002) reported positive relationships between age and the adoption behavior of farmers and the resulting production efficiency. Some other findings (Coop, 1958; Bembridge & Williams, 1990; Foltz *et al*, 2002) indicate negative relationships (Table 2.1). It is, however, generally assumed that younger people are more open to new ideas than older ones and therefore, are believed to be more likely to adopt agricultural technologies relatively earlier. In this context and based on the time dimension of Lewin's (1951) theory of life space, Neel (1977: 339) asserts that as a person become older, he is able to exist in a broader time perspective, which includes his past, present, and future, while the small child lives completely in the present and is determined in its behavior by it.

Agronomical speaking middle altitude agro ecological areas, where moisture supply is relatively better-off, yield better output than lower altitude areas where moisture supply is a major limiting factor for crop growth. According to Getahun *et al,* (2000), fertilizer use by farmers in the Southern Ethiopia showed positive response in the middle altitude zone than the lowland zone while significant difference was not observed in variety use.

The number of years the farm operator spent in farming will increase the experiential base and this should assist in making adoption decision (Abd-Ella, 1981:45). Such a consistent result is not, however, found in the review of the literature. Experience is found to have no relation with adoption behavior in some cases (Düvel & Botha, 1999; Zegeye *et al,* 2001; Zegeye & Tesfaye, 2001) while it has been positively (e.g., Omotayo *et al,* 1997) and negatively (e.g., Abd-Ella *et al,* 1981) related regarding the rest of the studies reviewed (Table 2.1).

According to Abd-Ella (1981:45), larger farm size means more resource and greater ability to take the risk involved in the adoption of recommended practices. Rogers

(1983:252) has also generalized that early adopters have a larger-sized units than later adopters. Review results are in agreement with this generalization, i.e. farm size is found to be positively related with adoption in twelve cases. (Opare, 1977; Omotayo *et al,* 1997; Elias, 1999; Alene *et al,* 2000; Zegeye *et al,* 2001; Getahun *et al,* 2002) can be cited as examples. Farm size does not show any relationship only in some cases (Getahun *et al,* 2000; Zegeye & Tesfaye, 2001) while it is negatively related in a single case.

Education is a human capital that is regarded as the best option of empowering farm operators. It is, therefore, expected that education increase the adoption level of farmers. Rogers (1983:251) has also reported that earlier adopters have more years of education than the later adopters have. The review indicates inconclusive findings. Although positive relationships are found in most cases (Bembridge & Williams, 1990; Mensah & Seepersad, 1992; Foltz *et al*, 2002), significantly large number of studies does not show any relationship between the educational level of the farm operator and his adoption behavior. Studies conducted by Düvel & Botha (1999), Elias (1999), and Getahun *et al,* (2000) are some examples. A negative relationship (Omotayo & Ogunwale, 1996) is also rarely reported.

Abd-Ella (1981:45) has reported that interaction with the environment (cooperative activity, communication behavior, and extension contact) is essential for the farm operator so that he can learn about the recommended practices. Rogers (1983:259) has also generalized that these variables, such as extension, media contact and organizational participation are positively related with adoption behavior. The review also shows that extension contact has been positively related with adoption behavior (Elias, 1999; Alene *et al*, 2000; Zegeye & Tesfaye, 2001) in more than 90 percent of the studies reviewed. Reports regarding the relationships between media exposure and adoption are highly inconsistent. Abd-Ella *et al*, (1981) found a negative relationship. Omotayo *et al*, (1997) reported no relationship whereas Bizmana *et al*, (2002) found negative relationship. Organization is found to be positively related (Elias, 1999; Getahun *et al*, 200) with adoption in more than fifty percent of the cases and does not show any relationship

(Omotayo *et al*, 1997; Getahun *et al*, 2000; Zegeye *et al*, 2001) regarding the rest of the studies reviewed.

Male-headed households are said to have better access to agricultural information than female-headed households, which is attributed to negative influence of cultural norms and traditions. A study conducted by Mensah & Seepersad (1992), found positive relationship between gender and the adoption behavior of cocoa farmers in Ghana i.e. Male farmers are more likely to adopt agricultural technologies than female farmers.

According to Rogers (1983:257) personality variables, like attitudinal modernity have not received much research attention, in part because of difficulties of measuring personality dimensions in field interviews. The same observation is made in this study. A study by Saeed (1989) that considered attitudinal modernity *per se* (as a composite variable) in its behavior analysis found positive relationship. Concerning the study of the influence of this variable on adoption behavior, many other studies focus their assessment only on specific issues or on elements like attitude toward science, attitude toward education, fatalism, etc, that form the composite variable attitudinal modernity rather than looking at its composite or holistic effect. Rogers (1983:258), for example, has made the generalizations that adoption behavior is positively related with favorable attitudes toward education, science, credit, change, etc.

**Table 2.1 Summary of studies on independent variables-adoption behavior relationship**

| Variable | Researcher | Year | N | Place | Subjects | DV | r*,**,*** |
|---|---|---|---|---|---|---|---|
| Age | Alene et al, | 2000 | 110 | West Shoa (Ethiopia) | Maize men | Maize varieties | NS* |
| | Elias | 1999 | 150 | West Ethiopia | Wheat men | Wheat practices | NS |
| | Elias | 1999 | 154 | West Ethiopia | Teff men | Teff practices | NS |
| | Zegeye & Tesfaye | 2001 | 363 | South Ethiopia | Maize men | Maize practices | NS |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | NS |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Variety | NS |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Fertilizer | NS |
| | Bizmana et al, | 2002 | 183 | South Rwanda | Coffee men | Package | +, Sig. |
| | Bembridge & Williams | 1990 | 170 | SW South Africa | Maize men | Package | -,Sig. |
| | Opare | 1977 | 1191 | Ghana | Cocoa growers | Cocoa practices | NS |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | +, Sig. |
| | Omotayo et al, | 1996 | 150 | Nigeria | Farmers | Animal traction | +, Sig. |
| | Mensah & Seepersad | 1992 | 180 | Ghana | Cocoa growers | Cocoa practices | NS |
| | Düvel & Botha | 1999 | 79 | South Africa | Farmers | Conservation practices | NS |
| | Foltz et al, | 2002 | 245 | Connecticut, USA | Dairy men | rbst | -,Sig. |
| | Brown et al, | 1976 | 202 | Horby, US | Dairy men | Insimination service | NS |
| | Copp | 1958 | 157 | Kansas-USA | Cattlemen | Beef practices | 0.24** |
| | Copp | 1958 | 177 | Wisconsin- | Dairy men | Dairy practices | -0.23** |
| Agro ecology | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Variety | +, Sig. |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Fertilizer | NS |
| Farming experience | Zegeye & Tesfaye | 2001 | 363 | South Ethiopia | Maize men | Maize practices | NS |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | NS |
| | Opare | 1977 | 1191 | Ghana | Cocoa growers | Cocoa practices | +, Sig. |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | +, Sig. |
| | Duvel & Botha | 1999 | 79 | South Africa | Farmers | Conservation practices | NS |
| | Abd-Ella et al, | 1981 | 844 | Lowa-USA | Family farm | Farming practices | -0.230** |
| | Havens | 1965 | 145 | Ohio -USA | Dairy farmers | Bulk milk tanks | -0.089 |
| Farm size | Alene et al, | 2000 | 110 | West Shoa (Ethiopia) | Maize men | Maize varieties | +, Sig. |
| | Elias | 1999 | 150 | West Shoa (Ethiopia) | Wheat men | Wheat practices | NS |
| | Elias | 1999 | 154 | West Shoa (Ethiopia) | Teff men | Teff practices | +, Sig. |
| | Zegeye & Tesfaye | 2001 | 363 | South Ethiopia | Maize men | Maize practices | NS |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | +, Sig. |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Variety | NS |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Fertilizer | NS |
| | Bizmana et al, | 2002 | 183 | South Rwanda | Coffee men | Package | +, Sig. |
| | Opare | 1977 | 1191 | Ghana | Cocoa growers | Cocoa practices | +, Sig. |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | +, Sig. |
| | Omotayo et al, | 1996 | 150 | Nigeria | Farmers | Animal traction | +, Sig. |
| | Mensah & Seepersad | 1992 | 180 | Ghana | Cocoa growers | Cocoa practices | -, Sig. |
| | Duvel & Botha | 1999 | 79 | South Africa | Farmers | Conservation practices | +, Sig. |
| | Foltz et al, | 2002 | 245 | Connecticut, USA | Dairy men | rbst**** | +, Sig. |
| | Havens | 1965 | 145 | Ohio-USA | Dairy farmers | Bulk milk tanks | 0.267** |
| | Copp | 1958 | 157 | Kansas-USA | Cattle men | Beef practices | 0.52*** |
| | Copp | 1958 | 177 | Wisconsin- | Dairy men | Dairy practices | 0.43*** |
| | Abd-Ella et al, | 1981 | 844 | Lowa-USA | Family farm | Farming practices | 0.155** |
| | Brown et al, | 1976 | 202 | Horby, US | Dairy men | Insimination service | NS |

*,**,*** Significant at 10 percent, 5 percent, 1 percent level
* Not significant
**** Recombinant bovine somatotropin

**Table 2.1 Continued…**

| Variable | Researcher | Year | N | Place | Subjects | DV | r*,**,*** |
|---|---|---|---|---|---|---|---|
| Education | Alene et al, | 2000 | 110 | West Shoa (Ethiopia) | Maize men | Maize varieties | +, Sig. |
| | Elias | 1999 | 150 | West Shoa (Ethiopia) | Wheat men | Wheat practices | NS |
| | Elias | 1999 | 154 | West Shoa (Ethiopia) | Teff men | Teff practices | NS |
| | Zegeye and Tesfaye | 2001 | 363 | South Ethiopia | Maize men | Maize practices | NS |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | +, Sig. |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Variety | NS |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Fertilizer | NS |
| | Bizmana et al, | 2002 | 183 | South Rwanda | Coffee men | Package | +, Sig. |
| | Bembridge & Williams | 1990 | 170 | SW South Africa | Maize men | Package | +, Sig. |
| | Omotayo et al, | 1996 | 150 | Nigeria | Farmers | Animal traction | -, Sig. |
| | Mensah & Seepersad | 1992 | 180 | Ghana | Cocoa growers | Cocoa practices | +, Sig. |
| | Duvel & Botha | 1999 | 79 | South Africa | Farmers | Conservation practices | NS |
| | Foltz et al, | 2002 | 245 | Connecticut, USA | Dairy men | rbst | +, Sig. |
| | Abd-Ella et al, | 1981 | 844 | Lowa-USA | Family farm | Farming practices | 0.214** |
| | Havens | 1965 | 145 | Ohio-USA | Dairy farmers | Bulk milk tanks | 0.094 |
| | Copp | 1958 | 157 | Kansas-USA | Cattle men | Beef practices | 0.34*** |
| | Copp | 1958 | 177 | Wisconsin- | Dairy men | Dairy practices | 0.19** |
| Organization | Elias | 1999 | 150 | West Shoa, Ethiopia | Wheat men | Wheat practices | +, Sig. |
| | Elias | 1999 | 154 | West Shoa, Ethiopia | Teff men | Teff practices | NS |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | NS |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Variety | +, Sig. |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Fertilizer | NS |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | NS |
| | Copp | 1958 | 157 | Kansas-USA | Cattle men | Beef practices | 0.48*** |
| | Copp | 1958 | 177 | Wisconsin- | Dairy men | Dairy practices | 0.58*** |
| | Abd-Ella et al, | 1981 | 844 | Lowa-USA | Family farm | Farming practices | 0.015** |
| Extension | Alene et al, | 2000 | 110 | West Shoa (Ethiopia) | Maize men | Maize varieties | +, Sig. |
| | Elias | 1999 | 150 | West Shoa, Ethiopia | Wheat men | Wheat practices | +, Sig. |
| | Elias | 1999 | 154 | West Shoa, Ethiopia | Teff men | Teff practices | NS |
| | Zegeye and Tesfaye | 2001 | 363 | South Ethiopia | Maize men | Maize practices | +, Sig. |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | +, Sig. |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Variety | +, Sig. |
| | Getahun et al, | 2000 | 240 | South Ethiopia | Maize men | Fertilizer | NS |
| | Bizmana et al, | 2002 | 183 | South Rwanda | Coffee men | Package | +, Sig. |
| | Bembridge & Williams | 1990 | 170 | SW South Africa | Maize men | Package | +, Sig. |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | -, Sig. |
| | Omotayo et al, | 1996 | 150 | Nigeria | Farmers | Animal traction | +, Sig. |
| | Mensah & Seepersad | 1992 | 180 | Ghana | Cocoa growers | Cocoa practices | +, Sig. |
| | Abd-Ella et al, | 1981 | 844 | Lowa-USA | Family farm | Farming practices | 0.219** |
| | Elias | 1999 | 150 | West Shoa, Ethiopia | Wheat men | Wheat practices | +, Sig. |
| | Elias | 1999 | 154 | West Shoa, Ethiopia | Teff men | Teff practices | +, Sig. |
| | Zegeye and Tesfaye | 2001 | 363 | South Ethiopia | Maize men | Maize practices | NS |
| | Zegeye et al, | 2001 | 1460 | Whole Ethiopia | Maize men | Maize practices | +, Sig. |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | +, Sig. |
| Media | Abd-Ella et al, | 1981 | 844 | Lowa-USA | Family farm | Farming practices | 0.269** |
| | Bizmana et al, | 2002 | 183 | South Rwanda | Coffee men | Package | -, Sig. |
| | Omotayo et al, | 1997 | 5000 | Nigeria | Farmers | Package | NS |
| Gender | Mensah & Seepersad | 1992 | 180 | Ghana | Cocoa growers | Cocoa practices | +, Sig. |
| Modernity | Saeed | 1989 | 216 | White Nile, Sudan | Farmers | Practices | +, Sig. |

*,**,*** Significant at 10 percent, 5 percent, 1 percent level

The intervening variables considered in this study are need and perception related. As indicated before, results of previous studies in these areas are consistent with expectations except in one case (Table 2.2). Düvel & Scholtz (1986) found that perception of controlled selective grazing (CSG) has not been related with adoption of recommended veld management practices. Association of need related variables (need compatibility, need tension) and adoption behavior has been positive and significant. Studies by (Koch, 1986; Koch, 1987; Louw & Düvel, 1993; Düvel & Botha, 1999) for example, found positive and significant relationships. Koch (1986) found negative relationship between perceived current efficiency and adoption. This means that adoption of agricultural practices is inhibited by problem misperception or by a lack of clear perception.

Perception of technology attributes is positively related with adoption behavior regarding most of the studies reviewed (Botha, 1986; Louw & Düvel, 1993; Düvel & Botha, 1999) are some examples.

Table 2.2 Summary of studies on intervening variables-adoption behavior relationship

| Variable | Researcher | Year | N | Place | Subjects | Dependent variable | Association |
|---|---|---|---|---|---|---|---|
| **NC[**]- atriplex nummularia** | Louw & Düvel | 1993 | 46 | NW South Africa | Farmers | Attriplex nummularia | +, Significant |
| **NC-Conservation practices** | Düvel & Botha | 1999 | 79 | South Africa (SA) | Farmers | Conservation practices | +, Significant |
| **NT[***]-income** | Koch | 1985 | 100 | Orange free state, SA | Commercial farmers | Package | +, Significant |
| **NT-CSG** | Düvel & Scholtz | 1986 | 77 | Volksrust, SA | Farmers | CSG | +, Significant |
| **NT-package** | Koch | 1987 | 100 | Orange free state, SA | Commercial farmers | Package | +, Significant |
| **PCE[****]-package** | Koch | 1987 | 100 | Orange free state, SA | Commercial farmers | Package | -, Significant |
| **PTA[*****]-atriplex nummularia** | Louw & Düvel | 1993 | 46 | NW SA | Farmers | Attriplex nummularia | +, Significant |
| **PTA-conservation farming** | Botha | 1986 | 52 | SW Africa | Beef farmers | Beef practices | +, Significant |
| **PTA-pasture management** | Botha | 1986 | 52 | SW Africa | Beef farmers | Beef practices | +, Significant |
| **PTA-production systems** | Botha | 1986 | 52 | SW Africa | Beef farmers | Beef practices | +, Significant |
| **PTA-fodder banking** | Botha | 1986 | 52 | SW Africa | Beef farmers | Beef practices | +, Significant |
| **PTA-fodder cropping** | Botha | 1986 | 52 | SW Africa | Beef farmers | Beef practices | +, Significant |
| **PTA-package** | Koch | 1985 | 100 | Orange free state, SA | Commercial farmers | Package | +, Significant |
| **PTA-package** | Koch | 1986 | 100 | Orange free state, SA | Commercial farmers | Package | +, Significant |
| **PTA- CSG** | Düvel & Scholtz | 1986 | 77 | Volksrust, SA | Farmers | CSG[*] | NS |
| **PTA-c-conservation practices** | Düvel & Botha | 1999 | 79 | South Africa | Farmers | Conservation practices | +, Significant |

[**] Need compatibility
[***] Need tension
[****] Perceived current efficiency
[*****] Perception of total attributes
[*] Controlled selective grazing

## 2.6 Towards a formulation of hypotheses

Against the theoretical background of this chapter, presenting the literature review and an assessment of different models, the following research hypotheses emerge:

Hypothesis 1:

The adoption of recommended technologies or production practices[1] contribute significantly to production efficiency[2]

Hypothesis 2:

Production efficiency is determined by independent[3] and intervening variables[4], of which the influence of the former is indirect and only becomes manifested in production efficiency via intervening variables, which are the direct and immediate precursors of production efficiency.

Support for the above hypothesis can be found in evidence indicating that

2.1 There is a significant relationship between independent personal and environmental factors[3] and production efficiency[2]

2.2 There is a significant relationship between intervening factors[4] and production efficiency[2]

2.3 Intervening variables[4]are the most important predictors, and taken together, will account for a significantly greater proportion of the variance of production efficiency[2]

---

[1] = Improved seeds, fertilizer, line planting, spot application, breed, housing, feed, and medical practices
[2] = Maize and dairy farmers
[3] = Agro ecology, education, farm size, farming experience, gender, change agent contact, media exposure, organizational participation, attitudinal modernity,, and age
[4] = Perceived current efficiency, need tension, need compatibility, perceived total attribute

Hypothesis 3:

Adoption behavior[2] is determined by independent[3] and intervening variables[4], of which the influence of the former is indirect and only becomes manifested in behavior via intervening variables, which are the direct and immediate precursors of decision making and adoption behavior.

Support for the above hypothesis can be found in evidence indicating that

3.1 There is a significant relationship between independent personal and environmental factors[3] and adoption behavior[2]

3.2 There is a significant relationship between intervening variables[4] and adoption behavior[2]

3.3 Intervening variables[4] are the most important predictors, and taken together, will account for a significantly greater proportion of adoption behavior[2]

# CHAPTER 3

# METHODOLOGY

## 3.1 INTRODUCTION

Chapter three commences by briefly describing the two areas where the research had been conducted. Report on the research design proceeds with sampling and data collection methods. This is followed by definition of the variables and the statistical analysis procedure employed.

## 3.2 THE STUDY AREA

The study was conducted in the Southern part of Ethiopia in the Shashemene district and the Debrezeit town (Ada Liben) of Oromia regional state during the period February to December 2002 (Fig. 3.1).

Shashemen district is well known for its potential in maize production and is one of the districts where the package-based extension program was first initiated by the SG 2000 project. Moreover, a dairy establishment, the second interest of the researcher, is found along the highway to Shashemene, which makes the nomination of Shashemene and Debrezeit realistic not only from a technical point of view but also due to its economic relevance. This is to say that due to financial and time constraints the study was conducted only in one district concerning maize. However, the results are expected to be reasonably representative of the wider maize growing areas than is usually possible. Most of the maize growing areas in the country are found under similar geographical (Low and medium agro ecological zones) and socio-economic conditions (similar input and output marketing system, similar technology and technology promotion services, similar land ownership policy etc.). Similar assumptions apply in the case of dairy production.


**Fig. 3.1 Location of the study sites**

### 3.2.1 Shashemene District

It is located some 275 km South of Addis Ababa nearby the capital of Southern Nations, nationalities and peoples' region, Awassa. It comprises the three traditionally known agro ecological zones (AEZs) namely the low altitude (below 1500masl.), the middle altitude (1500-2500masl.) and the high altitude (2500-3500masl.) AEZs.

Maize is believed to be one of the most widely grown cereals in the first two AEZs planted along with wheat, potato and beans. The rainfall is bimodal; the major rainy season (July to September) offers the main harvest for the district. During the small rainy season, which covers the periods February to March, farmers grow potato and maize to sell while the cob remains still green to earn a small income. Lack of water is a major constraint in the use of recommended practices especially in the lower altitude zone where the rainfall is highly erratic, small in amount and irregular in distribution.

A typical farmer in Shashemene district is believed to own only a small piece of land (<2 ha.) and on average only one ox (an important element of the farming system), 2 to 3 other farm animals, a few sheep and a donkey (mainly used as a source of income and for draught purposes. The farmlands are usually flat and gently sloping and fertile. Most of the marginal lands are found either near depressions (highly eroded) sloping or hilly areas and mainly used for afforestation or communal grazing supporting farm animals.

According to a report from the district Bureau of Agriculture, the district has 36 peasant associations (PAs[1]) of which 28 are located in the low and middle altitude AEZs and 15,000 farm families are believed to reside in the first two maize growing AEZs having an average of 530 farm households per PA. PAs are the most important institutions in the village, which were first established during the previous socialist oriented regime of the military government with the purpose of facilitating the participation of the peasant community in the development process of their village and the country at large. They are responsible to organize the community to participate and nominate its representatives during elections and are delegated by the government to administer rural land especially farm lands. Service cooperatives are the second forms of peasant institutions (mainly working in close association to the PAs catering for provision of agricultural inputs such as fertilizer, seed and agro chemicals and agricultural credit. Two to three PAs form a service cooperative. These important institutions are currently in the process of being reinstated in the district after they collapsed during the change in the government in 1991 and are not yet in a position to offer the required services to members.

Extension is one of the most important services provided by the government to the district. There is one development center per PA with a multipurpose development agent, usually a certificate holder, deployed at each center. In view of the very critical yet very demanding nature of the profession, however, the quality of training of DAs does not seem to be sufficient. The government being aware of this problem has embarked on a very ambitious, but rather naïve training program. 3000 trainees nominated from all over the country, including Shashemene have, for example, recently been enrolled in one of

[1] Lowest administrative unit

the training centers situated some 100 km away from Shashemene without prior preparation of the syllabus and program.

### 3.2.2 Ada Liben Woreda Dairy and Dairy Products Marketing Association

This association is found in the town of Debre Zeit situated in the Oromia region, 45 km south east of Addis Ababa. It was established about four years ago with the major objective of providing services vital to its members such as artificial insemination, animal health, training, marketing and input delivery. It works towards fulfilling the growing demands for milk by the surrounding urban and peri-urban areas such as Addis Ababa, Nazareth, Debre Zeit, Dukem, and Mojo. It also aims at promoting dairy production technologies for the surrounding rural communities and plays the role of a model farm for currently emerging similar associations in other areas of the country.

Presently, it has seven milk collection sites engaged with the collection, handling and transportation of milk to the cooperative shop from where it is finally hauled to terminal markets. The association is currently looking for financial sources to implement its plan of expanding the current dairy plant to a fully-fledged establishment consisting of a dairy processing plant, feed processing plant, animal health unit, artificial insemination unit, conference and training unit, and other service providing units. Although there are other cooperatives equally becoming important and flourishing within a radius of 200 km around Addis Ababa, ALWDDPMA was selected because of cost implications. ALWDDPMA is closer to the second study site, Shashemene, which allowed for significant savings in survey cost and time.

## 3.3 SAMPLING AND DATA COLLECTION

The formal field survey began by a ten days reconnaissance survey aimed at nomination of representative sample areas, interviewers, and community leaders who would be involved in the study. The draft questionnaire (see Appendix 3.1) was thoroughly discussed with researchers and subject matter specialists working in extension. This is followed by a one-week training of interviewers conducted along with the pretest of the questionnaire.

Care was taken to ensure randomness of the sample by making sure that every PA and maize and dairy farmer had an equal chance of being selected and that the sample size was reasonably representative. Regarding maize, simple random sampling techniques were employed to choose four among the 28 maize growing peasant associations (PAs), two from each AEZ. However, in one case, another adjacent PA had to be considered due to the inaccessibility of the nominated PA and the unavailability of the assigned development agent (the interviewer).

Finally, considering the available time and financial resource allocated for the research and assuming that a sample size of about 10 percent is a fairly representative one, 50 farmers from each of the four PAs or a total of 200 farmers from 2120 farm households of the two AEZs were randomly drawn. The same procedure was followed to nominate 200 dairymen for the study. But the fact that dairy farmers are residing in one town, decreased travel and other expenses and enabled to cover more farmers (46 percent) with the available budget than in the case of maize farming.

## 3.4 DEFINITIONS AND MEASUREMENT OF VARIABLES

The variables identified to have an influence on behavior as established from the extensive review of the literature can broadly be classified into independent and intervening variables. Once the variables considered for behavior analysis were identified, scales were developed (Table 3.1) for purposes of quantification and for providing a basis for analyzing relationships. The procedure used to measure and categorize each of the independent, intervening and dependent variables considered in this study is provided in this section.

### 3.4.1 The independent variables

Independent variables considered in this study include personal variables such as attitude toward change, attitude toward education, attitude toward science, secularism and fatalism which were all aggregated into one composite variable, namely attitudinal modernity (David and Inkeles in Saeed 1999:309-316) age, education and literacy. Other variables included socio economic and communication variables such as farm size, the geographical region where farmers reside (agro ecology), organizational participation, change agent contact and mass media exposure (Rogers, 1983:251-258; Bembridge and Williams, 1990:53; Ristow & Bembridge, 1993:38-40; Elias, 1999:72-74). The following is a more detailed description of these variables:

*Age:* Measured on a continuous scale in terms of the respondent's number of years of age at the time of data collection. Based on the deviation of their age from the mean, maize and dairy farmers were categorized into four groups as indicated in Table 3.1.

*Formal education:* Measured in terms of the number of years of formal schooling the respondent has completed at the time of data collection. If the learner did not pass a year, he is enumerated as illiterate. Participants who completed grades 1 to 6 and 7 to 12 are said to have a primary and secondary level of education. Those farmers who passed secondary school leaving examinations and joined higher learning institutions were categorized into those who have a tertiary level of education.

*Literacy:* Refers to the ability to read and write. It was measured on the ordinal scale by asking respondents to read few written lines. It was, however, dropped from further analysis as it was found to be multicollinear with formal education.

*Farming experience:* Defined as the chronological time or the number of years spent in farming by the respondent. Among respondent maize farmers' farming experience revealed a high degree of multicollinearity with age. Dairy farmers were categorized into three farming experience groups of, least, medium and most based on the deviation of their experience from the sample mean.

*Organizational participation:* This reflects on the degree of involvement of the respondent in existing formal and or non-formal organizations during the last five years. Respondents were categorized into those who have low or high participation based on the deviation of their mean organizational participation score from the sample mean score obtained by aggregating item values.

*Gender:* Refers to the sex of respondent or head of the household.

*Attitudinal modernity:* Is a composite variable encompassing analytical (disposition to hold opinions, planning orientation, belief in the calculability of the world, distributive justice etc.), topical (kinship and family, women's rights, birth control, religion, social stratification, physic adjustment etc.) and behavioral (political orientation, religious affiliation, media exposure, etc.) factors assumed to be able to measure the level of modernity (Inkeles, 1920: 35). The 33-item socio-psychological OM Scale (Smith & Inkeles, 1966:353-377) was used for this purpose. Based on the deviation of their attitudinal score from the sample mean score, respondents were classified into low, medium and high attitudinal modernity groups.

*Agro ecology:* Refers to the geographical area in which the maize respondent is currently residing and producing. Hundred farmers were drawn equally from each of two-agro ecological zone namely lower and middle altitude known for growing maize.

*Farm size/size of enterprise:* Farm size is defined as the scale of operation. As far as maize farming is concerned, it was measured as the total land holding of the respondent excluding land leased-in and out. In dairy this is measured by the preceding year's average fortnightly milk supply of the individual to the dairy marketing association. This was found to be an appropriate measure since it was assessed to be an established procedure where the cooperative had been using it to classify its members. Dairy farmers were also suspicious and not willing to report on the actual and exact number of their dairy cattle whereas the amount of milk supplied to the cooperative could easily be captured from milk and financial records found in the cooperative office. Maize and dairy farmers were grouped into small, medium and bigger farm size groups depending on the deviation of their score from the mean.

*Change agent contact:* This refers to the frequency of contact that the respondent made with the various information sources. Field experience with the package program has shown that, farmers require extension advices mainly at critical periods like during planting, weeding, topdressing, spraying, etc. These activities are roughly occurring one month apart from each other. If farmers have access to extension during these periods, they are expected to receive sufficient information required to properly implement their field activities. Respondents having an average contact of at least once a month were categorized into the high extension contact group whereas those having a contact of less than once a month were categorized into the low contact category.

*Mass media exposure:* This is also a composite score measured on an ordinal scale. The number of times, which a respondent listens to radio and TV, participate in meetings and read any print material were used as the basis to form a composite scale of respondents' level of exposure to media and classify them into low and high media exposure categories.

### 3.4.2 The Intervening variables

According to Düvel (1995:46), the obvious variables on which attention needs to be placed in behavior analysis are the intervening variables. He broadly categorized these variables into needs, perceptions, and knowledge. There is a certain degree of overlapping between these concepts, certain aspects of knowledge, for example, are synonymous with aspects of perceptions and needs and are sufficiently covered by them (Düvel, 1991:81). Needs and perceptions are considered in this study.

**Table 3.1 Categorization of maize and dairy farmers regarding independent variables**

| | Maize | | Dairy | |
|---|---|---|---|---|
| **Variable** | Category | Frequency | Category | Frequency |
| **Age** | 18-30 | 54 | 13-38 | 53 |
| | 31-41 | 50 | 39-45 | 47 |
| | 41-52 | 44 | 46-57 | 48 |
| | 55-85 | 52 | 58-80 | 52 |
| **Agro Ecology** | Low altitude | 100 | - | - |
| | Middle altitude | 100 | - | - |
| **Gender** | Male | 184 | Male | 166 |
| | Female | 16 | Female | 34 |
| **Farming Experience** | Least | 65 | Least | 68 |
| | Medium | 58 | Medium | 67 |
| | Most | 77 | Most | 65 |
| **Education** | Illiterate | 98 | Illiterate | 39 |
| | Primary | 70 | Primary | 29 |
| | Secondary | 32 | Secondary | 95 |
| | | | Tertiary | 37 |
| **Farm size** | Small | 50 | Small | 68 |
| | Medium | 94 | Medium | 67 |
| | Bigger | 56 | Bigger | 65 |
| **Organizational participation** | Low | 75 | Low | 173 |
| | High | 125 | High | 27 |
| **Extension contact** | Low | 163 | Low | 190 |
| | High | 37 | High | 10 |
| **Media contact** | Low | 75 | Low | 66 |
| | High | 125 | High | 134 |
| **Attitudinal modernity** | Low | 74 | Low | 57 |
| | Medium | 72 | Medium | 71 |
| | High | 54 | High | 72 |

*Needs:* According to Witkin and Altsculd (1995:9), need is the gap or discrepancy between the present (what is) and the desired state, future state, or condition (what should be). In this sense a need is problem related. Another type of need relates to need compatibility, which refers to the degree to which a practice or an innovation is compatible with the individual's needs. These variables were measured as follows:

*a) Perceived current efficiency (PCE):* Based on the experience of Koch (1987:21), both respondents and enumerators (local development agents) were asked to estimate the current efficiency of practice adoption and production efficiency among both maize and dairy farmers. A five-point scale was used to determine the level of over or under assessment. Respondents were then categorized into those who either under-rate, slightly under rate, had no perception discrepancy, slightly over-rate or overrate their efficiency or level of adoption of a practice as shown in Table 3.2. Problem perception discrepancies were determined in respect of production efficiency and the practices of fertilizer use, spot application of fertilizer, improved seed, and line planting in the case of maize farming. Similarly problem perception discrepancies in respect of production efficiency and the practices regarding breed, housing, medical and feed were determined in the case of dairy.

*b) Need tension (NT):* The need tension or the perceived problem is referred to as the gap between the existing and the desired situation (Düvel, 1991: 80). Based on this definition, respondents were asked to rate (on the same five-point scale) their present and aspired level of practice adoption and production efficiency. They were then based on the scope of the difference, classified into low, medium and high need tension classes in terms of production efficiency and the already mentioned identified practices in both maize and dairy farming.

*c) Need compatibility (NC):* Need incompatibility arises when the recommended practice does not fit the life space or need situation of the individual or when it is not perceived as a means of achieving the individual's goal (Düvel, 1998:35). Correspondingly, respondents were asked to estimate the level of production they would have attained if they had used (or not used) the practices or packages as recommended with the aim of assessing the compatibility of each of the individual practices to the goals of the respondents. Respondents were then classified into either the low, medium or high need compatibility classes for each variable as depicted on Table 3.2. This assessment was made in terms of need compatibility-fertilizer, -seed, -spot application, -line planting in maize and need compatibility-breed, -housing, -medical, and -feed in the case of dairy.

***Perception of total attributes (PTA):*** Düvel (1991:80) associates perceptions with the way the attributes of innovations are perceived and he distinguishes between (a) the awareness of relative advantages, (b) awareness or concern about disadvantages, (c) the overall prominence or relative advantage of innovation (practice) and (d) the compatibility with situational circumstances. The procedure involved to measure perceptions in this survey were as follows:

- A comprehensive list of attributes has been prepared by the researcher based on prepared questionnaire and discussions with specialists in the field and used as a checklist during the actual survey.
- Determining the reason (s) why a respondent had personally considered the adoption or rejection of specific innovation as part of the interview, each reason being recorded as a positive or negative psychological field factor based on the responses of respondents. Interviewers were trained to provoke discussion and stimulate respondents' memory.
- Determining the valences (strength) of each of these perceptions by being them assessed on a five-point scale.
- Computing the total valences for behavior positive and negative psychological field forces to come up with net perception of total technology attributes.

In connection with this procedure, Düvel (1975:9) asserts that when the sum total of positive forces is more than that of negative ones, there is a possibility for positive decision-making in respect of the adoption of innovation.

The perceptions of innovation attributes were assessed in terms of four maize practices (perception of technology attribute-fertilizer, -seed, -spot application of fertilizer, -line planting) and four dairy practices (perceptions of technology attributes-breed, -housing, -medical, -feed).

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**Table 3.2 Categorization of maize and dairy farmers regarding intervening variables**

| Maize | | | Dairy | | |
|---|---|---|---|---|---|
| Variable | Category | Frequency | Variable | Category | Frequency |
| **PCE*-efficiency** | Had no discrepancy (ND) | 19 | PCE-efficiency | Under rate | 14 |
| | Slightly over rate (SOR) | 108 | | Slightly under rate | 116 |
| | Over rate (OR) | 73 | | Had No discrepancy | 70 |
| **PCE-fertilizer** | Slightly under rate (SUR) | 37 | PCE-breed | Under rate | 95 |
| | Had no discrepancy | 133 | | Had no discrepancy | 70 |
| | Over rate | 30 | | Over rate | 35 |
| **PCE-spot** | Slightly under rate | 38 | PCE-housing | Under rate | 32 |
| | Had no discrepancy | 137 | | Had no discrepancy | 70 |
| | Over rate | 25 | | Over rate | 98 |
| **PCE-seed** | Slightly under rate | 32 | PCE-medical | Under rate | 74 |
| | Had no discrepancy | 168 | | Had no discrepancy | 86 |
| | | | | Over rate | 40 |
| **PCE-line planting** | Slightly under rate | 30 | PCE-feed | Under rate | 66 |
| | Had no discrepancy | 130 | | Had no discrepancy | 102 |
| | Over rate | 40 | | Over rate | 32 |
| **NT*-efficiency** | Low | 32 | NT-efficiency | Low | 136 |
| | Medium | 107 | | High | 64 |
| | High | 61 | | | |
| **NT-fertilizer** | Low | 63 | NT-breed | Low | 74 |
| | Medium | 61 | | High | 106 |
| | High | 75 | | | |
| **NT-spot** | Low | 72 | NT-housing | Low | 79 |
| | Medium | 59 | | Medium | 92 |
| | High | 69 | | High | 29 |
| **NT-seed** | Low | 56 | NT-medical | Low | 71 |
| | Medium | 58 | | Medium | 81 |
| | High | 86 | | High | 48 |
| **NT-line planting** | Low | 113 | NT-feed | Low | 22 |
| | High | 87 | | Medium | 138 |
| | | | | High | 40 |
| **NC*-fertilizer** | Low | 66 | NC-breed | Low | 44 |
| | Medium | 51 | | Medium | 98 |
| | High | 83 | | High | 58 |
| **NC-spot** | Low | 66 | NC-housing | Low | 99 |
| | Medium | 70 | | Medium | 101 |
| | High | 64 | | | |
| **NC-seed** | Low | 56 | NC-medical | Low | 73 |
| | Medium | 86 | | Medium | 90 |
| | High | 58 | | High | 37 |
| **NC-line planting** | Low | 67 | NC-feed | Low | 60 |
| | Medium | 61 | | Medium | 77 |
| | High | 72 | | High | 54 |

**Table 3.2 Continued...**

| Maize | | | Dairy | | |
|---|---|---|---|---|---|
| **Variable** | Category | Frequency | Variable | Category | Frequency |
| **PTA*-fertilizer** | Low | 65 | PTA-breed | Low | 69 |
| | Medium | 63 | | Medium | 65 |
| | High | 72 | | High | 66 |
| **PTA-spot** | Low | 67 | PTA-housing | Low | 67 |
| | Medium | 73 | | Medium | 67 |
| | High | 60 | | High | 66 |
| **PTA-seed** | Low | 66 | PTA-medical | Low | 63 |
| | Medium | 64 | | Medium | 67 |
| | High | 70 | | High | 70 |
| **PTA-line planting** | Low | 71 | PTA-feed | Low | 56 |
| | Medium | 60 | | Medium | 75 |
| | High | 69 | | High | 69 |

* PCE=Perceived current efficiency, NT=Need tension, NC=Need compatibility, PTA=perceived total attributes

### 3.4.3 The dependent variables

Extension interventions are normally evaluated or focused on the adoption behavior regarding recommended practices for optimizing sustainable production and thus the resulting outcome in terms of physical (e.g., yield) and economic (e.g., profit) success. Adoption or use of recommended practices and production efficiency as measured by the yield of each of the respondents harvested during the previous season were, therefore, the major dependent variables considered in this study.

Based on the deviation of their score from the mean of the total adoption and efficiency score, participants were classified into two, three or four adoption and efficiency categories, i.e. maize farmers were classified into four adoption (non, low, medium and high) and five efficiency (least efficient to most efficient) categories while dairy farmers were classified into three adoption and five efficiency classes (Table 3.3).

**Table 3.3 Categorization of maize and dairy farmers according to dependent variables**

| Maize Farming | | | Dairy Farming | | |
|---|---|---|---|---|---|
| Variable | Category* | Frequency | Variable | Category | Frequency |
| **Efficiency** | 1 | 41 | **Efficiency** | 1 | 35 |
| | 2 | 24 | | 2 | 41 |
| | 3 | 43 | | 3 | 48 |
| | 4 | 54 | | 4 | 40 |
| | 5 | 38 | | 5 | 36 |
| **Adoption (Package)** | None | 47 | **Adoption (Package)** | Low | 60 |
| | Low | 49 | | Medium | 69 |
| | Medium | 47 | | High | 71 |
| | High | 57 | | | |
| **Row planting** | None | 20 | **Breed** | Medium | 37 |
| | Low | 84 | | High | 163 |
| | Medium | 61 | | | |
| | High | 35 | | | |
| **Seed** | None | 102 | **Housing** | Low | 58 |
| | Low | 27 | | Medium | 72 |
| | High | 71 | | High | 70 |
| **Fertilizer** | None | 47 | **Feed practice** | Low | 85 |
| | Low | 61 | | Medium | 44 |
| | High | 92 | | High | 71 |
| **Spot application** | None | 57 | **Medical practice** | Low | 62 |
| | Low | 78 | | Medium | 52 |
| | High | 65 | | High | 86 |

*1=Least efficient, 5=Most efficient

## 3.5 STATISTICAL ANALYSIS

The analysis of data involved the use of statistical package for social sciences (SPSS$^x$ version 9). Before analysis, the data was put in a computer readable format which involved coding (making sure that numbers are assigned to each variable and that the labels are correctly measured either at the interval, ordinal or nominal levels), editing (checking the questionnaire repeatedly as complete and error free as possible), data cleansing (running frequency tables and inspect the outputs to check if mistakes were made during entry) and finally modifications regarding the collapse or creation of new variables.

The principal techniques employed for data analysis included: a) frequency distribution together with the use of graphic displays, tables and charts to illustrate data and facilitate analysis b) correlation analysis such as Pearson's product moment correlation, Spearman's correlation, none parametric tests, Chi square ($\chi^2$) test, t-test and one way analysis of variance (ANOVA) to test significance of the differences between two or more independent groups respectively and c) multiple and hierarchical regression analysis to assess the contributions of independent and intervening variables on the dependent variables.

### 3.5.1 Frequency distribution and graphic analysis

Frequency distributions and some graphical techniques like the histograms, bar charts and line graphs were used to summarize large amounts of information, for example yield, and facilitate presentation and analysis of data and the respective findings.

### 3.5.2 Correlation analysis and significant tests

Bivariate correlation analysis, a contingency table analysis procedure and mean comparison methods (independent samples t-test and one way ANOVA) were employed to compute the Pearson product moment correlation coefficient, the $\chi^2$ and the F values respectively depending on the nature of the variable under investigation. The aim has been to assess the existence and magnitude of associations between the independent and the dependent variables and identify the appropriate variables that could be included for further analyses and test the existence of significant difference between the various statistical groups.

### 3.5.3 Multiple regression analysis

Multiple regression analysis (ordinary list squares) is a statistical technique that can be used to analyze relationships between a single dependent (criterion) variable and several independent (predictor) variables with the object of using the independent variables whose values are known to predict the single dependent value (Hair *et al,* 1998: 148). Standard and hierarchical multiple regression analysis procedures were employed for testing relationships hypothesized in this study and make comparisons between the effects of the set of independent and intervening variables on the criterion variable. Path analyses were also employed in some cases based on regressed values to determine indirect effects.

According to Tabachnick and Fidell (2001:111), the regression equation takes the form:

$\grave{y} = A+B_1X_1+B_2X_2+\ldots+B_kX_{ky}$

Where $\grave{y}$ is the predicted value on the dependent variable, A is the Y intercept, the Xs represent the various independent variables (of which there are k), and the Bs are the coefficients assigned to each of the independent variables during regression.

According to Field (200:127), for a regression model to be valid it has to be ensured that the underlying assumptions have been met so that the likelihood of similarity between population parameters and results of the sample model will be high. The test should be conducted both in univariate and multivariate analyses. Testing for the assumptions of univariate analysis involves obtaining descriptive statistics such as the mean, standard deviation, range, skewness and kurtosis to see the normality of the distribution of scores and the absence of outliers.

Preliminary analyses were made to check for the aforesaid two assumptions. Analyses of the distribution of scores (skewness and kurtosis) on the independent, intervening and dependent variables both in maize and dairy farmers showed that there is no serious violation of the assumption of normality. Although the skewness and kurtosis values of some variables tended a little above 1 and below –1, the fact that the sample size, both for the dairy and maize farmers, is quite large, reduces the effects of peaked and unsymmetrical distribution on model results. According to Tabachnick & Fidell, (2001:74) with reasonably large samples (200 or more cases), skewness and kurtosis will not make a substantive difference in the analysis.

Univariate outliers are observations with a unique combination of characteristics identifiable as distinctly different from other observations (Hair *et al,* 1998:64). Descriptive statistics showed that the five percent trimmed mean is lower than the mean for need compatibility regarding production efficiency in the cases of both the two commodities. The box plot analysis also produced similar results. This observation was, however, retained for further analyses after revaluating it to a lesser extreme value as suggested by Hair, *et al,* (1998:66) and Pallant (2001:62).

With multivariate analyses, the existence of a high pair-wise correlation (in excess of 0.8) among regressors indicates a serious degree of multicollinearity (Gujarati, 2003:359). By multicollinearity, is meant that it may not be possible to tell the difference of one independent variable free from the influence of the other independent variables with which it is correlated (Bernard, 2000: 632). Most obvious means of identifying collinearity is an examination of the correlation matrix of the independent variables (Hair *et al,* 1998:191). Tabachnick & Fidell (2001:84) suggest the omission of one of two variables if they are found to have a bivariate correlation of more than 0.7. Farming experience and literacy were accordingly omitted from adoption and efficiency models of maize farmers whereas their respective covariance age and education were retained. In dairy, only literacy was omitted for purposes of multicollinearity problem (Tables 3.4 and 3.5 below). As illustrated in Table 3.4, in maize, the correlation between literacy and education is 0.939, while the correlation value of age and farming experience is 0.913. In the same way Table 3.4 illustrates that in dairy the variable literacy has a bivariate correlation value of 0.854 with education.

Concerning psychological factors, the causal variables need compatibility relating to seed is found to be multicollinear with need compatibility of fertilizer rate and spot application. Need compatibility relating to line planting is also multicollinear with need compatibility of seed, fertilizer, and spot application (Table 3.6). The variable need compatibility of fertilizer rate is, therefore, the one considered in the regression analysis. There was no multicollinearity problem concerning the intervening factors regarding dairy farming.

**Table 3.4 The correlation matrix of independent variables affecting the production efficiency of maize growers**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Ecology | 1.000 | | | | | | | | | |
| 2 Age | -.194 | 1.000 | | | | | | | | |
| 3 Education | .060 | -.534 | 1.000 | | | | | | | |
| 4 Literacy | .024 | -.555 | .939* | 1.000 | | | | | | |
| 5 Farm size | -.565 | .115 | -.078 | -.061 | 1.000 | | | | | |
| 6 Experience | -.161 | .913* | -.514 | -.543 | .097 | 1.000 | | | | |
| 7 Agent contact | .060 | -.004 | .111 | .132 | -.159 | -.015 | 1.000 | | | |
| 8 Media | .183 | -.333 | .509 | .509 | -.199 | -.37 | .368 | 1.000 | | |
| 9 Modernity | -.039 | -.210 | .414 | .403 | -.171 | -.212 | .414 | .495 | 1.000 | |
| 10 Efficiency | .244 | -.300 | .349 | .359 | .023 | -.284 | -.018 | .336 | .05 | 1.000 |

*=Multicollinear

**Table 3.5 The correlation matrix of independent variables affecting the production efficiency of dairy farmers**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 Age | 1.000 | | | | | | | | |
| 2 Education | -.196 | 1.000 | | | | | | | |
| 3 Literacy | .214 | .854* | 1.000 | | | | | | |
| 4 Gender | -.096 | .319 | .354 | 1.000 | | | | | |
| 5 Farm size | .172 | .07 | .083 | .008 | 1.000 | | | | |
| 6 Experience | .314 | -.195 | -.129 | -.155 | .154 | 1.000 | | | |
| 7 Media | -.166 | .456 | .451 | .217 | -.020 | .024 | 1.000 | | |
| 8 Modernity | -.204 | .541 | .473 | .227 | .041 | -.294 | .203 | 1.000 | |
| 9 Efficiency | .158 | .265 | .228 | .032 | .324 | .042 | .023 | .177 | 1.000 |

*=Multicollinear

**Tale 3.6 Inter correlations of intervening factors affecting production efficiency (Maize)**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 PCE*-Efficiency | 1.000 | | | | | | | | | | | | | | | | | | |
| 2 NT*-Efficiency | -.508 | 1.000 | | | | | | | | | | | | | | | | | |
| 3 PTA*-fertilizer | .067 | -.233 | 1.000 | | | | | | | | | | | | | | | | |
| 4 PTA-spot application | .059 | -.038 | -.104 | 1.000 | | | | | | | | | | | | | | | |
| 5 PCE-seed | -.120 | .051 | .220 | .120 | 1.000 | | | | | | | | | | | | | | |
| 6 PTA-line planting | .132 | -.071 | -.190 | .632 | -.110 | 1.000 | | | | | | | | | | | | | |
| 7 PCE-Fertilizer | -.065 | .110 | .122 | -.422 | -.119 | -.312 | 1.000 | | | | | | | | | | | | |
| 8 PCE-spot application | -.107 | .149 | -.005 | -.484 | -.060 | -.363 | .342 | 1.000 | | | | | | | | | | | |
| 9 PCE-Seed | -.076 | .091 | .031 | -.218 | -.004 | -.210 | .384 | .269 | 1.000 | | | | | | | | | | |
| 10 PCE-line planting | -.020 | .044 | .087 | -.302 | -.108 | -.178 | .258 | .343 | .189 | 1.000 | | | | | | | | | |
| 11 NT-Fertilizer | -.095 | .469 | -.018 | -.096 | -.014 | -.133 | .046 | .165 | .159 | .123 | 1.000 | | | | | | | | |
| 12 NT-spot application | .031 | .177 | .139 | .004 | .056 | .010 | .075 | -.137 | .232 | .011 | .606 | 1.000 | | | | | | | |
| 13 NT-seed | -.091 | .329 | .155 | -.236 | -.062 | -.261 | .309 | .083 | .183 | .101 | .559 | .442 | 1.000 | | | | | | |
| 14 NT-line planting | -.257 | .425 | -.188 | .247 | .128 | .125 | -.132 | .036 | -.174 | -.177 | .251 | .080 | .080 | 1.000 | | | | | |
| 15 NC*-fertilizer | -.076 | -.277 | -.087 | -.109 | .043 | -.003 | -.094 | .040 | -.106 | -.009 | -.416 | -.414 | -.463 | -.131 | 1.000 | | | | |
| 16 NC-spot application | -.087 | -.332 | -.107 | -.039 | .080 | .034 | -.131 | -.043 | -.170 | -.035 | -.610 | -.463 | -.495 | -.117 | .896* | 1.000 | | | |
| 17 NC-seed | -.092 | -.320 | -.061 | -.090 | .077 | -.022 | -.066 | -.039 | -.120 | -.017 | -.581 | -.438 | -.356 | -.134 | .880* | .971* | 1.000 | | |
| 18 NC-line planting | -.115 | -.268 | -.162 | .013 | .079 | .064 | -.150 | -.029 | -.210 | -.031 | -.649 | -.584 | -.552 | -.059 | .856$^{\$}$ | .960$^{\$}$ | .926$^{\$}$ | 1.000 | |
| 19 Adoption package | .110 | -.348 | -.155 | .144 | .044 | .180 | -.282 | -.125 | -.338 | -.136 | -.785 | -.738 | -.747 | -.157 | .563 | .677 | .590 | .754 | 1.000 |

*PCE=Perceived current efficiency, NT=Need tension, NC=Need compatibility, PTA=Perceived total attributes

Multivariate assumptions of normality, homoscedasticity, linearity and absence of outliers can be checked from the standardized residual scatter and normal probability plots, which are generated as part of the multiple regression procedure (Pallant, 2001:137). Both the normal probability and the scatter plot yielded a reasonably straight diagonal line with roughly rectangularly distributed residuals for all of the four maize and dairy behavior models except for the dairy efficiency model, which shows a little deviation. This suggests that there is no serious violation concerning the assumption of normality and linearity. Homoscedasticity refers to the assumption that dependent variables exhibit equal level of variance across the range of predictor variables (Hair, et al, 1998:73). Uniform diagonal distribution of sample data over the scatter plot for both dairy and maize farmers' adoption and efficiency models revealed that homoscedasticity is not a cause for concern.

Multivariate outliers are observations with a unique combination of characteristics identifiable as distinctly different from other observations (Hair, *et al,* 1998:64). Tabachnick & Fidell (2001:122) maintain that outliers are cases that have a standardized residual value of more than 3.3 or less than –3.3. The distribution of the values of residuals in all the developed behavior change models ranges between 3 and –3, most of them falling between 2 and -2. This suggests that the assumption is not broken in any way.

# CHAPTER4

# PRODUCTION EFFICIENCY AND THE ADOPTION BEHAVIOR OF MAIZE AND DAIRY FARMERS

## 4.1 INTRODUCTION

As conceptual basis for this study, Düvel's behavior analysis model (1987:91) was selected. Its assumed behavior determinants are associated with Lewin's (1951) forces of behavior, but to test or establish their influence, it is essential to first assess the relationship regarding the current production efficiency and the causal behavior or practice adoption. This chapter, therefore, tries to evaluate the current production efficiency and assess the difference in the level of technology use among the various efficiency classes of program participant maize and dairy farmers.

## 4.2 CURRENT PRODUCTION EFFICIENCY

Successes or failures of extension programs are more often than not assessed by their ultimate outcome or efficiency, which is generally measured in terms of physical (e.g., yield) and/or economical (e.g., profit) indicators. Yield per production unit was used as criteria for evaluating the efficiency of both the maize and dairy farming.

As reported by the respondents themselves, their productivity ranges from a minimum of 0.8 to a maximum of 6 tons per hectare and from 4 to 16 liter per cow. The mode is 4 tons and 10 liters (Fig. 4.1 & 4.2). The productivity of the majority of maize farmers (77.5 percent) falls below the mode with very few farmers achieving higher yields while dairy farmers are relatively evenly distributed across all productivity levels. The mean yield is 3.49 tons per hectare and 10.2 liters per cow, respectively (Table 4.1).

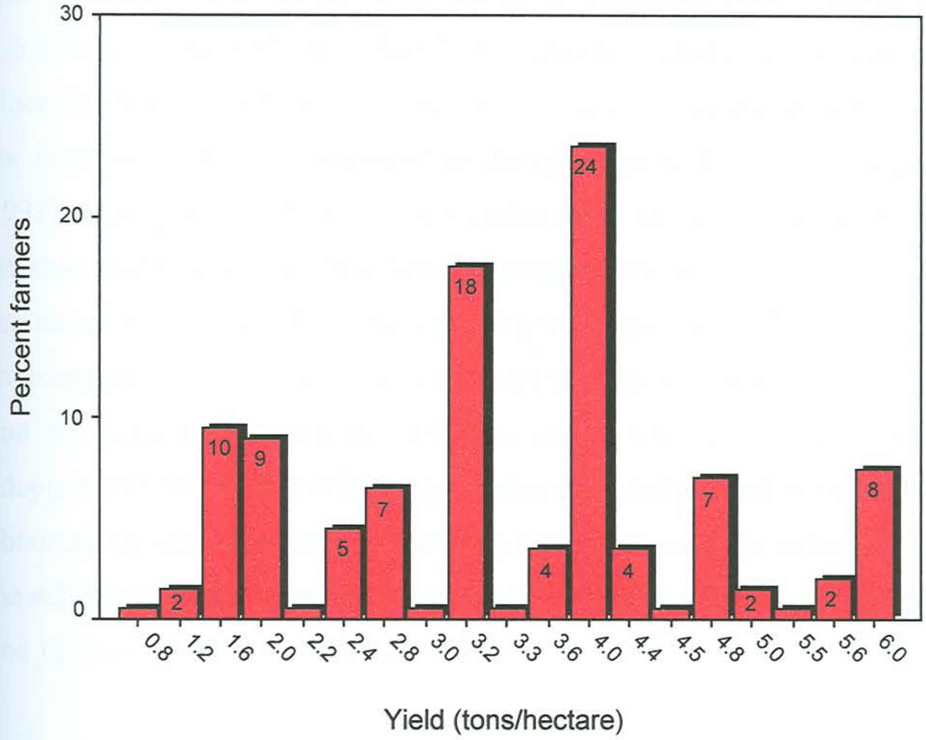


**Fig. 4.1** **Percentage distribution of maize farmers according to production efficiency**

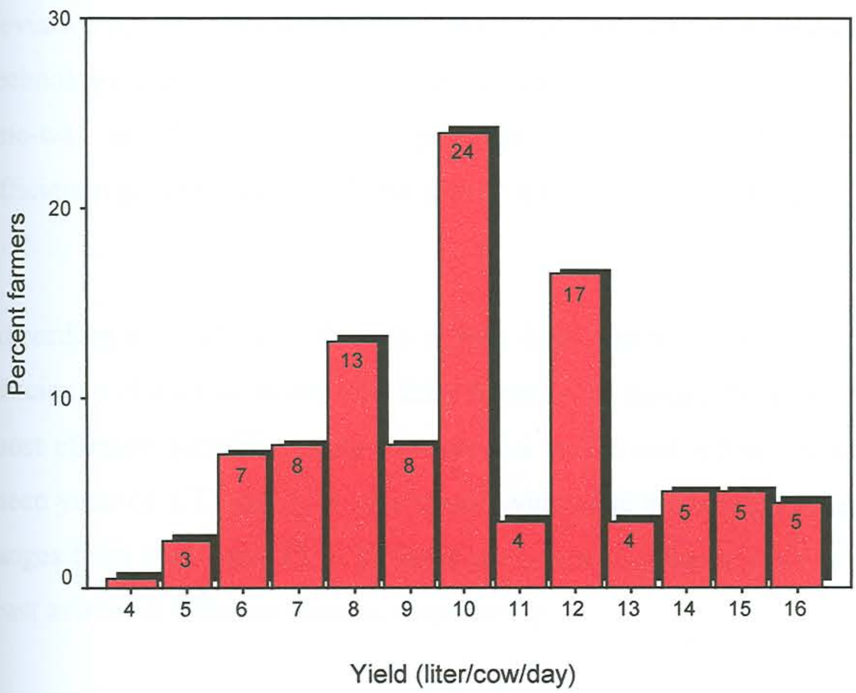


**Fig. 4.2** **Percentage distribution of dairy farmers according to production efficiency**

The yield level of maize farmers is very high compared to the national maize average of 1.6 tons per hectare (CSA, 1996/97). It is also suspected that yield can be underestimated since maize is consumed in the area while still green. However, there is still much room for improvement when compared to the optimum yield of 12 tons per hectare (MoA, 1998). This yield is, however, achievable only by using the complete recommended package and in areas like Shashemene (project area) where the agro ecology is favorable for maize production. The reasons for low yields obtained by maize farmers will be investigated in the following section where the focus is on adoption levels. Chapters five and six, which deal with the influence of the situational and intervening factors on adoption and production efficiency are also expected to shed some light on the low yield obtained. On the other hand, the average for dairy farmers is within the expected range as the achievable yield from full adoption of the recommended dairy package is between 10 and 12 liters per cow per day (MoA, 1998).

The initial step of assessing relationships between variables is to see the variability of data. If a variable has no variability, its influence cannot be assessed (Bernard, 200: 505). Maize and dairy farmers were categorized into five efficiency classes based on the deviation of their score from the overall mean yield to critically assess their variation in technology use and production efficiency as indicated in sections 4.3 and 4.4 below. A one-way analysis of variance procedure was employed to compare the different efficiency groups and to evaluate if they are statistically different from each other (Table 4.1).

According to Table 4.1, there is a very high variability in yield between the different efficiency classes of maize and dairy farmers. In maize, the productivity of the least and most efficient farmers ranges between 0.8 to 2.0 and 4.5 to 6.0 tons per hectare with a mean yield of 1.73 and 5.38 tons respectively. The production efficiency of dairy farmers ranges from 4 to 7 and 13 to 16 liters per cow with a mean yield of 6.23 and 14.58 for the least and most efficient farmers respectively.

**Table 4.1 Efficiency categories of maize and dairy farmers**

| Commodity | Category | N | Yield/unit | Mean ± SED | Std. error | F | P |
|---|---|---|---|---|---|---|---|
| Dairy | 1 | 35 | 4.0-7.0 | 6.23±0.81 | 0.14 | 928 | 0.000 |
| | 2 | 41 | 8.0-9.0 | 8.37±0.49 | 0.01 | | |
| | 3 | 48 | 10.0 | 10.0 | 0.0 | | |
| | 4 | 40 | 11.0-12.0 | 11.83±0.38 | 0.01 | | |
| | 5 | 36 | 13.0-16.0 | 14.58±1.02 | 0.18 | | |
| | Total | 200 | 4.0-16.0 | 10.19±2.80 | 0.20 | | |
| Maize | 1 | 41 | 0.8-2.0 | 1.73±0.29 | 0.45 | 800 | 0.000 |
| | 2 | 24 | 2.2-3.0 | 2.63±0.23 | 0.46 | | |
| | 3 | 43 | 3.2-3.6 | 3.27±0.15 | 0.23 | | |
| | 4 | 54 | 4.0-4.4 | 4.06±0.14 | 0.18 | | |
| | 5 | 38 | 4.5-6.0 | 5.38±0.57 | 0.91 | | |
| | Total | 200 | 0.8-6.0 | 3.49±1.26 | 0.89 | | |

(1 = Least efficient, 5 = Most efficient)

## 4.3 INFLUENCE OF ADOPTION OF RECOMMENDED MAIZE PRODUCTION PRACTICES ON EFFICIENCY

As it was indicated in Chapter 1, PADETES is involved in promoting technology packages formulated for each commodity or enterprise. The basic components of the current technical package for cereals include recommendations for fertilizers and seeds along with the use of complimentary management practices (Kiflu, 1995:21).

In this section of the thesis, the level of adoption of maize farmers will be evaluated against the five efficiency classes in order to see the differences between them and thereby determine the relationship between adoption and production efficiency.

### 4.3.1 Influence of fertilizer use on production efficiency

#### a) Fertilizer type

The two commonly used fertilizers in Ethiopia are diamonium phosphate (DAP) having 46 percent of phosphorus and 18 percent nitrogen and a nitrogenous fertilizer (urea) containing 46 percent nitrogen. In total while 76.5 percent of all farmers use fertilizer, 62 percent use the recommended types. The differences between efficiency classes of maize farmers regarding the type of fertilizer use are highly significant ($\chi^2 = 158$, df = 8, p = 0.000). The difference lies in the fact that with increasing efficiency there is a tendency to use more fertilizer and more of the recommended fertilizer type. For example, in the lowest efficiency category only 4.9 percent of the farmers use both DAP and urea (Table 4.2). This percentage increases in an almost linear fashion to 94.7 percent in the most efficient category. This clear relationship or positive relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.63, p= 0 .000).

#### b) Fertilizer rate

Though fertilizer rate recommendations vary from place to place depending on the agro ecology and the soil type, the recommended rate advised by PADETES for the Shashemene area is to use 100 kg of each of DAP and urea.

In total 46 percent of survey farmers apply the recommended rate of fertilizer. The differences between efficiency groups in their rate of fertilizer application are highly significant ($\chi^2 = 161.4$, df = 12, p = 0. 000). The difference lies in the fact that with increasing efficiency there is a tendency to use more fertilizer or the recommended rate of fertilizer. For example, not a single farmer uses the recommended rate of fertilizer in the least efficiency category. The number of farmers applying the recommended rate increases with increasing efficiency to 73.7 percent in the most efficient category. Similarly while 87.8 percent of the least efficient farmers do not use fertilizer, not a single farmer from the most efficient category of maize farmers uses any fertilizer at all. This clear relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.52, p = 0.000), thereby supporting Hypothesis 1, namely that adoption of the recommended fertilization practice is directly correlated with higher production efficiency.

**Table 4.2 Relationships between fertilizer adoption and production efficiency as reflected in percentage distributions and a test of association**

| Practice | Percentage distribution of farmers per efficiency class* 1 n=41 | 2 n=24 | 3 n=43 | 4 n=54 | 5 n=38 | Total N=200 | $\chi^2$ Value | p | Cramer's V Value | p | df |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **a. Type** | | | | | | | | | | | |
| Non | 87.8 | 41.7 | - | 1.9 | - | 23.5 | | | | | |
| DAP | 7.3 | 33.3 | 23.3 | 11.1 | 5.3 | 14.5 | | | | | |
| Both | 4.9 | 25 | 76.7 | 87 | 94.7 | 62 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 158 | 0.000 | 0.63 | 0.000 | 8 |
| **b. Rate** | | | | | | | | | | | |
| Nil | 87.8 | 41.7 | - | 1.9 | - | 23.5 | | | | | |
| <= 100 kg of one | 7.3 | 33.3 | 23.3 | 11.1 | 5.3 | 14.5 | | | | | |
| 50-100 kg each | 4.9 | - | 16.3 | 27.8 | 21.1 | 16 | | | | | |
| 100 kg each | - | 25 | 60.5 | 59.3 | 73.7 | 46 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 161 | 0.000 | 0.52 | 0.000 | 12 |
| **c. Measurement** | | | | | | | | | | | |
| Drill | 92.7 | 70.8 | 30.2 | 27.8 | 10.5 | 43.5 | | | | | |
| Estimation | 7.3 | 29.2 | 69.8 | 72.2 | 89.5 | 56.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 73 | 0.000 | 0.6 | 0.000 | 4 |
| **d. Method** | | | | | | | | | | | |
| Nil | 90.2 | 45.8 | 9.3 | 9.3 | - | 28.5 | | | | | |
| With seed | 9.8 | 37.5 | 53.5 | 40.7 | 47.7 | 38 | | | | | |
| Besides seed | - | 16.7 | 37.2 | 50 | 52.6 | 33.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 118 | 0.000 | 0.54 | 0.000 | 8 |

*1 = least efficient, 5 = Most efficient

### c) Fertilizer measurement

When farmers decide to apply fertilizer to their fields, they are at first advised to learn how they can apply the exact recommended amount of fertilizer per spot or hill. The recommended amount is to apply 4 gram per spot, using a coca cola cup. Other time, when they become skillful and get adapted with the application of this recommended amount, they are advised to move on to the use of the next more timesaving technique, namely judging or estimating the amount.

In general, while 43.5 percent of program participant farmers do not currently use fertilizer at all or drill, the majority (56.5 percent) uses the recommended measurement technique i.e. apply their skill in estimating the recommended amount (Table 4.2). Regarding the relationship of adoption of fertilizer measurement and production efficiency, the differences between the various efficiency classes in terms of their fertilizer estimation technique are highly significant ($\chi^2 = 73$, df = 4, p = 0.000). Again there is a clear and highly significant linear relationship between the fertilizer measurement technique and production efficiency (Cramer's V = 0.60, p = 0.000) thereby providing further evidence in support of Hypothesis 1. This relationship is also evident from the fact that 92.9 percent of the least efficient farmers use no fertilizer at all or drills while amongst the most efficient farmers; only 10.5 percent use this technique. The opposite tendency is evident in the use of the recommended estimation technique. In the lowest efficiency category only 7.3 percent apply the recommended technique. This percentage increases in an almost linear fashion with increasing efficiency to 89.5 percent in the most efficient production category.

**d) Fertilizer placement**

The recommended method is to place the recommended amount of fertilizer beside the seed in such a way that the fertilizer and the seed do not come in contact.

In general, the method of fertilization placement by maize farmers was not in accord to the recommended one. The great majority (71.5 percent) of farmers either do not apply fertilizer at all or they apply it together with the seed. As far as the relationship of the use of recommended method of fertilizer placement and production efficiency is concerned, there are significant differences between the various efficiency classes ($\chi^2 = 118$, df = 8, p = 0.000). The difference lies in the fact that with increasing efficiency there is a tendency of using the correct method of fertilizer placement. None of the farmers in the lowest efficiency category use the current or recommended fertilizer placement method. The percentage of farmers applying the recommended technique increases with increasing efficiency to as high as 52.6 in the most efficient category. This significant linear relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.54, p = 0.000) providing further evidence in support of Hypothesis 1.

### 4.3.2 Influence of improved seed on production efficiency

#### a) Variety

Farmers have the option to use either or a combination of the recommended open pollinated varieties (e.g., A511, Beletech[2]), or the high yielding hybrids such as BH-660, BH-540, CG-4141, and PHB-3253. Most of the hybrids are the products of the National Research Organization (EARO) and are distributed through the Ethiopian Seed Enterprise. Only PHB-3253 is produced and marketed by a private seed company (Pioneer hybrid Seed Co.).

51 percent of the respondents do not use improved seed at all. Of the remaining percentage, the great majority (33 percent) of the farmers use the product of Pioneer Seed Co., PHB-3253, while the number of farmers who use other varieties (products of government seed agency) is only 16 percent (Table 4.3) despite the fact that the seed price of the private seed company is almost twice as high as that of the government. This is probably due to better marketing services provided by the private company compared

[2] = Presently out of production

to the government agency, which is known for its extended bureaucratic administration in seed marketing.

**Table 4.3 Relationships between adoption of seed practices and production efficiency as reflected in percentage distributions and a test of association**

| Practice | Percentage distribution of farmers per efficiency class* 1 n=41 | 2 n=24 | 3 n=43 | 4 n=54 | 5 n=38 | Total N=200 | $\chi^2$ Value | P | Cramer's V Value | P | df |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **a. Variety** | | | | | | | | | | | |
| Local | 100 | 70.8 | 53.5 | 29.6 | 10.5 | 50.5 | | | | | |
| Others | - | 25.0 | 11.6 | 24.1 | 21.1 | 16 | | | | | |
| PHB-3253 | - | 4.2 | 34.9 | 46.3 | 68.4 | 33.5 | | | | | |
| Total | 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100 | 86.0 | 0.000 | 0.46 | 0.000 | 8 |
| **b. Area coverage** | | | | | | | | | | | |
| Nil | 100 | 75.0 | 53.5 | 29.6 | 10.5 | 51 | | | | | |
| 50-75 percent | - | 16.7 | 11.6 | 11.1 | 13.2 | 10 | | | | | |
| >75 percent | - | 8.3 | 34.9 | 59.3 | 76.3 | 39 | | | | | |
| Total | 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100 | 86.0 | 0.000 | 0.66 | 0.000 | 8 |
| **c. Source of seed** | | | | | | | | | | | |
| Local | 100 | 79.2 | 62.8 | 44.4 | 18.4 | 59 | | | | | |
| Certified | - | 20.8 | 37.2 | 55.6 | 81.6 | 41 | | | | | |
| Total | 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100 | 63.4 | 0.000 | 0.56 | 0.000 | 4 |
| **d. Plant spacing** | | | | | | | | | | | |
| Broadcast | 87.8 | 79.2 | 44.2 | 42.6 | 23.7 | 53 | | | | | |
| 25 cm -1 seed/hill | 12.2 | 20.8 | 55.8 | 57.4 | 76.3 | 47 | | | | | |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100 | 43.3 | 0.000 | 0.47 | 0.000 | 4 |
| **e. Row spacing** | | | | | | | | | | | |
| <50cm-1 seed/hill | 95.1 | 91.7 | 81.4 | 74.1 | 65.8 | 80.5 | | | | | |
| 50-80 cm-2 seeds/hill | 4.9 | 8.3 | 18.6 | 25.9 | 34.2 | 19.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100.0 | 14.7 | 0.007 | 0.27 | 0.000 | 4 |
| **f. Measurement** | | | | | | | | | | | |
| Stick | 14.6 | 4.2 | 2.3 | - | 2.6 | 4.5 | | | | | |
| Foot steps | 85.4 | 95.8 | 97.7 | 100.0 | 97.4 | 95.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | - | - | - | - | - |

* 1 = Least efficient, 5 = Most efficient

According to information obtained from farmers and frontline extension workers during the field survey, which fortunately coincided with the planting time of maize, farmers effectively had only two options, either to plant their own seed or to buy the relatively more expensive PHB-3253 seed. Although maize varieties delivered by the government seed enterprise (A511, BH-660, BH-140, and BH-540) are cheaper in price, they were not available at planting. The extension workers, who are the delegates of the seed enterprise in delivering seeds at the local community levels, were busy working on other issues like the collection of credit repayments for the previous season instead of facilitating seed delivery which, was a burning issue at that time. The second most popular hybrid, BH-660, was grown by 8.5 percent of the respondents.

In general, 49.5 percent of the respondents use improved varieties. As far as the relationships between adoption of improved variety and the production efficiency of maize farmers are concerned, efficient farmers use improved seed than less efficient farmers ($\chi^2$ = 86.1, df = 8, p = 0.000) (Table 4.3). The difference between efficiency groups lies in the fact that with increasing efficiency the percentage of farmers using improved variety tends to increase. For example, while none of the least efficient farmers use improved variety, the percentage of farmers using improved variety increases in an almost linear fashion to as high as 89.5 percent in the most efficient category. This significant linear relationship is manifested in the highly significant Cramer's V value (Cramer's V = 0.46, p = 0.000) lending further evidence in support of Hypothesis 1.

### b) Area coverage by improved seed

When farmers lack the confidence of using a recommended variety, they tend to partition their plot and allocate only a portion of it for planting the new variety leaving the rest for local seed. At this stage extension reduces the suspicion by pushing further information or making credit available depending on the source of the problem encountered and encourage them to plant their entire maize plot with improved seed.

As far as the total farm area of maize growers planted with improved seed is concerned, in general, 49 percent of the farmers participating in the package program had planted their plot with improved seed. While 39 percent of the respondents had planted more than 75 percent of their plot, 10 percent of the respondents planted only 50 to 75 percent of their maize farm. The differences between the various efficiency classes are highly significant ($\chi^2 = 86$, df = 8, p = 0.000). The differences being that with increasing efficiency farmers tend to plant more land with improved seeds. For example, all of the farmers in the least efficient category plant more than 75 percent of their entire field with local seed. The number of farmers who had covered more than 75 percent of their field with improved seed increases with increasing efficiency in an almost linear fashion to 76.3 percent in the most efficient category. This clear and positive relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.46, p = 0.000) providing more evidence in support of Hypothesis 1.

**c) Source of seed**

When farmers decide to use improved variety, they are advised to use a certified seed. This becomes especially important regarding hybrids, where failure to follow recommendation will lead to a dramatic decline in yield. In general, 41 percent of respondent farmers use certified seed while the rest of the farmers use either an indigenous variety or own improved seed preserved from previous harvest. As far as the relationship between the source of seed of maize farmers and their production efficiency is concerned, there are significant differences between the various efficiency classes ($\chi^2 = 63.38$, df = 4, p = 0.000). The difference lies in the fact that with increasing efficiency the percentage of farmers using certified seed tends to increase. For example, none of the respondents in the lower efficiency category use certified seed (Table 4.3). The percentage of respondents using certified seed increases in an almost linear manner to 81.6 percent in the most efficiency category. This clear relationship is evident in the highly significant Cramer's V value (Cramer's V = 0.56, p = 0.000), lending further evidence in support of Hypothesis 1, namely that use of certified seed is significantly correlated with higher production efficiency.

### d) Plant spacing

Farmers are advised to plant their maize crop in line with a plant (intra row) and a inter row spacing of 50cm and 80cm, respectively. They are expected to plant 2 seeds per hill (spot).

In total, 47 percent of sample farmers follow the recommended plant spacing, namely planting in a row with plant spacing of 25cm-1 seed per hill. The rest of respondent farmers either broadcast or drill their seed. The differences between the various efficiency categories of maize farmers in applying the recommended plant spacing technique are highly significant ($\chi^2$ = 43.3, df = 4, p = 0.000). The difference lies in the fact that more farmers use the recommended plant spacing technique with increase in production efficiency. For example, in the lowest efficiency category only 12.2 percent of the farmers apply the recommended spacing. This percentage increases in an almost linear fashion to 76.3 percent in the highest efficiency category. This apparent relationship is also evident from the highly significant Cramer's V value (Cramer's V = 0 .46, p = 0.000) supporting the hypothesized relationship.

### e) Row spacing

The great majority of sample farmers (80.5 percent) either broadcast their seed or they plant it in a row with row spacing of less than 50cm-1 seed per hill. Only 19.5 percent of the respondents apply the recommended spacing. The differences between the various efficiency classes of maize growers in adoption of the recommended spacing are, however, statistically significant ($\chi^2$ = 14.7, df = 4, p = 0.007) though it is not as appreciable as the differences observed in the case of the rest of the practices discussed previously. The difference lies in the fact that with increasing production efficiency more farmers apply the recommended spacing. While only 4.9 percent of the least efficient farmers apply the recommended row spacing this percentage increases in an almost linear fashion with increasing efficiency to 34.2 percent in the most efficient category. These clear differences amongst the various efficiency classes together with a significantly higher correlation (Cramer's V = 0.27 p = 0.007) further validates the hypothesized association namely that adoption of row spacing practice is significantly related with production efficiency.

**f) Measurement**

Once farmers decide to plant their maize in line, the next problem towards implementing their decision has to do with measurement. They are, therefore, advised to use a 50 and 80 cm stick to keep the respective recommended plant and raw spacing at the initial stage. However, as this method is indeed very tiresome and tedious, they are pushed to move away from it and try the next best method, the use of footsteps. Once they have developed confidence on the use of these two methods, they are subsequently encouraged to use their own judgment as an alternative and best measurement scale.

The lack of normality in the distribution of scores does not allow successful assessment of the relationships. An indispensable measurement scale practiced by the entire maize farmers was the use of footsteps. While 95.5 percent of the respondents opted for this measurement technique, the percentage is obviously high both in the least efficiency (84.4 percent) and in the most efficiency (95.5 percent) categories. However, from the distribution, the fact that 14.6 percent of the least efficient farmers use the stick against only 4.5 percent of the most efficient farmers is an indication of a likely positive relationship.

In conclusion, the assessment indicates that there is a significant difference in the adoption behavior of the various efficiency categories of program participant maize growers regarding the nine out of the ten recommended maize technology practices in the Shashemene district. This together with the highly significant and positive association suggests that as far as production per unit area is concerned, the use of recommended practices is profitable. The finding disproves the claim that all program participant farmers are equally poor in their production efficiency and consequently have rejected or withdrawn form using the recommended practices. In addition, the fact that about 40 to 50 percent of respondent farmers have accepted and continued using them implies that the package-based extension program is successful, and leads to the conclusion that the negative claims associated with this program are unfounded.

## 4.4 INFLUENCE OF ADOPTION OF RECOMMENDED DAIRY PRODUCTION PRACTICES ON EFFICIENCY

The basic components of the current technical package for dairy production include, among other things, recommendations for breeds, improved housing or barn management practice, medical and different feeding recommendations (MoA, 1998).

Unlike maize farmers, the relationships between production efficiency and the adoption behavior of dairy farmers of ALWDADPMA are not found to be significant regarding all of the dairy production practices except breed. An assessment of the remaining three practices i.e. housing, feed and medical practices indicates that the use of these practices is almost similar between the least efficient and most efficient classes. The detail is provided as follows.

### 4.4.1 Influence of use of improved breeds on production efficiency

The general or blanket recommendation for livestock farmers in Ethiopia is to raise animals with an exotic blood level of 50 percent with a rationale of combining the best traits i.e. the production efficiency potential of exotic breeds with harsh environment survival ability of local breeds. It is customary, however, that in most commercial dairy farms (specialized private dairy farms, college farms, Government enterprises) to raise pure breed dairy animals usually Holstein Frisian.

The number of cross breed animas owned and their level of exotic blood are the two parameters considered in this study to evaluate the breed adoption behavior of dairy farmers.

Member farmers of ALWDDPMA are on the cross rod of transformation from a subsistence-small to a medium-commercial scale dairy farm. Inline with this, their level of adoption regarding improved breed animals in terms of both number and blood level is quite high compared to that of a common traditional small-scale dairy farmer.

### a) Number of cross breed animals

As far as the number of crossbred animals is concerned, the great majority (81.5 percent) of the respondents belong to the category where more than 75 percent of their animals are crossbreeds. There are also significant differences between the various efficiency categories of dairy farmers ($\chi^2 = 9.75$, df = 4, p = 0.045). The differences lie in the fact that with increasing efficiency there is a tendency to use more number of cross breed animals. For example, in the lowest efficiency category only 65.7 percent have a herd of more than 75 percent cross breed animals (Table 4.4). This percentage increases with increasing production efficiency in an almost linear trend to 91.7 percent in the most efficiency category. This clear relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.22, p = 0.05), which supports Hypothesis 1, namely that use of more number of cross breed animals is directly correlated with the production efficiency.

### b) Number of cross breed animals (more than 50 percent exotic blood level)

More than 75 percent of the herd of the great majority (80 percent) dairy farmers has an exotic blood level of more than 50 percent. There are again significant differences between the various efficiency categories in adopting crossbreed animals having more than 50 percent exotic blood ($\chi^2 = 8.09$, df = 4, p = 0.088). While more than 75 percent of the herd of only 68.6 percent of the least efficient dairy farmers have an exotic blood level of more than 50 percent, this figure increases to 94.4 percent in the most efficient groups indicating a linear positive relationship. This clear relationship is again manifested in the highly significant Cramer's V value (Cramer's V = 0.20, p = 0.09), which once again provides supportive evidence for the validity of the hypothesized relationship.

### c) Number of cross breed animals (more than 62.5 percent exotic blood level)

In general about the entire herd of 48.5 percent of the respondents has an exotic blood level of more than 62.5 percent. From the remaining percentage, 22.5 percent, 19.5 percent and 9.5 percent of the respondents, respectively own a herd where a quarter, a half or a three quarter of the animals have an exotic blood level of more than 62.5 percent (Table 4.4). There are again significant differences between the various efficiency categories of dairy farmers in adopting more than 62.5 percent exotic blood level animals ($\chi^2$ = 23.92, df = 12, p = 0.021). The difference lies in the fact that with increasing efficiency, there is a tendency to raise more crossbreed animals with more than 62.5 percent exotic blood in the herd. For example, the number of farmers with an entire herd having an exotic blood level of more than 62.5 percent in the lowest efficiency category is only 37.1 percent. This percentage increases gently or gradually to 48.5 percent in the most efficiency category. This relationship, although, not as strong as in the case of the former two breed practices, finds expression in the significantly higher Cramer's V value (Cramer's V = 0.20, p = 0.020), which supports Hypothesis 1.

**Table 4.4 Relationships between adoption of breeding practices and production efficiency as reflected in percentage distributions and a test of association**

| Practice | Percentage distribution of farmers per efficiency class* | | | | | | $\chi^2$ | | Cramer's V | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Total | Value | P | Value | P | df |
| | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 | | | | | |
| **a. Number of cross breeds** | | | | | | | | | | | |
| <75 | 34.3 | 22.0 | 12.5 | 17.5 | 8.3 | 18.5 | | | | | |
| > 75 | 65.7 | 78.0 | 87.5 | 82.5 | 91.7 | 81.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 9.75 | 0.045 | 0.22 | 0.05 | 4 |
| **b. Number of c. b (>50 percent exotic)** | | | | | | | | | | | |
| <75 percent | 31.4 | 24.4 | 18.8 | 20.0 | 5.6 | 20 | | | | | |
| >75 percent | 68.6 | 75.6 | 81.3 | 80.0 | 94.4 | 80 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 8.09 | 0.088 | 0.20 | 0.09 | 4 |
| **c. Number of c. b (>62.5 percent exotic)** | | | | | | | | | | | |
| 1/4 of heard | 45.7 | 17.1 | 22.9 | 17.5 | 11.1 | 22.5 | | | | | |
| Half | 5.7 | 26.8 | 29.2 | 12.5 | 19.4 | 19.5 | | | | | |
| 3/4 of heard | 11.4 | 9.8 | 4.2 | 12.5 | 11.1 | 9.5 | | | | | |
| About all | 37.1 | 46.3 | 43.8 | 57.5 | 58.3 | 48.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 23.92 | 0.021 | 0.20 | 0.02 | 12 |

*1= Least efficient, 5= Most efficient

## 4.4.2 Influence of improved housing practices on production efficiency

Significant differences are not found among the various efficiency categories of dairy farmers regarding all of the recommended housing practices (Table 4.5). There is, however an indication that farmers in the most efficient category use most of the recommended practices more than the least efficient farmers suggesting a positive relationship between adoption and production efficiency as expected (Hypothesis 1). Regarding the adoption of one of the housing practices, recommended floor type, for example, the majority of farmers (85 percent) have either a poor (52 percent) or moderate (33 percent) condition floor and only 15 percent have a good condition floor. But 62.9 percent of the least efficient farmers have a poor condition floor while the number of the most efficient farmers with poor condition floor is only 44.4 percent. The relationship, however, is not significant ($\chi^2$ = 5.79, df = 8, p = 0.067; Cramer's V= 0.12, P = 0.670).

**Table 4.5 Relationship between adoption of housing practices and production efficiency as reflected in percentage distributions and a test of association**

| Practice | Percentage distribution of farmers per efficiency class* 1 n=35 | 2 n=41 | 3 n=48 | 4 n=40 | 5 n=36 | Total N=200 | $\chi^2$ Value | P | Cramer's V Value | P | df |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **a. Condition of feed trough** | | | | | | | | | | | |
| No | 14.3 | 9.8 | 12.5 | 17.5 | 16.7 | 14.0 | | | | | |
| Poor | 45.7 | 43.9 | 47.9 | 40.0 | 25.0 | 41.0 | | | | | |
| Moderate | 22.9 | 29.3 | 22.9 | 22.5 | 47.2 | 28.5 | | | | | |
| Good | 17.1 | 17.1 | 16.7 | 20.0 | 11.1 | 16.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 11.03 | 0.526 | 0.14 | 0.526 | 12 |
| **b. Condition of gutter** | | | | | | | | | | | |
| No | 20.0 | 7.3 | 18.8 | 20.0 | 11.1 | 15.5 | | | | | |
| Poor | 51.4 | 56.1 | 43.8 | 47.5 | 50.0 | 49.5 | | | | | |
| Moderate | 28.6 | 36.6 | 37.5 | 32.5 | 38.9 | 35.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 5.02 | 0.755 | 0.11 | 0.755 | 8 |
| **c. Condition of floor** | | | | | | | | | | | |
| Poor | 62.9 | 41.5 | 56.3 | 55.0 | 44.4 | 52.0 | | | | | |
| Moderate | 25.7 | 39.0 | 31.3 | 27.5 | 41.7 | 33.0 | | | | | |
| Good | 11.4 | 19.5 | 12.5 | 17.5 | 13.9 | 15.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 5.79 | 0.67 | 0.12 | 0.670 | 8 |
| **d. Condition of roof & side wall** | | | | | | | | | | | |
| Poor | 51.4 | 41.5 | 52.1 | 57.5 | 52.8 | 51.0 | | | | | |
| Moderate | 31.4 | 36.6 | 35.4 | 32.5 | 38.9 | 35.0 | | | | | |
| Good | 17.1 | 22.0 | 12.5 | 10.0 | 8.3 | 14.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 4.99 | 0.764 | 0.11 | 0.764 | 8 |
| **e. Stall partition** | | | | | | | | | | | |
| No | 77.1 | 65.9 | 58.3 | 67.5 | 63.9 | 66.0 | | | | | |
| Poor | 17.1 | 19.5 | 22.9 | 20.0 | 27.8 | 21.5 | | | | | |
| Moderate | 5.7 | 14.6 | 18.8 | 12.5 | 8.3 | 12.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 5.69 | 0.682 | 0.12 | 0.682 | 8 |

*1= Least efficient, 5= Most efficient

### 4.4.3 Influence of recommended feed practices on production efficiency

The three major feed practices recommended for dairy herders, on top of the natural pasture and hay, are the use of industrial byproducts, products of feed processing plants and forage legumes (Table 4.6). The feed supply status of dairy farmers of ALWDADPMA is far below the recommended level both in the case of the most efficient and least efficient dairy farmers suggesting insignificant relationship between adoption of recommended feed practices and production efficiency. Many farmers feed their animals only with some of the recommended feed types or if they feed all of the recommended feed types, the supply is not regular. Although the relationship is not significant, the distribution indicates a positive relationship between adoption of recommended feed practices and production efficiency as expected.

Regarding the use of recommended forage legumes for example, 61 percent of all herders do not feed their animals with forage legumes at all. Only 12 percent of them feed regularly but with only some of the forage legumes recommended. The fact that 11.1 percent of the most efficient dairy farmers regularly feed their herd with the recommended forage legumes against only 5.7 percent of the least efficient ones suggests a likely positive relationship. The relationship is not, however, statistically significant ($\chi^2$ = 13.91, df = 8, p = 0.084; Cramer's V= 0.19, P = 0.084).

**Table 4.6 Relationships between adoption of feed practices and production efficiency as reflected in percentage distributions and a test of association**

| | Percentage distribution of farmers per efficiency class* | | | | | | $\chi^2$ | | Cramer's V | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Total | Value | P | Value | P | |
| **Practice** | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 | | | | | **df** |
| **a. Industrial byproducts** | | | | | | | | | | | |
| Some times | 17.1 | 14.6 | 20.8 | 7.5 | 11.1 | 14.5 | | | | | |
| Regularly (Some) | 68.6 | 61.0 | 70.8 | 82.5 | 66.7 | 70.0 | | | | | |
| Regularly (All) | 14.3 | 24.4 | 8.3 | 10.0 | 22.2 | 15.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 10.1 | 0.256 | 0.16 | 0.257 | 8 |
| **b. Feed processing plant** | | | | | | | | | | | |
| Some | 11.4 | 19.5 | 25.0 | 17.5 | 13.9 | 18.0 | | | | | |
| Regularly (Some) | 62.9 | 41.5 | 50.0 | 52.5 | 47.2 | 50.5 | | | | | |
| Regularly (Most) | 25.7 | 39.0 | 25.0 | 30.0 | 38.9 | 31.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 6.78 | 0.561 | 0.13 | 0.561 | 8 |
| **c. Forage legume** | | | | | | | | | | | |
| Not at all | 71.4 | 58.5 | 45.8 | 57.5 | 77.8 | 61.0 | | | | | |
| Sometimes | 22.9 | 31.7 | 33.3 | 32.5 | 11.1 | 27.0 | | | | | |
| Regularly (Some of them) | 5.7 | 9.8 | 20.8 | 10.0 | 11.1 | 12.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 13.91 | 0.084 | 0.19 | 0.084 | 8 |

*1= Least efficient, 5= Most efficient

### 4.4.4 Influence of recommended medical practices on production efficiency

Vaccination of the entire herd against the deadly diseases of anthrax, black leg and rinder pest and treatment against internal and external parasites are the five major medical practices advised for farmers to apply them before hand when they establish a dairy farm. Adoption of medical practices is evaluated based on the use of these practices by each herder.

The assessment indicates that the adoption levels of recommended medical practices are relatively very good. But the absence of variability among the various efficiency classes of dairy herders do not allow to effectively test the hypothesized relationship. Most herders (96 percent) had vaccinated their animals against anthrax, black leg and rinder pest. Variations are observed only in their use of control measures of internal and external parasites, nevertheless, the inter-efficiency class difference among dairy farmers of ALWDDPMA is not found to be statistically significant even regarding these two practices (Table 4.7).

In conclusion, out of the four dairy production practices, breed and medical practices are better adopted than feed and housing practices. While the relationships between adoption of breeding practices and production efficiency is found to be highly significant, the lack of normal distribution in the adoption behavior of dairy farmers regarding medical practices associated with vaccination (96 percent adoption rate) does not allow to sufficiently test the hypothesized relationships.

**Table 4.7 Relationships between adoption of medical practices and production efficiency as reflected in percentage distributions and a test of association**

| | Percentage distribution of farmers per efficiency class* | | | | | | $\chi^2$ | | Cramer's V | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Total | Value | P | Value | P | |
| **Practice** | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 | | | | | df |
| **a. Anthrax** | | | | | | | | | | | |
| <100 percent | 8.6 | 2.4 | 2.1 | 7.5 | - | 4.0 | | | | | |
| 100 percent | 91.4 | 97.6 | 97.9 | 92.5 | 100.0 | 96.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | NC | | | | |
| **b. Black leg** | | | | | | | | | | | |
| <100 percent | 8.6 | 2.4 | 2.1 | 7.5 | - | 4.0 | | | | | |
| 100 percent | 91.4 | 97.6 | 97.9 | 92.5 | 100.0 | 96.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | NC | | | | |
| **c. Render pest** | | | | | | | | | | | |
| <100 percent | 8.6 | 2.4 | 2.1 | 7.5 | - | 4.0 | | | | | |
| 100 percent | 91.4 | 97.6 | 97.9 | 92.5 | 100.0 | 96.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | NC | | | | |
| **d. Ecto parasite** | | | | | | | | | | | |
| Not at all | 62.9 | 46.3 | 54.2 | 45.0 | 47.2 | 51.0 | | | | | |
| 100 percent | 37.1 | 53.7 | 45.8 | 55.0 | 52.8 | 49.0 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 3.3 | 0.509 | 0.128 | 0.509 | 4 |
| **e. Indo parasite** | | | | | | | | | | | |
| Not at all | 40 | 24.4 | 27.1 | 15 | 30.56 | 27 | | | | | |
| <100percent | 11.4 | 12.2 | 14.6 | 17.5 | 5.6 | 12.5 | | | | | |
| 100percent | 48.6 | 63.4 | 58.3 | 67.5 | 63.9 | 60.5 | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 8.3 | 0.455 | 0.144 | 0.405 | 8 |

*1= Least efficient, 5= Most efficient

The level of adoption regarding the rest two practices (housing and feed) is quite low and the relationship with production efficiency is not found to be significant. Possible reasons for low adoption of these practices will be further investigated in chapter five and six where the influence of the intervening and independent variables will be discussed in a greater detail. Moreover, we had a general impression felt at the time of the survey that the main cause for low adoption or use of feeds especially concerning the use of forage legumes could probably be attributed to the lack of land for growing green legumes. All of the herders were urban dwellers and local authorities do not yet consider their application for land. There was also a high shortage in the supply of industrial byproducts and products of feed processing plants. On the other hand, the reason for low adoption concerning housing practices could probably be associated with the absence of favorable perception towards improved housing. The two traditionally highly valued technologies by herders are only the use of improved breeds "yefernje lam"[3] and medical interventions. As far as housing is concerned, in a country where a small iron roofed single room house is perceived to be appropriate to shelter the people themselves, it shall not be surprising for farmers not giving sufficient attention for the housing of their animals.

## 4.5 Contribution of adoption of maize and dairy production practices to production efficiency variance

Ordinary Least Squares (OLS) method was employed to assess the contributions of adoption of maize and dairy practices on production efficiency of respondent farmers. According to Tabachnick & Fidell (2001:7), discrete variables composed of qualitatively different categories are analyzed after being changed into a number of dichotomous variables known as dummy variables. The different categories of maize and dairy practices (measured on a nominal and ordinal scale) were accordingly changed into a series of dummy variables for further analysis although differences are not observed in the $R^2$ values when the dummy variables are used (0.555 verses 0.556). According to Table 4.8, which shows the multiple regression estimates of the effects of recommended technology practices on production efficiency, the overall impact is more significant in maize farming (55.6 percent) than in dairy. The different efficiency classes of dairy farmers do not show significant variation in their adoption behavior of three practices (housing, feed and medical). However, the reason why adoption of dairy breeds, where significant variation is revealed, does not influence production efficiency is not clear. The situation is not however, unusual. A study conducted by Düvel and Vander Merwe (1989:34), shows that the adoption behavior of table grape farmers in Hex river valley of South Africa is not related at the less than 0.05 level of significance with their production efficiency. Demeke (1989:229) also found no significant relationship between adoption

[3] Technology of the white man

of improved seeds and fertilizer and the production efficiency of farmers and surprisingly enough, he reported that the relationships are negative.

In maize, use of fertilizer explains more of the variation in production efficiency. The use of 100-200 kg or a little lesser amount of DAP and urea fertilizers increases yield by about 1.3 tons per hectare against an increase of only 0.2 tons by using improved variety, which is regarded as one of the high yielding technologies in maize production.

**Table 4.8 Multiple regression estimates of the effects of technology adoption on production efficiency**

| Commodity | Variable | Beta | t | p |
|---|---|---|---|---|
| Maize | (Constant) | 19.241 | 15.131 | 0.057 |
| | Improved variety dummy: 1 represents any improved variety | 2.136 | 0.814 | 0.417 |
| | Area coverage dummy: 1 represents > 75 percent coverage | 3.660 | 1.481 | 0.140 |
| | Certified seed dummy: 1 represents certified | 1.327 | 0.500 | 0.618 |
| | Plant spacing dummy: 1 represent 25 cm-1 seed/hill | 1.767 | 0.932 | 0.353 |
| | Row spacing dummy: 1 represents 50-80 cm-2 seeds/hill | -1.516 | -0.699 | 0.485 |
| | Fertilizer type-1 dummy: 1 represents DAP + urea | 3.236 | 1.316 | 0.190 |
| | Fertilizer type-2 dummy: 1 represents any type | 12.723 | 5.837 | 0.000 |
| | Fertilizer rate dummy: 1 represents 100 kg each | 0.563 | 0.246 | 0.806 |
| | Fertilizer measurement dummy: 1 represents own skill | -0.061 | -0.027 | 0.979 |
| | Method of fertilization dummy: 1 represents spot | 0.377 | 0.156 | 0.876 |
| Dairy | | | | |
| | (Constant) | 8.73 | 17.97 | 0.046 |
| | Cross breed dummy: 1 represents >75 percent of herd | 0.94 | 1.29 | 0.199 |
| | >50 percent exotic blood dummy: >75 percent of herd | 0.52 | 0.71 | 0.479 |
| | >62.5 percent exotic blood dummy: >50 percent of herd | 0.50 | 1.19 | 0.234 |

$R^2 = .556$ (maize), 0.053 (dairy)

## 4.6 Current status of adoption of maize and dairy production technology package

The adoption of the recommended maize and dairy production practices were individually evaluated in the previous sections. The adoption status of maize and dairy farmers regarding the respective packages will be assessed here.

Adoption is a decision to make full use of an innovation as best appropriate course of action available (Rogers, 1983:176). For multiple practices (package), there are two options of measuring adoption; (i) adoption index: measures the adoption or rejection at the time of the survey or (ii) adoption quotient: measure the degree or extent of use with reference to the optimum possible without taking time into consideration. In this study, the second option was employed. Accordingly, each practice was valued and an aggregate adoption quotient was determined as indicated in Tables 4.9 and 4.11 to evaluate the level of package adoption attained by respondents.

**Table 4.9 Practices encompassing the recommended maize production package and its adoption quotient**

| | Practice | Score | | Practice | Score |
|---|---|---|---|---|---|
| **1** | **Seed** | | **3** | **Fertilization** | |
| 1.1 | Percent Improved cultivars grown | | 3.1 | Type of fertilizer | |
| | • All local | 0 | | • Non | 0 |
| | • <50 percent | 1 | | • UREA | 1 |
| | • 50-75 percent | 2 | | • DAP | 2 |
| | • >75 percent | 3 | | • Both | 3 |
| 1.2 | Source of seed | | 3.2 | Rate of fertilization | |
| | • Local | 0 | | • Nil | 0 |
| | • Own improved seed | 1 | | • <100 kg of 1 type | 1 |
| | • Own + certified | 2 | | • 50-100 kg of each | 2 |
| | • Certified | 3 | | • 100 kg of each | 3 |
| 1.3 | Total cultivars adoption Score | | 3.3 | Total Practice adoption score | |
| | • Minimum | 0 | | • Minimum | 0 |
| | • Maximum | 6 | | • Maximum | 6 |
| **2** | **Method of Planting** | | **4** | **Spot Application** | |
| 2.1 | Plant spacing | | 4.1 | Measurement | |
| | • Broadcast | 0 | | • Broad cast | 0 |
| | • <25 cm/drill | 1 | | • Coca cola cup | 1 |
| | • 25 cm-1seed/hill | 2 | | • Imagination | 2 |
| | • 25-50 cm-2 seeds/hill | 3 | 4.2 | Placement of seed | |
| 2.2 | Row pacing | | | • Broadcast | 0 |
| | • Broadcast | 0 | | • Together with fertilizer | 1 |
| | • <50 cm-1 seed/hill | 1 | | • Besides | 2 |
| | • 50-79 cm-2 seeds/hill | 2 | 4.3 | Total Practice adoption score | |
| | • 80 cm-2 seeds/hill | 3 | | • Minimum | 0 |
| 2.3 | Spacing measurement | | | • Maximum | 4 |
| | • Broadcast | 0 | **5** | **Total Package adoption score** | |
| | • Stick | 1 | | • Minimum | 0 |
| | • Foot steps | 2 | | • Maximum | 25 |
| | • Imagination | 3 | | | |
| 2.4 | Total planting adoption Score | | | | |
| | • Minimum | 0 | | | |
| | • Maximum | 9 | | | |

## 4.6.1 Current status of adoption of maize production technology package

As far as maize farming is concerned, the possible achievable score (adoption quotient) ranges between a minimum of 0 points to a maximum of 25. The actual total adoption score achieved by program participant farmers ranges between 4 and 25, upon which respondents were classified into four package adoption categories based on the deviation of their score from the mean total adoption score (Tables 4.10). One-way ANOVA was employed to test if the various groups were statistically different in their adoption score or level of adoption.

**Table 4.10 Package adoption categories of maize producers**

| Adoption category | N | Adoption score | Mean | SD | F | P |
|---|---|---|---|---|---|---|
| Non-adopters | 47 | 4.0-8.0 | 6.5 | 1.5 | 1241 | 0.000 |
| Low adopters | 49 | 10-16 | 13.3 | 2.0 | | |
| Medium adopters | 47 | 17-22 | 20.0 | 1.9 | | |
| High adopters | 57 | 23-25 | 24.0 | 0.9 | | |

As clearly shown in Table 4.10, the number of adopters and non-adopters is nearly equal. 96 (48 percent) of the respondents, who scored between 4 and 16 out of the total adoption score of 25, fall under the non-and low adoption category while 104 farmers (52 percent) fall under the high and medium adoption category. Only 57 farmers (28.5 percent) fall under the high adoption category. The cause for the low yield or production efficiency achieved by some maize farmers could, therefore, be attributed to this low level of adoption. The reasons for low adoption will be investigated in chapters 5 and 6 where the influence of the human and situational factors will be analyzed in a greater depth.

### 4.6.2 Current status of adoption of dairy production technology package

In the same way to maize, the package adoption status of dairy farmers was assessed by the degree or extent of use of each practice with reference to the optimum or recommended level. Adoption quotient was, therefore, developed (Table 4.11) to measure dairy production practices incorporated into the package namely breed, housing, medical and feeding practices. As shown in Table 4.11, adoption quotient of dairy farmers or the possible minimum and maximum score to be achieved by program participant dairy farmers ranges between 0 (where no single practice is adopted) and 40 (where all of the practices are adopted).

The actual adoption score of respondent dairy farmers ranges between 9 and 38. As their score is very high (minimum = 9) they were categorized into only three classes (low, medium and high) based on the deviation of their score from the mean total adoption score ignoring non-adoption. Table 4.12 indicates the number of farmers falling under each package adoption category and their mean adoption score. Out of the total score of 40, 60 and 69 farmers who scored between 9 and 20 and 21 and 25 were categorized under the low and medium adoption categories, respectively while the rest 71 farmers with the highest adoption score of 26-38, were grouped into the higher adopter category.

The three-adopter classes are significantly different in their level of adoption as tested by one-way ANOVA procedure.

**Table 4.11 Practices encompassing the recommended dairy production package and its adoption quotient**

| Practice and adoption scale | Score | Practice and adoption scale | Score |
|---|---|---|---|
| **1 Breed** | | 2.5 Stall (partition, width) | |
| 1.1 Number of dairy heard owned with blood level of 50 percent and above (percent) | | • No | 0 |
| • Nil | 0 | • Poor | 1 |
| • <50 percent | 1 | • Moderate | 2 |
| • 50-75 percent | 2 | • Good | 3 |
| • >75 percent | 3 | 2.6 Total adoption score | |
| 1.3 Adoption Score breed | | • Minimum | 0 |
| • Minimum | 0 | • Maximum | 15 |
| • Maximum | 3 | **3 Medical practices** | |
| **2 Housing practices** | | 3.1 Vaccination (anthrax) | |
| 2.1 Feed trough (width, depth, smoothness) | | • Not at all | 0 |
| • No | 0 | • <100 percent | 1 |
| • Poor | 1 | • 100 percent | 2 |
| • Moderate | 2 | 3.2 Vaccination (black leg) | |
| • Good | 3 | • Not at all | 0 |
| | | • <100 percent | 1 |
| 2.2 Gutters (slope, width, depth, smoothness) | | • 100 percent | 2 |
| • No | 0 | 3.3 Vaccination (render pest) | |
| • Poor | 1 | • Not at all | 0 |
| • Moderate | 2 | • <100 percent | 1 |
| • Good | 3 | • 100 percent | 2 |
| 2.3 Floor (slope, smoothness) | | 3.4 Spray (accaricide) | |
| • No | 0 | • Not at all | 0 |
| • Poor | 1 | • <100 percent | 1 |
| • Moderate | 2 | • 100 percent | 2 |
| • Good | 3 | 3.5 Use of antehelmintics | |
| 2.4 Roof and side walls (Ventilation, draft, construction material) | | • Not at all | 0 |
| • No | 0 | • <100 percent | 1 |
| • Poor | 1 | • 100 percent | 2 |
| • Moderate | 2 | 3.6 Total adoption Score | |
| • Good | 3 | • Minimum | 0 |
| | | • Maximum | 10 |

**Table 4.11 continued...**

| Practice and adoption scale | Score | Practice and adoption scale | Score |
|---|---|---|---|
| 4 **Feed practices** | | 4.4 Total practice adoption score | |
| 4.1 Use of industrial by products | | • Minimum | 0 |
| • Not at all | 0 | • Maximum | 12 |
| • Rarely | 1 | 4.5 Total Package adoption score | |
| • Sometimes | 2 | • Minimum | 0 |
| • Regularly (some of them) | 3 | • Maximum | 40 |
| • Regularly (most of them) | 4 | | |
| 4.2 Use of feeds from feed factory | | | |
| • Not at all | 0 | | |
| • Rarely | 1 | | |
| • Sometimes | 2 | | |
| • Regularly (some of them) | 3 | | |
| • Regularly (most of them) | 4 | | |
| 4.3 Use of forage legume | | | |
| • Not at all | 0 | | |
| • Rarely | 1 | | |
| • Sometimes | 2 | | |
| • Regularly (some of them) | 3 | | |
| • Regularly (most of them) | 4 | | |

**Table 4.12 Number of dairy producers by package adoption category**

| Adoption category | N | Adoption score | Mean | SD | F | P |
|---|---|---|---|---|---|---|
| **Low adopters** | 60 | 9-20 | 17.3 | 2.07 | 476 | 0.000 |
| **Medium adopters** | 69 | 21-25 | 22.8 | 1.36 | | |
| **High adopters** | 71 | 26-38 | 28.9 | 2.74 | | |

## 4.7 RELATIONSHIPS BETWEEN ADOPTION OF RECOMMENDED PACKAGES AND EFFICIENCY

The relationships between technology practices included in both maize and dairy packages and production efficiency was assessed in previous sections. It is here tried to evaluate the aggregate influence of the packages on the respective production efficiencies of maize and dairy farmers. As can be seen in Table 4.13, in the same manner to the relationships found between efficiency and adoption of maize and dairy practices, significant relationship is found only regarding adoption of maize package ($R^2 = 0.51$). This $R^2$ value is a little less than that of the influence of separate practices ($R^2 = 0.55$) probably due to rounding of numbers.

**Table 4.13 Multiple regression estimates of the influence of package adoption on production efficiency**

| Variable | Beta | t | p |
|---|---|---|---|
| Constant | | 2.7 | 0.007 |
| Maize package | 0.72 | 14.45 | 0.000 |
| Constant | | 16.0 | 0.000 |
| Dairy package | 0.072 | 1.01 | 0.312 |

$R^2 = 0.51$ (maize); 0.005 (dairy)

# CHAPTER 5



# INDEPENDENT VARIABLES AND THEIR INFLUENCE ON PRODUCTION EFFICIENCY AND ADOPTION

## 5.1 INTRODUCTION

In the past it has been believed that human behavior, particularly the adoption behavior of farm operators is largely determined or influenced by socio-economic and personal factors (independent variables). This has led to a research tradition in the area of behavioral sciences, which is largely dominated by an investigation of the relationships between these variables and behavior. Roger's (1983) generalizations based on the findings of more than 200 studies, regarding the factors responsible for behavior change of a farm operator are, for example, reflecting the importance of these variables without taking account of the more direct intervening variables, which according to Düvel (1989 & 1991) are the immediate precursors of behavior. However, the findings are inconclusive and usually contradictory as already explained.

With an ultimate objective of assessing their relative importance and obtain a better perspective of the influence relationships, in this chapter an attempt will be made to identify the socio economic and personal characteristics of respondent farmers such as age, education and farm size, which are assumed to differentiate maize and dairy farmers into their various efficiency classes and thereby determine the relationships between these variables and production efficiency. It is also intended to evaluate the influence of the stimuli independent variables on the practice adoption behavior of maize and dairy farmers in the study area. Following the identification of the explanatory variables significantly associated with the two criterion variables, a more rigorous analysis will be made by employing the OLS method to determine the contributions of these factors to the variance in production efficiency and package adoption behavior of maize and dairy farmers.

## 5.2 PROFILE OF RESPONDENT FARMERS AND INFLUENCE OF INDEPENDENT VARIABLES ON PRODUCTION EFFICIENCY

### 5.2.1 Age

Literature review showed that studies conducted regarding the relationship between age and the adoption behavior and production efficiency of farmers are not consistent. (Alene *et al,* 2000:639; Getahun *et al,* 2001:21; Mahabile *et al,* 2002:326) did not find significant relationships between age and adoption. Significantly higher number of other studies (Coop, 1958; Bembridge & Williams, 1990; Foltz *et al*, 2002) also reported that age is negatively related with the adoption behavior and production efficiency of farmers and led to the hypothesis that there is a negative relationship between age and the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

As far as maize farming is concerned, Table 5.1 shows that there are significant differences between the different efficiency categories in age ($F = 4.84$, $p = 0.001$). The mean age of the efficiency categories show a systematic and an almost linear decrease from the least to the most efficient category. For example, the farmers in the least efficiency category have a mean age of 50.2 years, while that of the most efficient farmers (category 5) is only 37.2 years. This suggests that an increase in age tends to be associated with a decrease in efficiency, and thus a clear relationship or negative relationship between maize farmers' age and their production efficiency. This relationship is supported by the correlation coefficient ($r = -0.300$, $p = 0.000$) shown in Table 5.1 and provides evidence in support of the hypothesis (Hypothesis 2.1), that age is negatively related with production efficiency.

In contrast with the hypothesis, a positive relationship (r = 0.158, p = 0.025) is found in dairy. The lack of significant difference amongst the efficiency classes (F = 1.5, p = 0.191), does not, however, support this finding. A more sensitive efficiency scale (more than 5 categories) might have brought out this difference.

### 5.2.2 Education

Several studies (Alene *et al*, 2000:639; Zegeye *et al*, 2001:46; Mahabile *et al*., 2002:326) showed that education is positively related with the adoption behavior of farmers. Foltz and Chang (2002:1031) for instance, found that educated dairy farmers are more likely to use recombinant bovine somatotropin than the less educated ones. Education is also found to be positively related with production efficiency (Nigussie, 2001:53; Alene and Hassen, 2003:1). The findings of these empirical studies led to the Hypotheses in this study that education is positively related to adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

**Table 5.1 The percentage distribution of maize and dairy farmers according to their efficiency and age**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Age** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 50.2 | 48.8 | 43.4 | 41.3 | 37.2 | 43.7 |
| | 18-30 | 19.5 | 8.3 | 23.3 | 33.3 | 42.1 | 27 |
| | 31-40 | 14.6 | 33.3 | 25.6 | 27.8 | 26.3 | 25 |
| | 41-52 | 26.8 | 25 | 25.6 | 14.8 | 21.1 | 22 |
| | 55-85 | 39 | 33.3 | 25.6 | 24.1 | 10.5 | 26 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 44 | 47.7 | 46.4 | 47.5 | 51.3 | 47.3 |
| | 12-38 | 37.1 | 34.1 | 25 | 27.5 | 8.3 | 26.5 |
| | 39-45 | 20 | 19.5 | 29.2 | 22.5 | 25 | 23.5 |
| | 46-57 | 17.1 | 22 | 25 | 22.5 | 33.3 | 24 |
| | 58-80 | 25.7 | 24.4 | 20.8 | 27.5 | 33.3 | 26 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Mize (F=4.84, p=0.001; r=-0.300, p= 0.000), Dairy (F=1.5, p=0.191; r=0.158, p=0.025)

1= Least efficient, 5 = Most efficient

According to Table 5.2, which presents the education characteristic or profile of maize and dairy farmers, it appears that dairy farmers are more educated than maize farmers. This is shown by the fact that 18.5 percent and 47.5 percent of dairy farmers have a tertiary and secondary level of education respectively, while in maize there is not a single farmer with a tertiary level of education and the number of those who attended secondary school education is only 16 percent.

As far as dairy farmers are concerned, Table 5.2 shows that there are significant differences between the different efficiency categories (F = 3.49, p = 0.009). The mean educational level of the efficiency categories shows a systematic and an almost linear increase from the least to the most efficient category. For example, the farmers in the least efficient category have a mean education of 6.7 years, while that of the most efficient farmers is 10.4 years. This suggests that higher education is associated with an increase in production efficiency, and thus a clear positive relationship between dairy farmers' education and their production efficiency. This relationship is supported by the correlation coefficient (r = 0.265, p = 0.000) shown in Table 5.2, and provides strong evidence in support of the hypothesized association (Hypothesis 2.1), which states that higher education is correlated with higher production efficiency. The same applies in maize, which present further evidence supporting the hypothesis.

**Table 5.2 The percentage distribution of maize and dairy farmers according to their efficiency and level of education**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Education** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 0.8 | 1.4 | 3.2 | 3.3 | 4.3 | 2.7 |
| | Illiterate | 78 | 66.7 | 44.2 | 37 | 28.9 | 49 |
| | Primary | 19.5 | 29.2 | 37.2 | 42.6 | 42.1 | 35 |
| | Secondary | 2.4 | 4.2 | 18.6 | 20.4 | 28.9 | 16 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 6.2 | 7.5 | 8.4 | 9 | 10.4 | 8.3 |
| | Illiterate | 22.9 | 26.8 | 20.8 | 17.5 | 8.3 | 19.5 |
| | Primary | 31.4 | 14.6 | 10.4 | 10 | 8.3 | 14.5 |
| | Secondary | 40 | 46.3 | 45.8 | 52.5 | 52.8 | 47.5 |
| | Tertiary | 5.7 | 12.2 | 22.9 | 20 | 30.6 | 18.5 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize ($F$=7.7, $p$=0.000; $r$=0.349, $p$=0.000), Dairy ($F$=3.49, $p$=0.009; $r$=0.265, $p$=0.000)

* 1 = Least efficient, 5 = Most efficient

### 5.2.3 Farm size

It is generally believed that for farming to be profitable, farmers need to move away from subsistence, small and fragmented land holding system to a more market oriented system. This necessitates the use of modern technologies, which are often scale sensitive, i.e. relatively small farmers have less incentives to adopt new practices. Small farmers are also associated with risk aversion behavior while relatively bigger farmers are risk takers. Both arguments indicate the need for increasing the scale of operation. These assumptions are supported by several others (Demeke, 1989:230; Bizimana *et al,* 2000:240; Foltz and Chang, 2002: 103; Mahabile *et al,* 2002:326; Alene *et al,* 2003:1; Tesfaye, in press) and led to the hypotheses in this study namely that farm size is positively related with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Very small farms or holdings of approximately one hectare characterize maize farming in the study area. In this study, 25 percent of the respondents were classified into small (less than 0.75 hectare holding), 47 percent of them were medium (0.75 to 1 hectare holding) and 28 percent were grouped into the bigger category (more than 1.25 hectare holding).

Regarding maize farming, there is, as expected, a positive association between farm size and production efficiency. Evidence of the association is the fact that 34.1 percent of least efficient farmers have small farm size while the number of the most efficient farmers having small farm size is only 23.7 percent. The difference is, however, not significant ($F = 1.8$, $p = 0.125$), nor is the correlation ($r = 0.023$, $p = 0.748$).

As far as dairy farming is concerned, although volume of production is sometimes considered as a measure of production efficiency, the cooperative has the tradition that classification of its members based on the amount of milk supply to the cooperative is a best indication of farm size. Farm size was, therefore, measured by the level of average fortnightly milk supply computed from the 2001 annual milk supply records of each member. Based on the deviation of their produce from the mean, three categories were formed. Those farmers who supplied less than 110 liters per fortnight were grouped into the small enterprise (farm) category while those who supplied from 110 to 219 liters and more than 219 liters were grouped into the medium and the bigger enterprise category respectively.

There are significant differences among the different efficiency classes of dairy farmers in farm size ($F = 7.6$, $p = 0.000$), i.e. bigger farmers or farmers with bigger enterprise are more efficient than small farmers. The most efficient category of dairy farmers produce an average of 215 liters of milk per fortnight while the mean for the least efficient ones is only 99 liters. The middle groups have means of between 151 and 178 liters. The significant association between farm size and production efficiency is confirmed by the highly significant positive correlation coefficient ($r = 0.324$, $p = 0.000$), thus providing evidence in support of the hypothesized relationship (Hypothesis 2.1).

**Table 5.3 The percentage distribution of maize and dairy farmers according to their efficiency and farm size**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Farm size** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 0.89 | 1.14 | 1 | 0.89 | 0.95 | 0.96 |
| | Small | 34.1 | - | 23.3 | 31.5 | 23.7 | 25 |
| | Medium | 36.6 | 62.5 | 44.2 | 48.1 | 50 | 47 |
| | Bigger | 29.3 | 37.5 | 32.5 | 20.4 | 26.3 | 28 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 99 | 151 | 178 | 164 | 215 | 163 |
| | Small | 62.9 | 34.2 | 22.9 | 35 | 16.7 | 33.5 |
| | Medium | 25.7 | 39 | 35.4 | 30 | 33.3 | 33 |
| | Bigger | 11.4 | 26.8 | 41.7 | 35 | 50 | 33.5 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize (F=1.8, p=0.125; r=0.023, p=0.748) Dairy (F=7.6, p=. 000; r=0.324, p=0.000)

*1 = Least efficient, 5 = Most efficient

### 5.2.4 Farming experience

Experience is considered to be an accumulation of human capital. With experience farmers are expected to build confidence and be willing to try alternative and better farming practices. Several studies support this assumption (Zegeye *et al,* 2001:46; Zegeye and Tesfaye, 2001:50; Mahalbile *et al,* 2002:326) and justify the hypothetical exposition that there is a positive association between farming experience and the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of respondents in the study area.

Regarding maize farming, the most efficient farmers appear to have less farming experience than the least efficient ones (F = 4.68, p = 0.001). Their mean experience is 21.4 years while the mean for least efficient ones is 30.6 years, clearly indicating that an increase in experience tends to be associated with a decrease in efficiency. This negative relationship is supported by the highly significant negative correlation coefficient (r = -

0.285, p = 0.000). This finding is not in accordance with expectations (Hypothesis 2.1). A possible explanation for the negative relationship is that experience above a certain threshold no longer contributes or differentiates regarding efficiency. With a mean of 25.7 years this threshold has probably been reached and can it be expected that the negatives associated with old age (which is highly correlated with farming experience r = -0.300) have a bigger influence.

**Table 5.4 The percentage distribution of maize and dairy farmers according to their efficiency and farming experience**

| Commodity | Experience | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 30.6 | 30.6 | 25 | 23.4 | 21.4 | 25.7 |
| | Least | 22.0 | 12.5 | 30.2 | 40.7 | 47.4 | 32.5 |
| | Medium | 26.8 | 37.5 | 27.9 | 31.5 | 23.7 | 29.0 |
| | Most | 51.2 | 50.0 | 41.9 | 27.8 | 28.9 | 38.5 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 10.7 | 9.3 | 9.2 | 10 | 11.5 | 10 |
| | Least | 48.6 | 48.8 | 20.8 | 32.5 | 22.2 | 34.0 |
| | Medium | 17.1 | 19.5 | 52.1 | 37.5 | 36.1 | 33.5 |
| | Most | 34.3 | 31.7 | 27.1 | 30.0 | 41.7 | 32.5 |
| | Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Maize (F=4.68,p= 0.001; r=-0.285, p=0.000), Dairy (F=0.55, p= 0.696; r=0.042, p=0.555)

* 1 = Least efficient, 5 = Most efficient

### 5.2.5 Media contact

The use of media in rural areas is believed to facilitate change in the behavior of farmers and ultimately leads to significant improvement in the production efficiency of farmers. Research results show positive associations between the use of media and adoption of agricultural technologies. According to Saeed (1989:263), mass media exposure constitutes a principal factor associated with adoption of agricultural innovations in the Sudan. Elias (1999:72) also found a similar positive association between the use of media and adoption behavior. Based on the above it was hypothesized that media exposure is positively associated with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Media facilities available for farmers in the research area include public gatherings (meetings), radio, TV and the print media and this use is shown in Fig. 5.1 and 5.2.

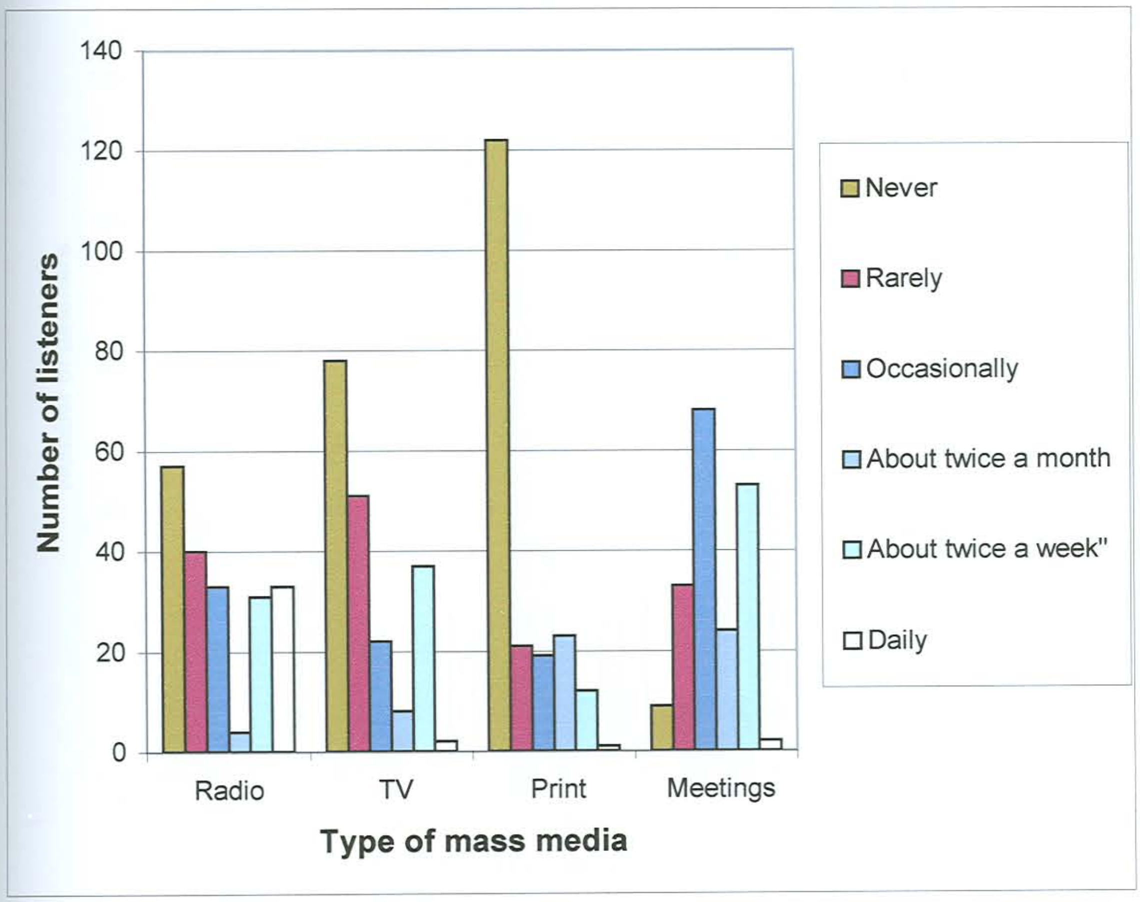


**Fig. 5.1** **Level of mass and group media use by maize growers**

As far as maize farming is concerned, the radio is the only mass media, which is daily used by about 17 percent of the respondents. A fair number of farmers (17 to 27 percent) use meetings, radio and TV about once or twice a week. 10 to 25 percent of maize producers occasionally (less than once a month) and rarely use all of the available media facilities. Moreover, the print media, TV and radio in order of importance are the ones that have never been used by many farmers in the Shashemene district (Fig. 5.1). Radio is, therefore, the only reliable means of disseminating agricultural information in addition to the development agent assigned for this purpose implying that a lot is expected from the extension service to invigorate available sources of agricultural information, as more specific channels are appropriate for different messages.

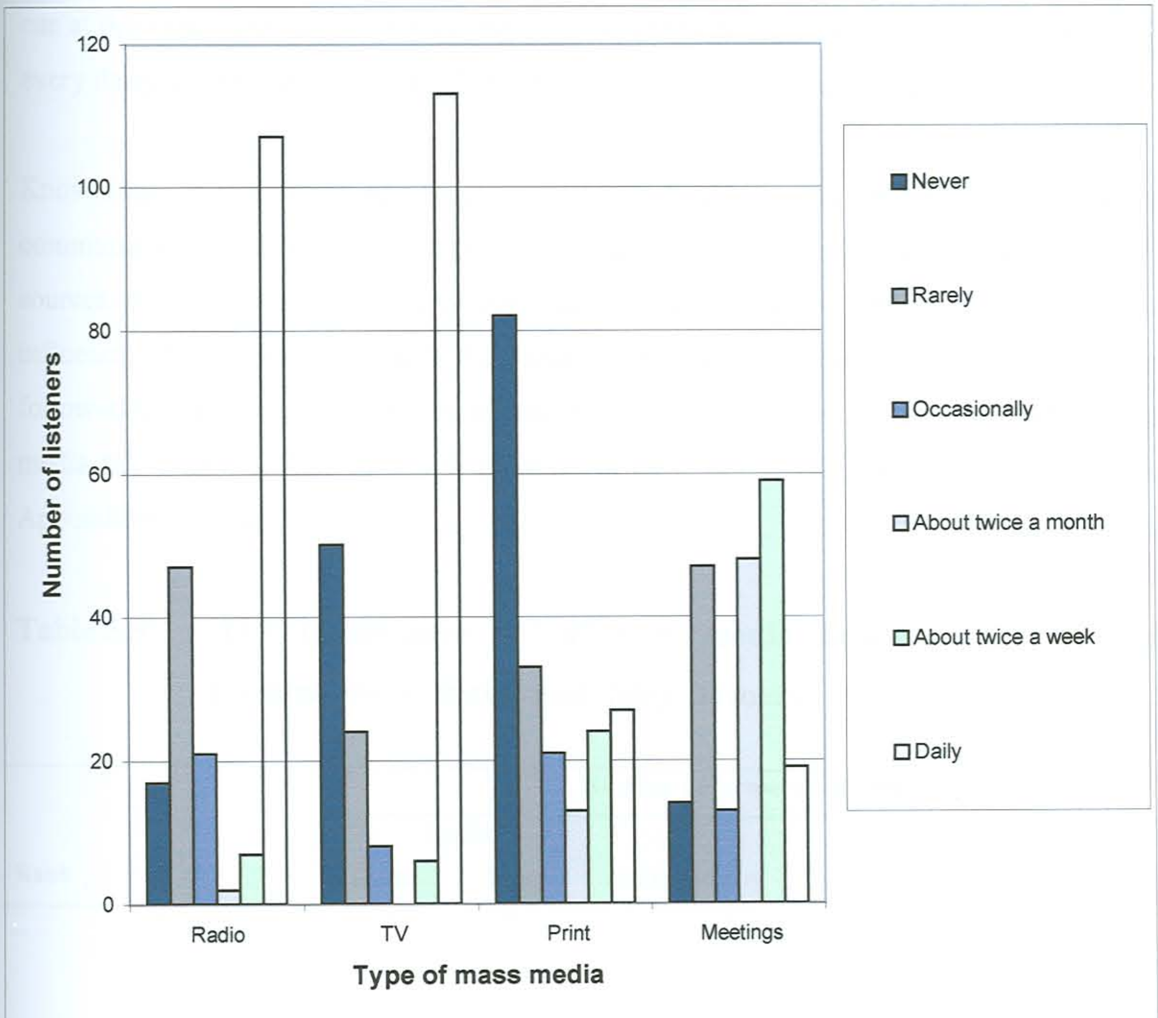


**Fig. 5.2 level of mass and group media use by dairy farmers**

Contrary to maize farmers, many dairy farmers have been extensively using all of the available media sources (Fig. 5.2). In dairy, TV and radio are the most popular media, which were daily used by more than 50 percent of the respondents. About 30 percent of dairy farmers use meetings at least once or twice a week. The least used is the print medium, which about 40 percent of dairy farmers had never used it at all. All of the mass media sources were never used by about 10 to 40 percent of all dairy farmers.

The extension service could make use of this opportunity and promote its services through the variety of information sources available for dairy farmers. Radio and TV, for example can be used for creating awareness and disseminate less skill oriented technologies. Meetings can be used to promote and enhance group decision-making. It can at the same time solve its own problem of being unable to assign extension agents for every dairy cooperative provided that the service has a shortage of manpower.

Knowledge of the extent of use of each media facility could help to design effective communication strategies. Correspondingly, respondents were asked to rank their media sources of information in order of importance or frequency to determine their potential influence. As depicted in Table 5.5, radio is found to be the most important source followed by meetings both for maize and dairy farmers. Importance of TV and the print media takes only a third or fourth position in both maize and dairy farming (See also Appendices 5.1 and 5.2).

**Table 5.5 The importance of different media based on rank order assessments by maize and dairy farmers** *

| | Number of farmers responded | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Radio | | TV | | Print | | Meetings | |
| **Rank** | Maize | Dairy | Maize | Dairy | Maize | Dairy | Maize | Dairy |
| **1** | 77 | 71 | 11 | 54 | 8 | 11 | 97 | 61 |
| **2** | 58 | 79 | 41 | 54 | 16 | 16 | 40 | 39 |
| **3** | 7 | 23 | 53 | 38 | 31 | 46 | 30 | 49 |
| **4** | 4 | 8 | 19 | 6 | 37 | 48 | 23 | 36 |
| **Total weight** | 500 | 575 | 292 | 460 | 179 | 232 | 483 | 495 |
| **Rank position** | 1st | 1st | 3rd | 3rd | 4th | 4th | 2nd | 2nd |

From field experience in disseminating technology in the form of a package program, it was found that farmers require extension assistance at critical periods or during the time of applying key recommendations such as improved seeds, planting, improved fertilizer, and methods of fertilization (Howard *et al,* 1999: 20-21). These activities are occurring

* The total weighted score is the sum of rank order frequencies multiplied respectively by 4 for the first position, 3 for 2nd position, 2 for 3rd position and 1 for 4th position.

roughly about one month apart from each other. If farmers listen to the mass media at least once a month, they are expected to receive timely information required to properly implement their field activities. Based on this assumption and for the purpose of analyzing the influence relationship between media exposure and production efficiency, those farmers who had no exposure to the available media at least once a month were grouped into the low media exposure category while those who had exposure at least once a month were grouped into the high exposure category.

**Table 5.6 The percentage distribution of maize and dairy farmers according to their efficiency and media contact**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Media** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 1.9 | 2.2 | 2.7 | 3 | 3.3 | 2.7 |
| | Low | 85.4 | 83.3 | 69.8 | 46.3 | 39.5 | 62.5 |
| | High | 14.6 | 16.7 | 30.2 | 53.7 | 60.5 | 37.5 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 3.8 | 3.9 | 3.4 | 3.8 | 3.7 | 3.7 |
| | Low | 28.6 | 29.3 | 39.6 | 30.0 | 36.1 | 33.0 |
| | High | 71.4 | 70.7 | 60.4 | 70.0 | 63.9 | 67.0 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize (F=10.8, p= 0.000; r=0.336, p=0.000), Dairy (F=0.66, p=0.62; r=0.023, p=0.745)

* 1 = Least efficient, 5 = Most efficient

As depicted in Table 5.6, there are significant differences between the different efficiency categories (F = 10.8, p = 0000). The mean media exposure score of the efficiency categories show a systematic and almost linear increase from the least to the most efficient category. For example, the farmers in the least efficient category have a mean media exposure score of 1.9, while that of the most efficient farmers is 3.3. This suggests that an increase in media exposure tends to be associated with a similar increase in production efficiency, and thus a clear positive relationship between media exposure and production efficiency of maize farmers in the study area. This relationship is supported by the highly significant positive correlation coefficient (r = 0.336, p = 0.000) and provides evidence in support of Hypothesis 2.1, namely that higher exposure to media is correlated with higher production efficiency

Although dairy farmers have a higher exposure to media, there is no clear relationship between media exposure and the production efficiency of dairy farmers of ALWDADPMA ($F = 0.66$, $p = 0.62$; $r = 0.053$, $p = 0.745$). The reason for the lack of relationship could probably be attributed to easy access to media sources and the consequent lack of variation between herders. Dairy farmers are residing in town (equally exposed to media) and may not have differences in their media exposure compared to the purely rural maize farmers where the elites and youngsters have better access.

### 5.2.6 Extension contact

Extension is instrumental to agricultural development and can play a big role in equipping farmers with information required to improve their farming practices. The literature reveals a positive association between extension and the adoption behavior of farmers (Legesse, 1992:68; Elias, 1999:72; Getahun *et al,* 2000:21; Zegeye *et al,* 2001:43) and led to the hypothesis that extension contact is positively associated with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

Available information sources for farmers in the study area include the local development agent (DA), fellow farmers who usually run farmer's demonstration plot on their own holding, demonstration plots (EMTPS), field days, Woreda Bureau of Agriculture (BoA), artificial insemination center (AI), Woreda Administrative Council (WAC), Non Governmental Organizations (NGOs) operating in the area and the peasant association (PA) itself. The frequency with which they are used is summarized in Fig. 5.3

Maize farmers have greater and frequent contact with their own fellow farmers, the PA, the DA, and the EMTPs. 54, 51,39, and 13 farmers respectively, have a very high and frequent contact (about twice a week) with these information sources. On the other hand, 184, 151, 148, and 132 farmers do not have any contact with NGOs, AI, WAC, and field days respectively.

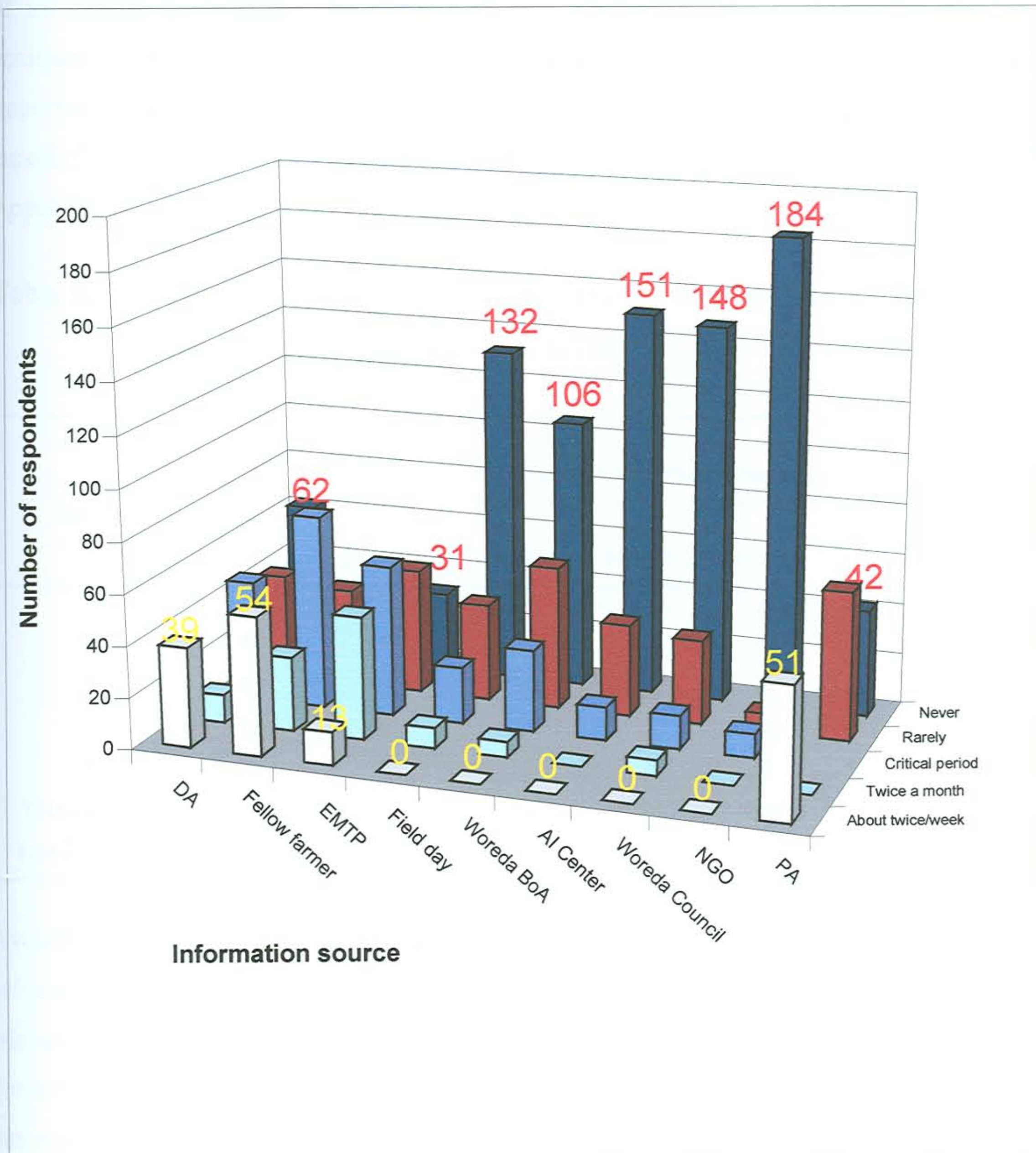


**Fig. 5.3 Level of change agent contact of maize growers**

As in the case of mass media, farmers were requested to rank their five most important information sources for the purpose of identifying the most widely used information sources in the district. The rank order position, which is determined based on the total weighted score is indicative of the fact that the fellow farmer, the PA, the EMTPS, the DA, and the BoA are, in order of importance, the five most important agricultural information sources, while WAC, AI, and NGOs are some of the least important sources of information. Based on the finding in Fig. 5.3 and judged according to the rank positions, it appears as if the fellow farmer, the PA, the DA, and EMTPS are the most important sources followed by BoA and field days. The rest are of little significance especially in view of the urgency of information needs of agricultural activities (see also Appendix 5.3).

**Table 5.7 The importance of different information sources based on rank order assessments by maize farmers**

| Rank | Number of farmers responded | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DA | Fellow farmer | EMTP | Field day | BoA | AI | WAC | NGO | PA |
| 1 | 29 | 111 | 30 | - | 1 | - | - | - | 29 |
| 2 | 40 | 50 | 46 | - | 4 | - | 1 | - | 49 |
| 3 | 46 | 27 | 30 | 3 | 8 | 5 | 3 | - | 39 |
| 4 | 13 | 6 | 49 | 5 | 16 | 1 | 4 | 1 | 34 |
| 5 | 6 | 2 | 7 | 29 | 37 | 5 | 13 | 2 | 6 |
| Total weight* | 475 | 850 | 522 | 48 | 114 | 22 | 34 | 4 | 532 |
| Rank position | 4th | 1st | 3rd | 6th | 5th | 8th | 7th | 9th | 2nd |

Available information sources for dairy farmers include the BoA, fellow farmer, EMTPs (displays), field days, International Livestock Research Institute (ILRI), research centers, educational center (Debrezeit Veterinary College), WAC, NGOs, and the private veterinary Services. In dairy 156,130 and 127 farmers at least occasionally use private veterinary services, BoA, and fellow farmers respectively. Displays, ILRI and Debrezeit Veterinary College are rarely used. The rest four sources namely WAC, field days, Research Center, and NGOs are the most little used sources where 196, 195, 194 and 185

* The total weighted score is the sum of the rank order frequencies multiplied respectively by 5 for the 1st position, 4 for 2nd position, 3 for 3rd position 2 for, 4th position and 1 for 5th position

farmers have never used them at all. The degree to which these sources are used is summarized in Fig. 5.4.

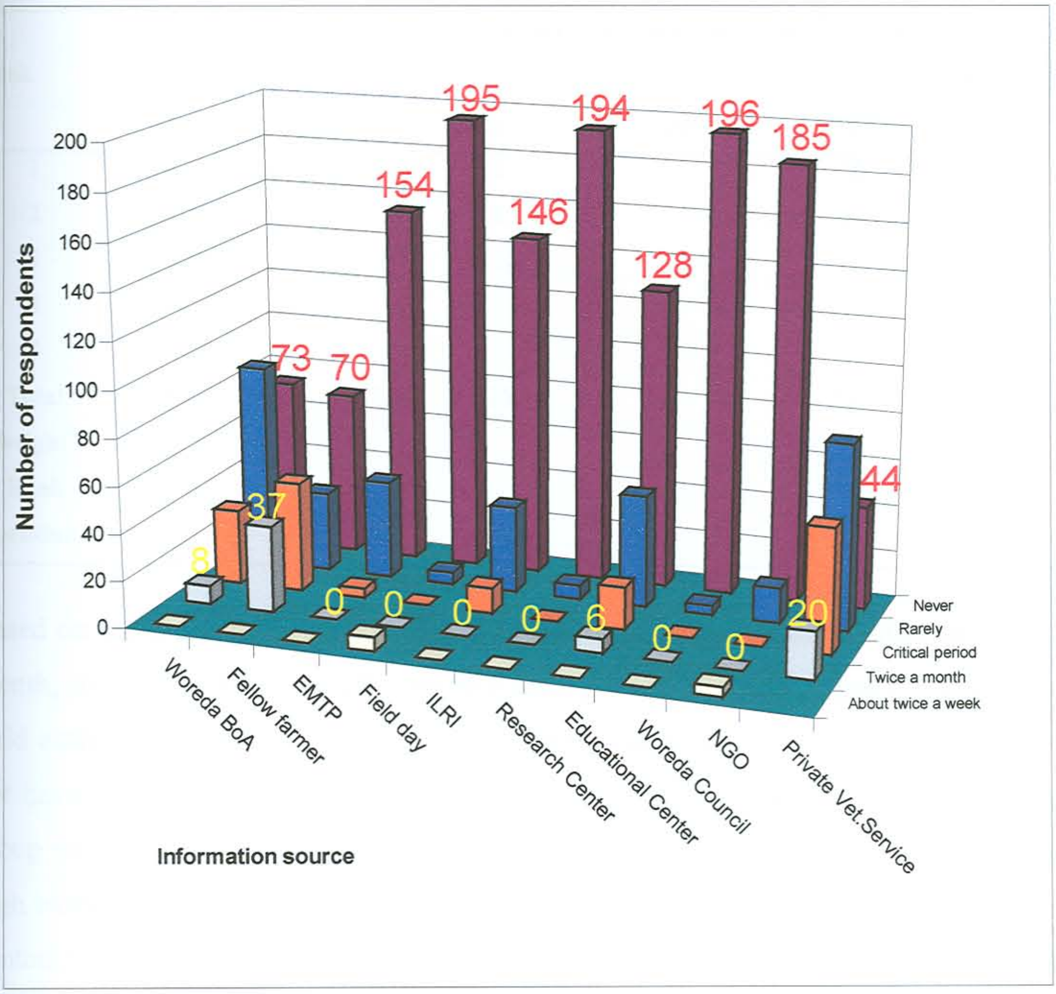


**Fig. 5.4 Level of change agent contact of dairy producers**

The response of respondents to rank their information sources in order of importance is summarized in Table 5.8. Private veterinary service, fellow farmer, BoA, veterinary college and ILRI are found to be the first five most important sources with weighted scores of 598, 562, 469, 233, and 175 respectively. Based on the frequency and weighted score values, it is concluded that private veterinary services, the fellow farmers and the Woreda BoA are the most important sources of agricultural information for dairy farmers of ALWDADPMA (see also Appendix 5.4).

**Table 5.8 The importance of different information sources based on rank order assessments by dairy farmers.**

| Rank | Frequency of use of information source | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BoA | Fellow farmer | EMTP | Field day | ILRI | Research center | Vet. College | Woreda council | NGO | Private vet. Center |
| 1 | 40 | 65 | 8 | 3 | 8 | - | 12 | - | - | 61 |
| 2 | 32 | 45 | 11 | 2 | 14 | 2 | 22 | - | 6 | 51 |
| 3 | 41 | 17 | 16 | 1 | 18 | 1 | 18 | 1 | 3 | 21 |
| 4 | 8 | 2 | 8 | - | 10 | 2 | 14 | 1 | 5 | 11 |
| 5 | 3 | - | 6 | - | 5 | 3 | 3 | 2 | 1 | 4 |
| Total weight* | 469 | 562 | 154 | 26 | 175 | 22 | 233 | 7 | 44 | 598 |
| Rank position | 3 | 2 | 6 | 8 | 5 | 9 | 4 | 10 | 7 | 1 |

Based on the assumption that, farmers need to make an extension contact at least once a month, in order to receive sufficient and timely information to properly implement their field activities, a categorization of respondents was undertaken. Those farmers who do not have contact at least once a month were categorized into the low extension contact group while those who have contacts once a month and more were categorized into the high extension contact group. Both maize and dairy farmers have a very low extension contact. It is only 18.5 percent and 5 percent of maize and dairy farmers, respectively, who have high contact with extension (Table 5.9). This abnormal distribution has also influenced the classification of the variable into only two rough categories of low and high. These categories were related to efficiency categories and the findings are summarized in Table 5.9.

As far as the relationships between extension contact and the production efficiency of farmers is concerned, there is no significant relationship between efficiency and contact with extension ($F = 0.88$, $p = 0.480$; $r = -0.018$, $p = 0.803$). A possible explanation for the non-significant correlation may be that the variation and thus the correlation are too

* The total weighted score is the sum of rank order frequencies multiplied respectively by 5 for the 1st position, 4 for 2nd position, 3 for 3rd position, 2 for 4th position and 1 for 5th position.

small because of the rough scale of only two categories. After all the percentage respondents that have a high contact is 9.8 in the least efficient category and increases more or less systematically to 26.3 in the most efficient category. In dairy, many farmers (95 percent) have low extension contact and therefore, the data could not help to see the association of the two factors.

**Table 5.9 The percentage distribution of maize and dairy farmers according to their efficiency and extension contact**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Extension** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 2 | 1.9 | 2 | 2.2 | 2.2 | 2.1 |
| | Low | 90.2 | 91.7 | 83.7 | 74.1 | 73.7 | 81.5 |
| | High | 9.8 | 8.3 | 16.3 | 25.9 | 26.3 | 18.5 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 1.5 | 1.5 | 1.47 | 1.48 | 1.57 | 1.5 |
| | Low | 97.1 | 95.1 | 100.0 | 92.5 | 88.9 | 95.0 |
| | High | 2.9 | 4.9 | | 7.5 | 11.1 | 5.0 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize (F=0.88, p=0.480; r=-0.018, p=0.803), Dairy (not computed)

* 1 = Least efficient, 5 = Most efficient

### 5.2.7 Gender

Some studies (Nigussie, 2001:54; Mahabile *et al,* 2002: 326; Tesfaye, in press) reported that there is no relationship between gender and adoption. They argue that agricultural technologies are not gender sensitive and provided that extension services are aware of the important roles of women in agriculture, they can consciously target the female-headed households so that they may equally benefit from extension services. But it is also claimed that male farmers are more likely to adopt agricultural technologies that can improve their production efficiency. Addo (1972) and Okali (1983), quoted by Mensah and Seepersad (1992:51), for example, found that male farmers vastly outnumbered women cocoa farmers in Ghana. Mensah and Seepersad (1992: 54) verified this claim in their study. They found that there is significant and positive relationship between gender and overall production efficiency and adoption of the recommended agro chemicals and cultural practices. For this study it was hypothesized that gender is positively related to the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers.

In the Shashemene district, the great majority (92 percent) of all respondents were found to be male headed, and due to lack of variability regarding gender, it was not possible to effectively test the hypothesis. From the distribution in Table 5.10, however, there is an indication that male farmers are more efficient. Almost all (97.4 percent) of the most efficient farmers, for example, are male while there are substantial (19.5 percent) numbers of female farmers in the least efficient category.

The distribution is relatively better in dairy farming, where, thirty-four farmers or 17 percent of the respondents were females. The differences between the various efficiency classes of dairy farmers are significant ($\chi^2 = 11.25$, df = 4, p = 0.024) suggesting that male-headed households are more efficient than their female counterparts. The association, however, is not significant (r = 0.032, p = 0.658). Table 5.10 gives the impression that some sort of non-linear relationship exists between the two variables, which can contribute for the lack of significant association.

In general, an indication of a positive relationship in the case of maize farming and the presence of significant difference between male and female dairy farmers in production efficiency suggest that male farmers tend to be more efficient than their female counterparts. The cause for low efficiency regarding women farmers may be due to the inefficiency of the extension service to effectively target its clients and provide appropriate advices. Further research, is, however, required to verify this finding.

**Table 5.10 The percentage distribution of maize and dairy farmers according to their efficiency and gender**

| Commodity | Gender | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|---|
| | | Percentage distribution per efficiency class* | | | | | |
| Maize | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Male | 80.5 | 95.8 | 90.7 | 96.3 | 97.4 | 92.0 |
| | Female | 19.5 | 4.2 | 9.3 | 3.7 | 2.6 | 8.0 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| Dairy | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Male | 80.0 | 87.8 | 85.4 | 67.5 | 94.4 | 83.0 |
| | Female | 20.0 | 12.2 | 14.6 | 32.5 | 5.6 | 17.0 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize ($\chi^2$ not computed), dairy ($\chi^2$=11.25, df=4, p=0.024; r=0.032, p=0.658)

*1 = Least efficient, 5 = Most efficient

### 5.2.8 Attitudinal modernity

Attitudinal modernity is a composite variable reflecting the beliefs and thoughts of the individual under investigation regarding his attitude towards science, education, credit, technology, religion, family, marriage, exposure to the mass media etc. (Alex and Smith 1974). Cosmopoliteness is sometimes considered as the proxy variable for attitudinal modernity. In the past, attitudinal modernity was considered almost a precondition for a traditional man to change his behavior into a modern man so that he will be amenable to accept and adopt new ideas. The assumption is supported by research results (Saeed, 1989:263; Elias, 1999:74) and led to the hypothesis that attitudinal modernity is positively related with the adoption behavior (Hypothesis 3.1) and production efficiency (Hypothesis 2.1) of farmers in the study area.

According to Table 5.11, which shows farmer characteristics regarding their attitude and its relationship with their production efficiency, dairy farmers are found to be more modern than maize farmers. The mean attitudinal modernity score for dairy farmers is 24.6 while that of the maize farmers is only 16.8. However, there are no significant differences between the various efficiency classes of maize and dairy farmers in their attitudinal modernity. The mean attitudinal score of maize growers in the lowest efficiency category, for example, is 16.9. This percentage remains constant with increasing production efficiency until it reaches to only 17.3 in the most efficient farmers category suggesting the lack of significant relationships (F = 0.59, p = 0.680; r = 0.053, p = 0.453).

**Table 5.11 The percentage distribution of maize and dairy farmers according to their efficiency and attitudinal modernity**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Modernity** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 16.9 | 16.3 | 16.6 | 16.8 | 17.3 | 16.8 |
| | Low | 36.6 | 33.3 | 37.2 | 40.7 | 34.2 | 37 |
| | Medium | 39.0 | 45.8 | 39.5 | 31.5 | 28.9 | 36 |
| | High | 24.4 | 20.8 | 23.3 | 27.8 | 36.8 | 27 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 24.2 | 23.8 | 24.5 | 24.4 | 26.4 | 24.6 |
| | Low | 28.6 | 36.6 | 27.1 | 35.0 | 13.9 | 28.5 |
| | Medium | 40.0 | 29.3 | 41.7 | 32.5 | 33.3 | 35.5 |
| | High | 31.4 | 34.1 | 31.3 | 32.5 | 52.8 | 36.0 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize (F=0.59, p=0.680; r=0.053, p=0453), Dairy (F=2.4, p=0.152; r=0.177, p=0.012)

1 = Least efficient, 5 = Most efficient

## 5.2.9 Organizational participation

Organizational participation, both formal and non formal, is assumed to enhance the use of agricultural technologies by creating access to information and boosting the bargaining power of producers particularly during the time of marketing. This assumption finds support in the literature (Saeed, 1989:264 Elias, 1999: 72; Getahun *et al,* 2000:21) and was accepted as a hypothesis in this study, namely that organizational participation is positively related to the adoption behavior and production efficiency of farmers in the study area.

The common institutions in the rural setting include, among others, Woreda Administrative Council (WAC), Peasant association (PA), Peasant association development committee (PADC), soil conservation teams, marketing cooperatives, irrigation associations, school and religious institutions. Respondents were requested to report their affiliation with any of these institutions during the last five years either as a member or in a leadership position. As can be seen in Fig. 5.5, the involvement of respondents in eight rural organizations is minimal. Between 165 and 200 farmers do not have any participation in any of these organizations. Institutions having the highest membership, albeit still very low, are religious institutions, PA and school committees.

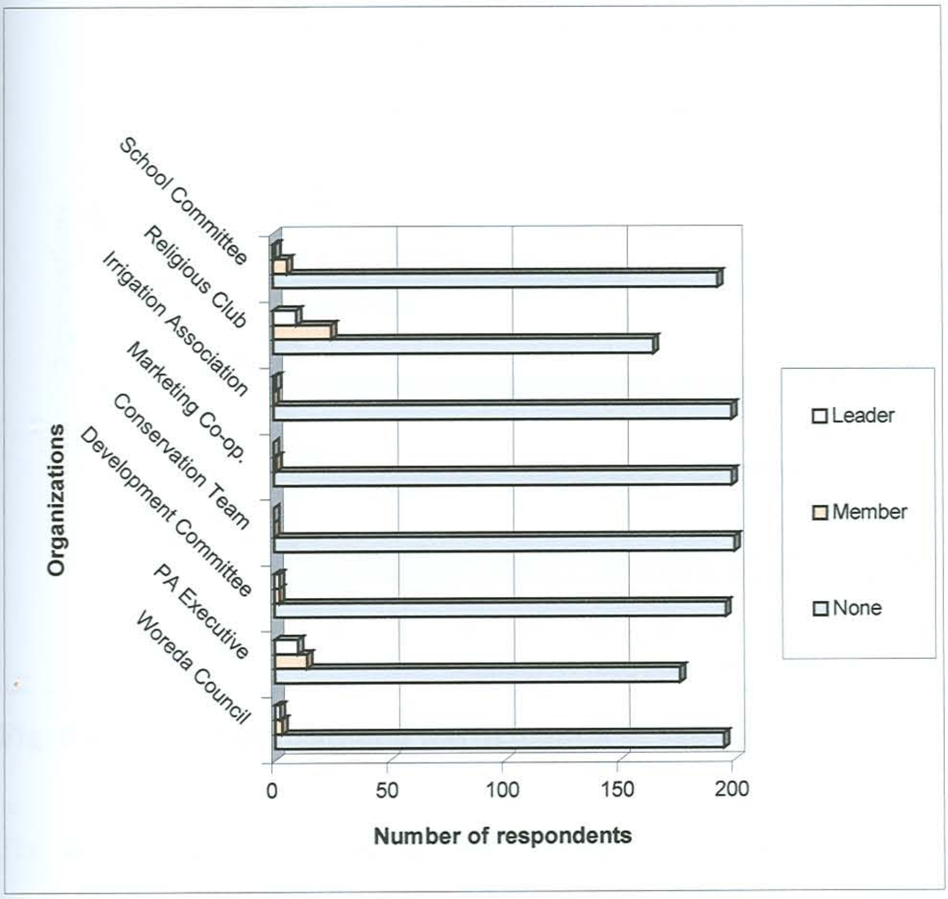


**Fig. 5.5 Organizational participation of sample maize farmers**

In addition to community-based organizations (CBOs), dairy farmers are affiliated with similar institutions commonly used by maize farmers. Most of the dairy farmers like the maize farmers do not have extensive organizational participation. Only 2 percent of the farmers have high organizational participation. The highest participation is in regard to CBOs and the marketing cooperative, of which 107 and 126 respondents are members. Most of the farmers (between 188 and 199), do not participate in any of the councils or clubs (Fig. 5.6).

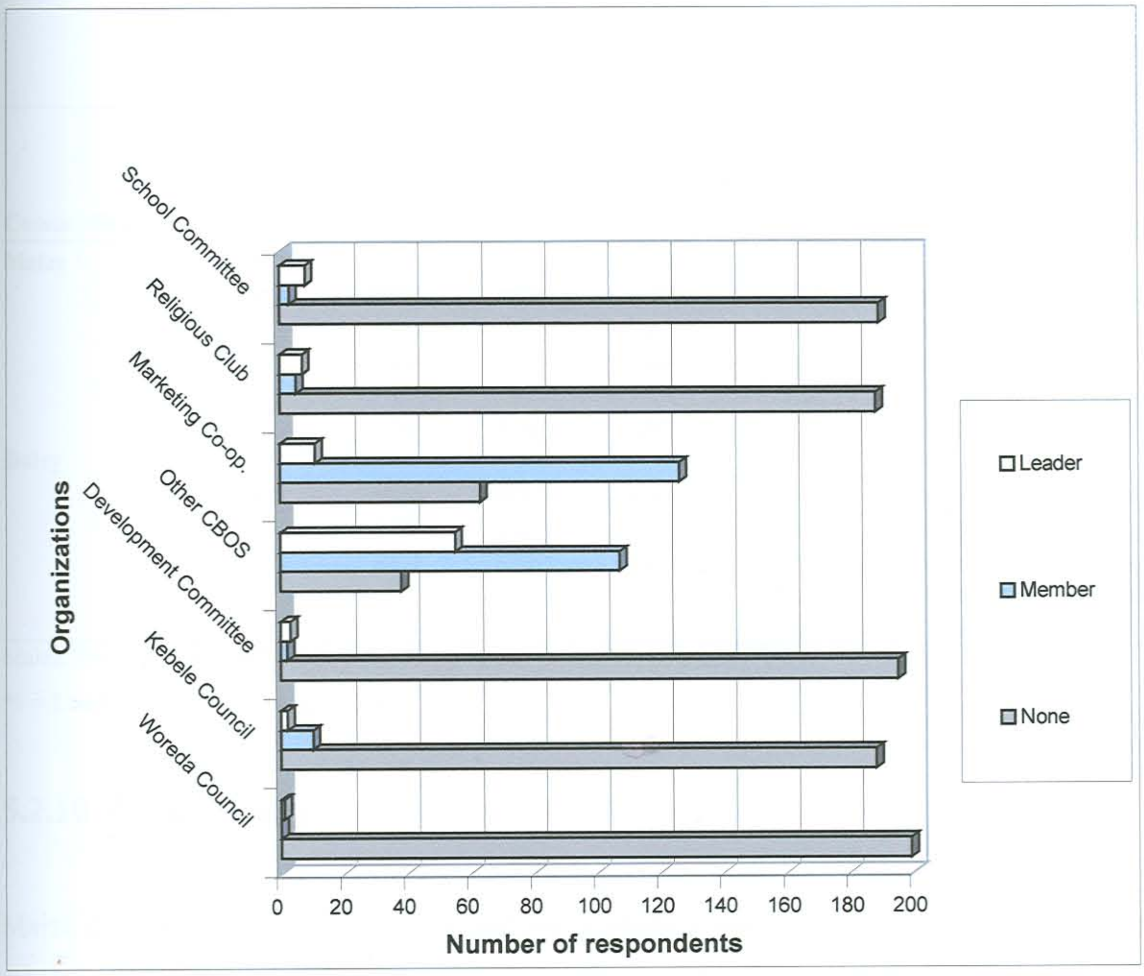


**Fig. 5.6 Organizational participation of sample dairy farmers**

The limited variation regarding organizational participation does not allow for valid analysis of variance, but the distributions in Table 5.12 indicate a tendency for efficient farmers to be slightly more organizationally involved. For example all the maize farmers that have a higher level of participation are efficient. As far as dairy farmers are concerned, there are significant differences between the various efficiency categories of dairy farmers (F = 3.6, p = 0.007). The percentage of farmers participating in one or other organization also tends to increase with increasing efficiency. In the lowest efficiency category the percentage of respondents with a higher level of participation is 8.6 percent and increases in an almost linear fashion to 19.4 in the case of the most efficient category. The relationship is, however, not significant (r = 0.077, p = 0.278).

**Table 5.12 The percentage distribution of maize and dairy farmers according to their efficiency and organizational participation**

| | | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|---|
| **Commodity** | **Participation** | 1 | 2 | 3 | 4 | 5 | Total |
| **Maize** | | | | | | | |
| | Frequency | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| | Mean | 1 | 1 | 1 | 1.02 | 1.08 | 1.02 |
| | Low | 100 | 100 | 100 | 98.1 | 92.1 | 98 |
| | High | - | - | - | 1.9 | 7.9 | 2 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |
| **Dairy** | | | | | | | |
| | Frequency | n=35 | n=41 | n=48 | n=40 | n=36 | N=200 |
| | Mean | 1.24 | 1.25 | 1.31 | 1.34 | 1.38 | 1.3 |
| | Low | 91.4 | 87.8 | 85.4 | 87.5 | 80.6 | 86.5 |
| | High | 8.6 | 12.2 | 14.6 | 12.5 | 19.4 | 13.5 |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 |

Maize (F= Not computed), Dairy (F=3.6, p=0.007; r=0.077, p=0.278)

*1 = Least efficient, 5 = Most efficient

## 5.2.10 Agro ecology

Maize does well both in the middle and low altitude agro-ecological zones. However, the middle altitude zone produces higher yields than the low altitude zone, especially during times when moisture is limited. Farmers producing in the middle altitude zone will presumably be more likely to adopt recommended maize technologies in an effort to exploit the suitable weather conditions and optimize their production. Getahun *et al,* (2000: 21) found a positive association between agro ecological zone (altitude) and the adoption of agricultural practices.

According to Table 5.13, farmers residing in the middle altitude zone are more efficient than those living in the low altitude zone (F = 6.7, p = 0.000). The correlation between agro ecology and production efficiency is also significant (r = 0.244, p = 0.001) and thus in support of Hypothesis 2.1, which implies a positive association between the agro ecological zone where a farmer resides and his production efficiency. The result implies that risk (e.g., for lowland areas) is an important factor in technology adoption and may entail that associated practices like irrigation are critical.

**Table 5.13 The percentage distribution of maize growers according to their efficiency and agro ecological area of production**

| | Percentage distribution per efficiency class* | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Total |
| **Agro ecology** | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 |
| Low altitude | 63.4 | 83.3 | 53.5 | 37.0 | 28.9 | 50 |
| Middle altitude | 36.6 | 16.7 | 46.5 | 63.0 | 71.1 | 50 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

F= 6.7, p=0.000; r=0.244, p=0.001; *1 = Least efficient, 5 = Most efficient

## 5.3 CONRIBUTIONS OF INDEPENDENT VARIABLES TO PRODUCTION EFFICIENCY VARIANCE

Multiple regression models were developed to assess the aggregate contribution of independent variables on the production efficiency of maize and dairy farmers and thereby select the most important variables affecting production efficiency. This aim was to identify a limited number of variables, which would account for a maximum amount of variance in production efficiency. According to Copp (1958:108), variable reduction has practical as well as theoretical values. He mentions that there is little reason for dealing with a large number of variables when a few variables will do the predictive job and furthermore, one of the goals of science is to secure a parsimonious summary of a system of relationships.

The bivariate analysis presented in section 5.2 provided the initial guide as to which variables should be included in the regression model. Explanatory, regressor or predictor variables subjected to multiple regression analysis were agro ecology, age, education, farm size, and media in maize and age, education, farm size and attitudinal modernity in dairy (Table 5.14). The rest of the variables, which were not significantly related with production efficiency such as extension contact, gender, organizational participation, and farming experience were discarded from further analyses.

All the variables included in the assumed regression models have signs corresponding to their theoretical definition.

**Table 5.14 Model specification for determinants of the production efficiency of maize and dairy farmers**

| Variable | Expected sign (relationship) | Variable description |
|---|---|---|
| Agro ecology* | + | Middle altitude = 1 |
| Age | - | Number of years of respondent |
| Education | + | Number of years of schooling |
| Farm size | + | Total holding excluding leased land |
| Mass media exposure* | + | Exposure once a month and better = 1 |
| Attitudinal modernity | + | A33 item attitudinal scale (pre established) |

*= Dummy variables

The results of the multiple regression analysis both for maize and dairy are given in Table 5.15. As far as maize farming is concerned, agro-ecological zone, education, farm size and media are found to be significantly correlated with production efficiency although the contribution of all the independent variables entered into the multiple regression model to the variance of production efficiency does not exceed 25.1percent.

**Table 5.15 Multiple regression estimates of the effects of independent variables on the production efficiency of maize and dairy farmers, 2002**

| Variable | Maize | | | Dairy | | |
|---|---|---|---|---|---|---|
| | Beta | t | p | Beta | t | p |
| Constant | - | 4.958 | 0.000 | - | 3.217 | 0.002 |
| Agro ecology* | 0.333 | 4.345 | 0.000 | - | - | - |
| Age | -0.950 | -1.270 | 0.206 | 0.173 | 2.569 | 0.001 |
| Education | 0.200 | 2.454 | 0.015 | 0.243 | 3.146 | 0.002 |
| Farm size | 0.276 | 3.646 | 0.000 | 0.275 | 4.183 | 0.000 |
| Media* | 0.196 | 2.658 | 0.009 | - | - | - |
| Modernity | - | - | | 0.069 | 0.902 | 0.326 |

$R^2$ = 0.251 (Maize), 0.193 (Dairy), *= Dummy variable

Age, education and farm size are also found to significantly contribute to the variance of the production efficiency of dairy farmers of ALWDADPMA. The contribution of these variables to the total variance in production efficiency is, however, rather limited and a mere 19.3 percent (Table 5.15), implying that they are probably not the major predictors of production efficiency. This appears to be in support of the general hypothesis of this study (Hypothesis 2.3), namely that independent variables are less important than intervening variables in explaining behavior variation. The latter will be analyzed in next chapters.

On the other hand, the respective significant association between some of the situational factors such as agro-ecology, media exposure and education with the production efficiency of both the maize and dairy farmers has an important implication for policies and strategies engaged in promoting rural development. The concerted effort of the Ethiopian Government in promoting primary education in rural Ethiopia is something to be appreciated and encouraged. But its attempt of spreading agricultural extension services equally to all parts of the country, irrespective of the agro ecological potential, does not seem the optimal use of scarce resources such as trained man power, time and financial resources that could have been invested to alternative development activities. If one area is found suited to crop, the other can, for example, be more favorable for mountain agriculture or forestry.

Regression analysis also revealed that media exposure is one of the key variables in predicting production efficiency, however, as indicted earlier, its use is limited to only very few number of farmers. From this it seems that revitalizing existing infrastructure and promoting development support communication or the use of mass media in rural extension is imperative.

The other, yet very important finding relates to farm size and its implication on landownership policies. The significant positive relationship with production efficiency suggests that land policies should be such as to prevent further land fragmentation.

## 5.4 INFLUENCE OF INDEPENDENT VARIABLES ON PRACTICE ADOPTION OF MAIZE FARMERS

Practices included in the maize package take account of fertilizer type, rate, measurement, and method of application, the variety, and area coverage by improved seed, source of seed, plant (inter- row) spacing and row spacing.

Chi-square analyses were used to test the significance of the relationships between recommended maize practices and independent variables. Cramer's V and Phi statistics (for 1 degree of freedom) for nominal variables and Gamma for ordinal variables were also used to specify the strength of the association between variables.

### 5.4.1 Age

A clear and negative relationship is found between age and the adoption behavior of maize growers in all of the nine practices at the less than 1 percent level of probability. Appendix 5.17 provides the detail statistics of the influence relationships. The finding is consistent with the hypothesized association (Hypothesis 3.1). As far as the adoption behavior of farmers regarding the type of fertilizer used is concerned, for example, there are significant differences between the different efficiency categories ($\chi^2 = 17.17$, df = 6, p = 0.009). The difference lies in the fact that with increasing age, farmers tend to use less fertilizer or use none of the recommended type of fertilizers. In the oldest age category (55 to 85 years), 36.5 percent of the farmers do not use fertilizer. Only 10 percent of the farmers in the youngest age category (18 to 35 years) plant their seed without fertilizer. The opposite tendency is evident in the use of the two recommended type of fertilizers. In the lowest age category, 72.2 percent of the farmers use both type of fertilizers. This percentage decreases in an almost linear fashion (Fig. 5.7) to 46.2 percent in the oldest age category. This clear relationship finds expression in the highly significant Cramer's V value (Cramer's V= 0.207, p = 0.009).

According to Figure 5.17, which shows the relationship between age and the percentage of farmers adopting the recommended rate of technology practices, there is also a tendency of hyperbolic relationship, i.e. the percentage of adoption tends to increase up to a certain threshold with increasing age and starts to fall at about the age of 35 years. The only practices where adoption of the recommended rate and age do not show this type of relationship are source and area coverage of improved seeds and use of the recommended type of fertilizer. Regarding these three practices the graph declines throughout indicating a linear negative relationship.

### 5.4.2 Education

There is a clear and positive association between education and the adoption behavior of maize farmers regarding almost all of the nine maize practices at the less than 1 percent level of probability (Appendix 5.17) thereby providing evidence in support of Hypothesis 3.1. Regarding the adoption of fertilizer rate for example, there is a clear and highly significant linear relationship with education (Gamma = 0.395, p = 0.000). This relationship is also evident from the Chi-square analysis ($\chi^2 = 21.54$, df = 6, p = 0.000).

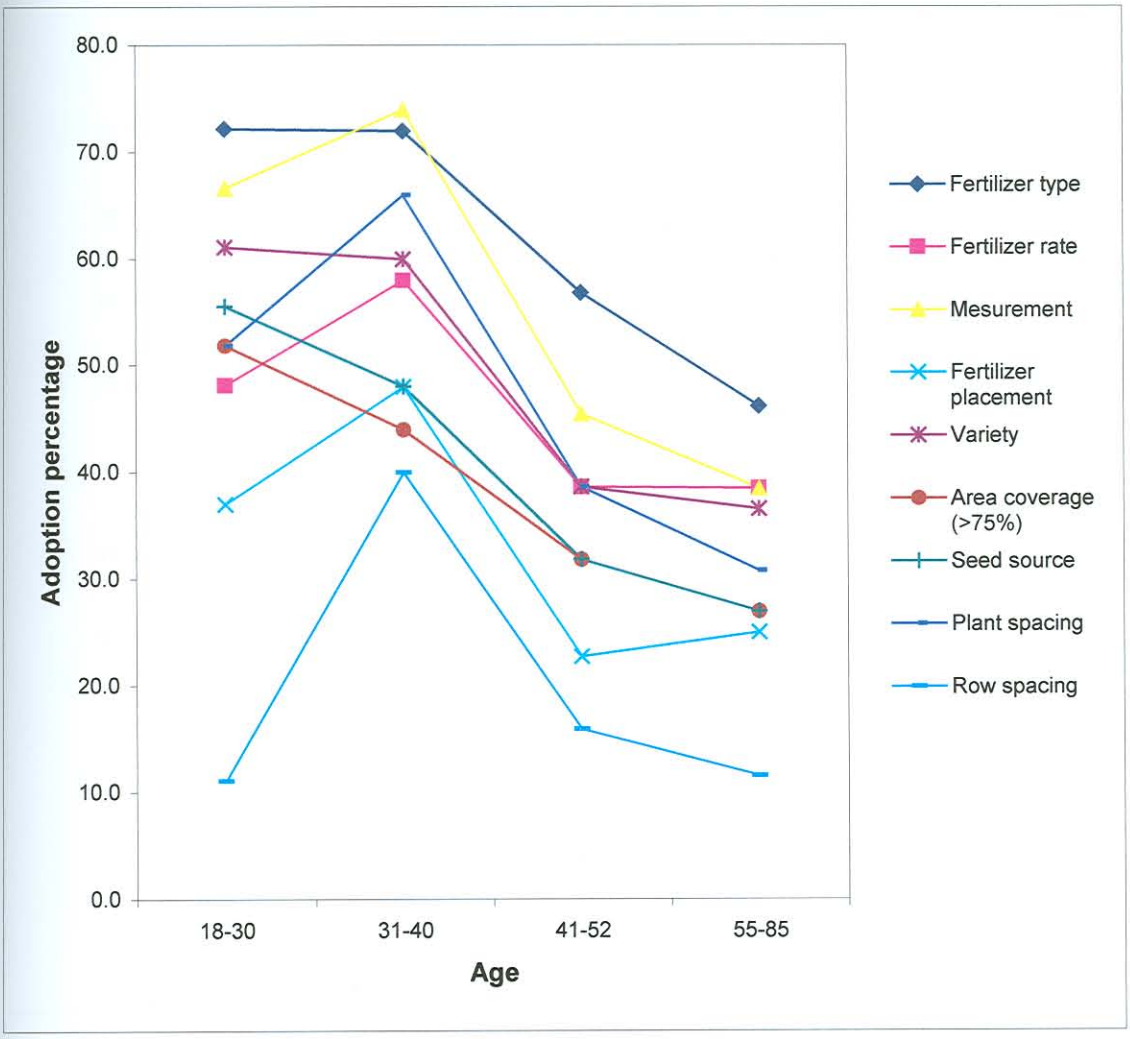


**Fig. 5.7** **Graphical illustration of the relationships between age and the percentage of farmers adopting the recommended rate of technology**

34.7 percent of the illiterate farmers use no fertilizer at all while amongst those farmers who have a secondary level of education; only 6.3 percent do not use fertilizer. In the illiterate farmers category only 36.7 percent use the recommended rate. This percentage increases in an almost linear manner (Fig. 5.8) with increasing level of education to 71.9 percent in the category of maize farmers having a secondary school level of education.

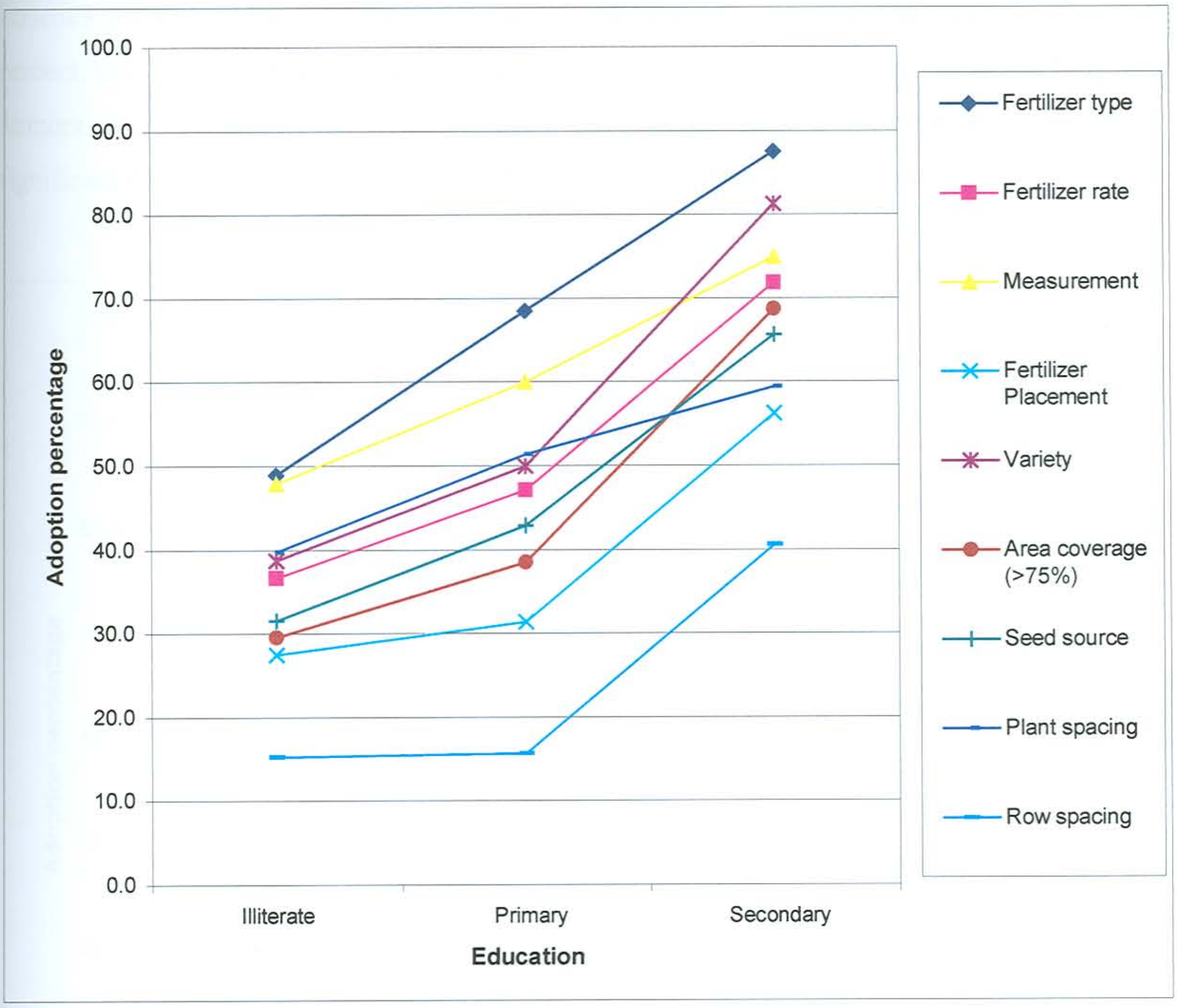


**Fig. 5.8** **Graphical illustration of the relationships between education and the percentage of farmers adopting the recommended rate of technology**

### 5.4.3 Farm size

Farm size is found to be negatively correlated with the adoption behavior of maize farmers at the less than 1 percent level of probability regarding all of the recommended maize practices except fertilizer type, which is significantly related only at the less than 10 percent level (Appendix 5.18). Regarding adoption of improved variety for example, there is a significant difference between farm size and adoption ($\chi^2 = 22.76$, df = 4, p = 0.000). 64.3 percent of the farmers on bigger units use local varieties. This percentage decreases in an almost linear fashion with a decrease in farm size to 30 percent in the small farmers category. Conversely, while the number of farmers who use improved varieties such as, PHB 3253, BH 660 and BH 140 from the small farmers category is 70 percent, this percentage decreases in a similar linear fashion to 35.7 percent in the bigger farmers category (Fig. 5.9). This negative relationship finds expression in the highly significant Cramer's V value (Cramer's V = 0.239, p = 0.000).

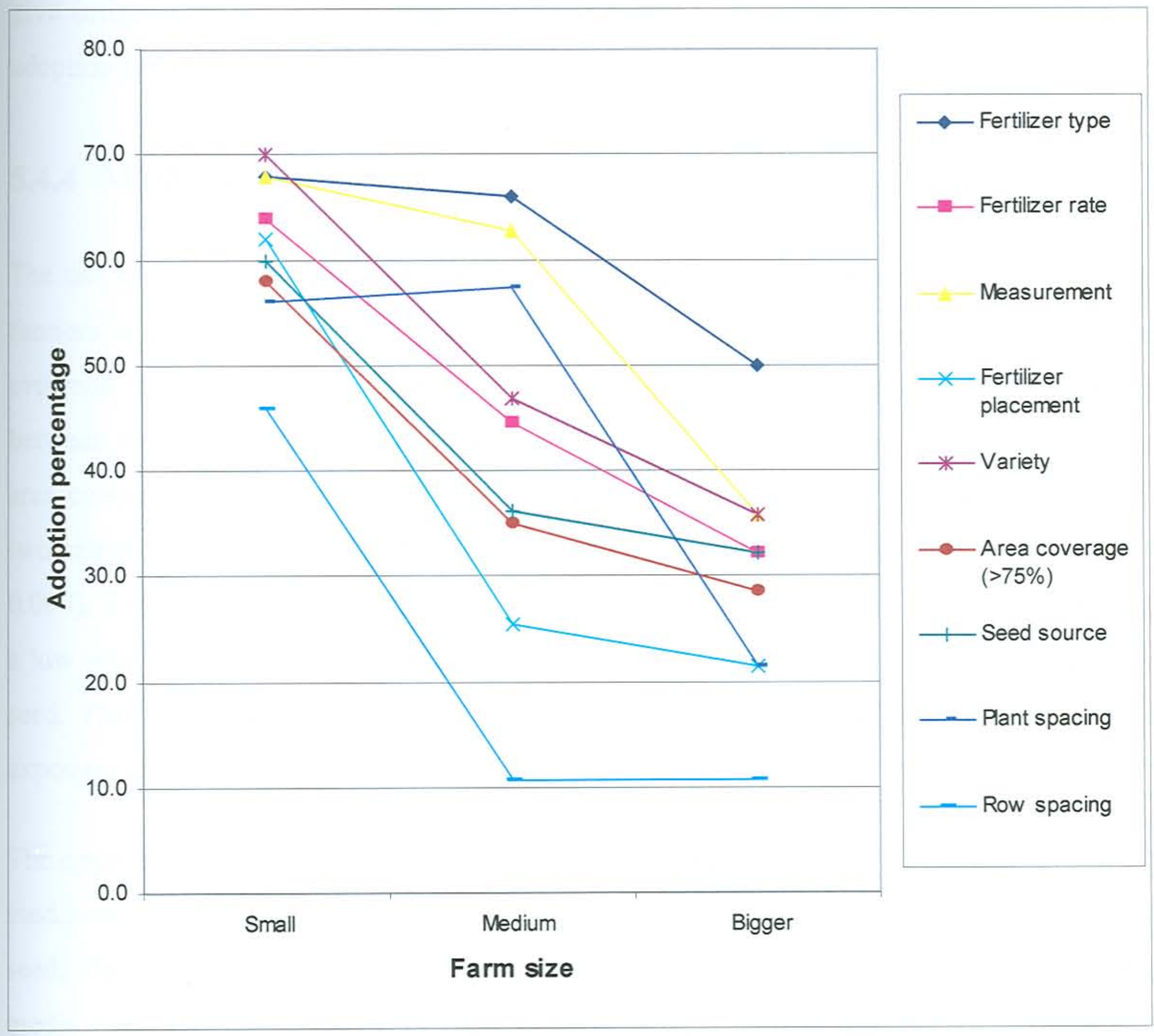


**Fig. 5.9** **Graphical illustration of the relationships between farm size and the percentage of farmers adopting the recommended rate of technology**

The result is not consistent with the hypothesized association (Hypothesis 3.1), which states that farmers on bigger units are more likely to adopt innovations than small farmers and the findings of most adoption studies conducted in Ethiopia (Demeke, 1989:230; Alene *et al,* 2003:1). However, Legesse (1992:68) found similar result in herbicide adoption on wheat and Zegeye and Tesfaye (2001:47) also found a similar negative association between farm size and the variety adoption of maize farmers in Southern Ethiopia, although the association was not insignificant. But the fact that the rate of decline of the graph regarding the majority of the practices decreases to almost zero leads to an expectation that it will increase with a further increase in farm size. In other words, the variation in farm size in the study area is very limited (0.50 to 2.0 ha.) and couldn't give insight into the true relationship that is likely to exist between farm size and the adoption behavior with a more normal distribution.

### 5.4.4 Media contact

The use of media is found to be positively related with the adoption behavior of maize farmers regarding all of the practices included in dairy package providing further evidence in support of Hypothesis 3.1 (see Appendix 5.18). As far as the relationship between media exposure and the adoption behavior of farmers regarding improved seed area coverage is concerned, for example, a significant difference is found between the two categories (having low and high media exposure) of farmers ($\chi^2 = 29.76$, df = 2, p = 0.000). Evidence of the relationship is the fact that only 25.6 percent of the farmers with a low exposure to media have planted more than 75 percent of their plot with improved seed. This percentage increases to 61.3 percent in the category of farmers having high exposure to media (Fig. 5.10).

The opposite tendency is evident in the case of the area coverage of local seed. In the low media exposure category 65.6 percent of the farmers have planted their plot with local seed. This percentage decreases with increasing exposure to 26.7 percent in the higher media exposure category. This clear positive relationship is manifested in the highly significant Gamma value (Gamma = 0.629, p = 0.000), which supports Hypothesis 3.1, namely that high exposure to media is directly correlated with an increase in area coverage of improved seed.

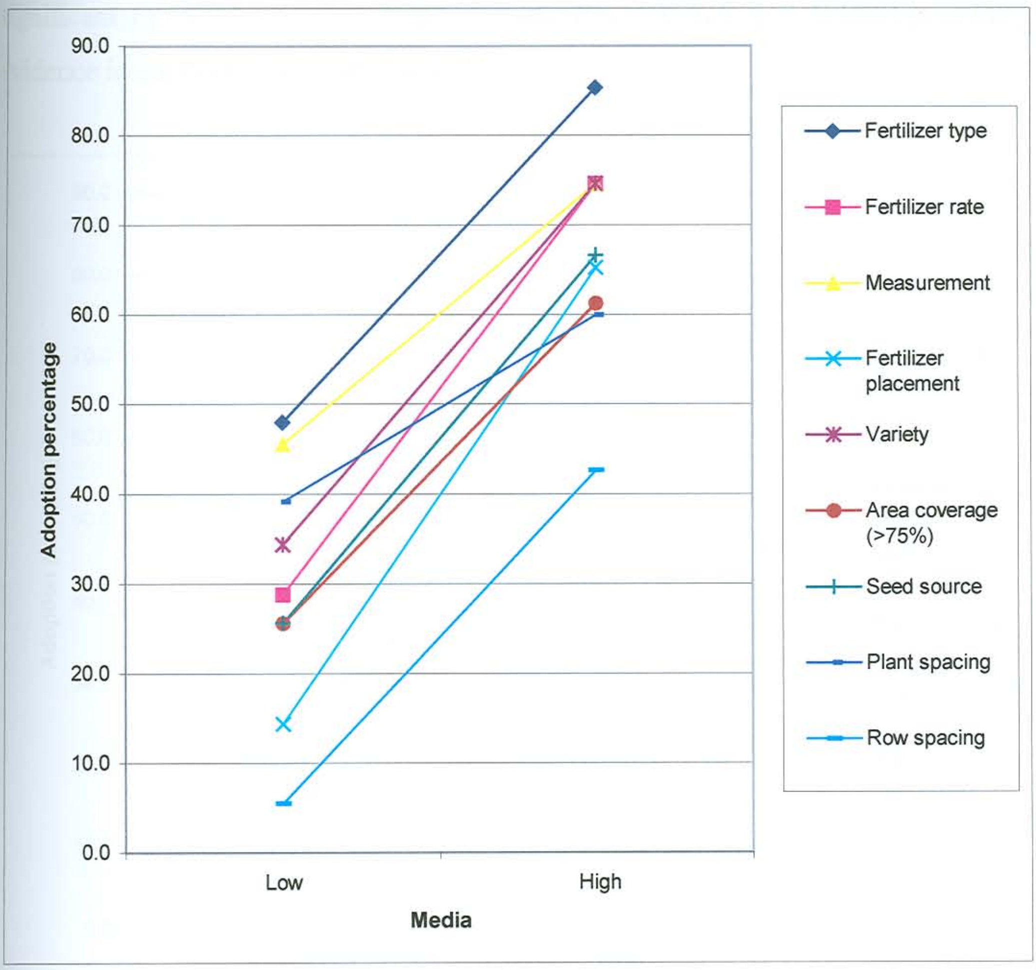


**Fig. 5.10** **Graphical illustration of the relationships between media exposure and the percentage of farmers adopting the recommended rate of technology**

### 5.4.5 Agro ecology

The practice adoption behavior of maize farmers in the Shashemene district is related with the agro ecology where they reside in. Farmers who reside in the Woina dega zone (middle agro ecology) are better adopters of all the nine recommended maize practices than those who live in kola zone (Lower agro ecology) (Appendix 5.18). The difference is significant at the less than 1 percent level in all of the practices. An example is the source of seed where only 25 percent of Kolla zone farmers use certified seed as opposed to 57 percent of the Woina dega zone farmers (Fig. 5.11). The relationship is highly significant ($\chi^2$ = 21.66, df = 1, p = 0.000; Phi = 0.325, p = 0.000) providing further evidence in support of Hypothesis 3.1.

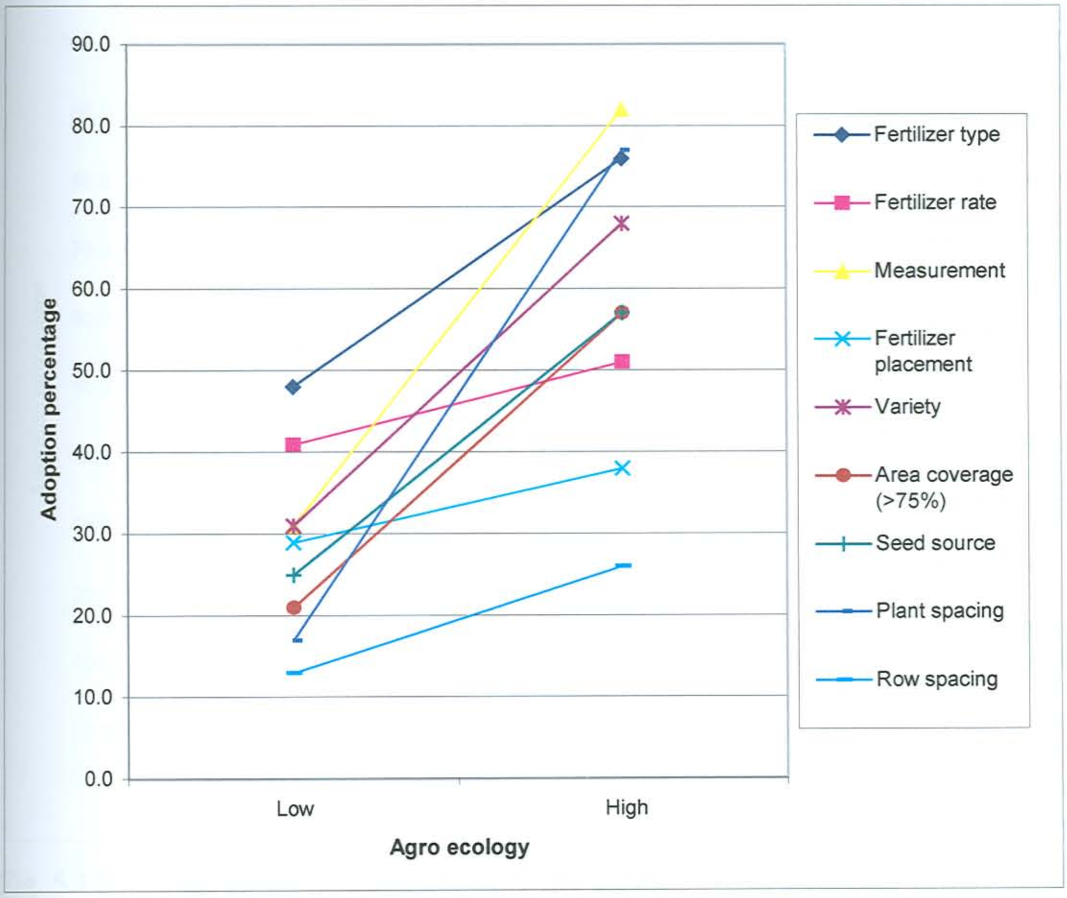


**Fig. 5.11** **Graphical illustration of the relationships between agro ecology and the percentage of farmers adopting the recommended rate of technology**

## 5.4.6 Extension contact

The adoption behavior of maize farmers is positively related with their extension contact regarding all of the recommended maize practices at the less than 1 percent level of significance. The relationship is significant at the less than 5 percent level regarding only plant (inter-row) spacing (Appendix 5.19). While 64.9 percent of the farmers with a high extension contact applied the recommended plant spacing, only 42.9 percent of those who had low contact, applied this recommendation (Fig. 5.12) indicating a significant and positive relationship ($\chi^2 = 5.82$, df = 1, p = 0.016; Gamma = 0.421, p = 0.016). The result is consistent with the hypothesized association (Hypothesis 3.1).

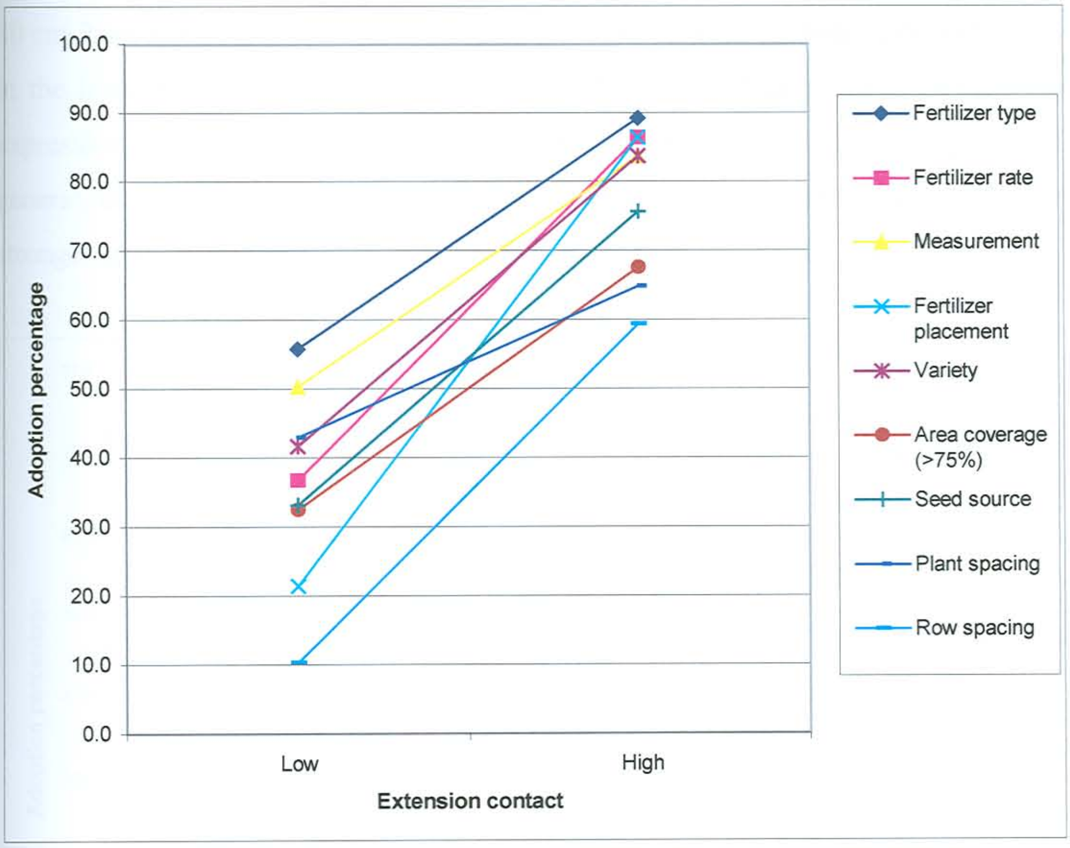


**Fig. 5.12** **Graphical illustration of the relationships between extension contact and the percentage of farmers adopting the recommended rate of technology**

### 5.4.7 Attitudinal modernity

The adoption behavior of maize farmers is positively related with their attitudinal modernity in five of the recommended practices (rate and method of fertilization and use source and row spacing of seed) at the less than 1 percent level of significance. The association is significant at 5 percent in the case of area coverage of improved seed, while the remaining practices (type and measurement of fertilizer and plant spacing) show no statistically significant relationship with attitudinal modernity (Appendix 5.19).

As far as row spacing is concerned, for example, there are significant differences between the various modernity categories ($\chi^2$ = 25.91, df = 2, p = 0.000). 42.6 percent of the farmers with high attitudinal modernity score had adopted the recommended spacing (50-80 cm-2 seed per hill). This percentage declines in an almost linear fashion to 8.1 percent in the least modern farmers category (Fig. 5.13). This clear positive relationship finds expression in the highly significant Gamma value (Gamma = 0.617, p = 0.000). In general, the results tend to support the hypothesized relationship, which could have been stronger with greater variation of attitudinal modernity among the respondents.

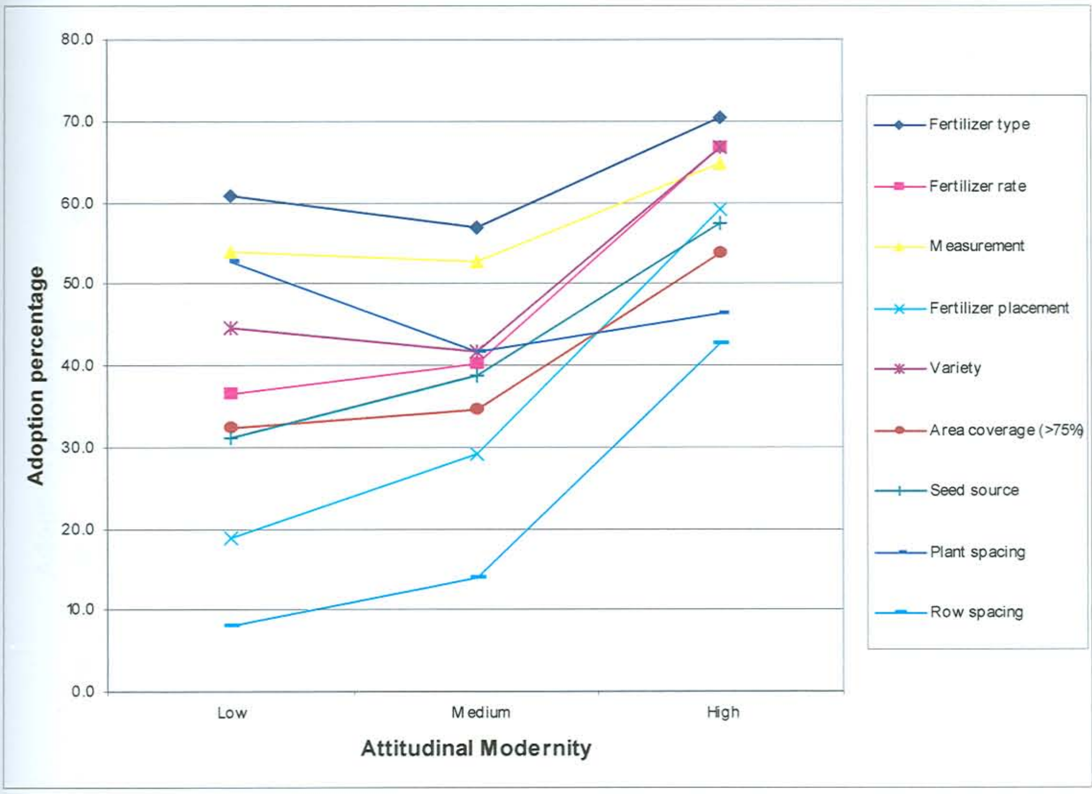


**Fig. 5.13** **Graphical illustration of the relationships between attitudinal modernity and the percentage of farmers adopting the recommended rate of technology**

### 5.4.8 Farming experience

There is a clear and negative relationship between the experience of maize farmers and their adoption behavior regarding almost all of the recommended maize practices

(Appendix 5.19). Regarding fertilizer measurement, for example, while 70.8 percent of the farmers with the least farming experience have adopted the recommended technique, only 46.8 percent of the farmers with the most experience have adopted this technique (Fig. 5.14). This relationship is significant ($\chi^2 = 8.58$, df = 2, p = 0.014; Gamma = -0.324; p = 0.003) but the negative nature is not in accordance with the hypothesized association (Hypothesis 3.1). The influence of farming experience is very similar to that of age, with which it is highly correlated (r = 0.913).

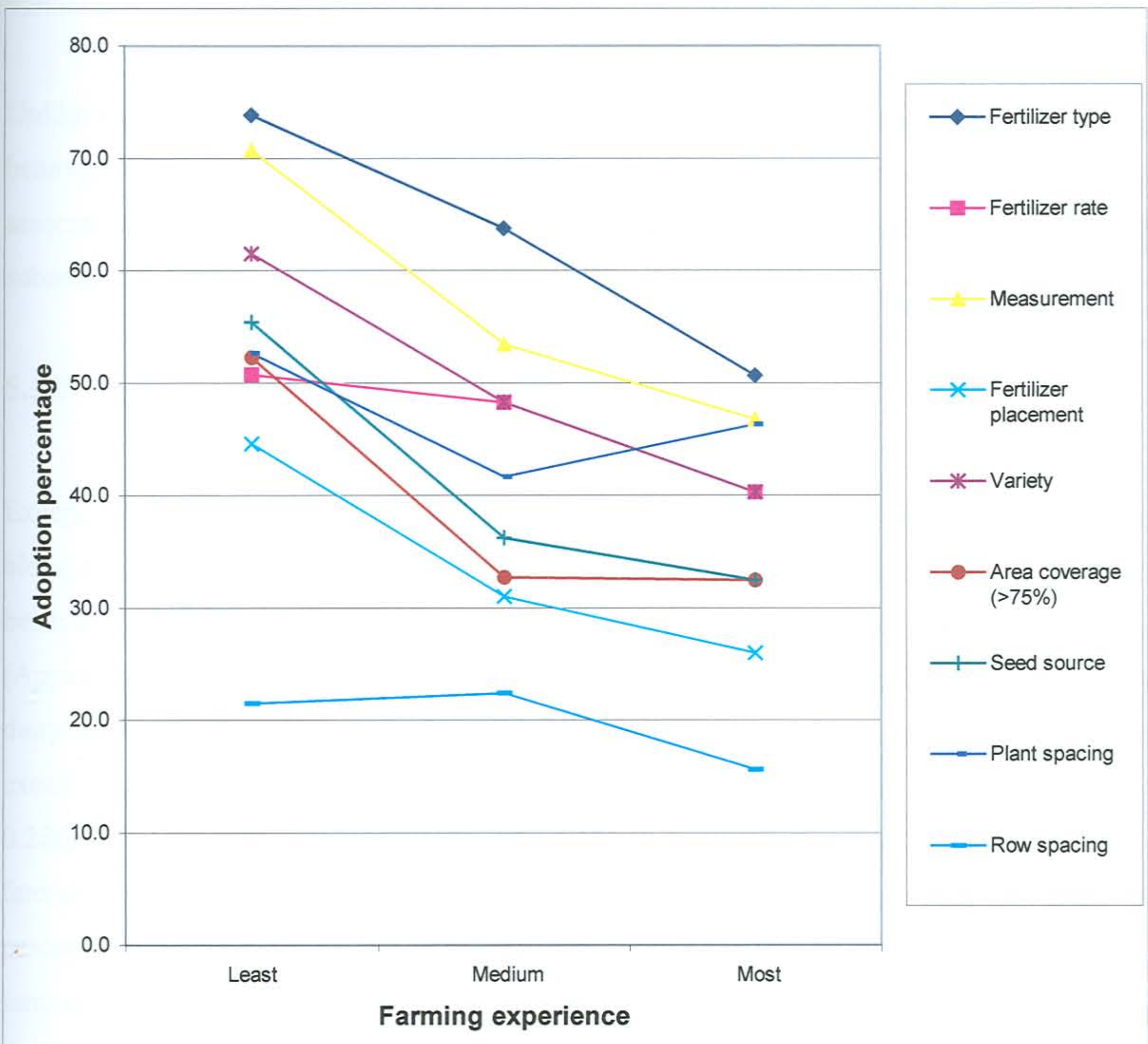


**Fig. 5.14 Graphical illustration of the relationships between farming experience and the percentage of farmers adopting the recommended rate of technology**

## 5.5 INFLUENCE OF INDEPENDENT VARIABLES ON PRACTICE ADOPTION OF DAIRY FARMERS

Production technologies incorporated in the dairy production package include breeding, housing, feeding and medical practices. As in the case of maize Chi-square analyses were used to test the significance of the relationships between variables. Cramer's V and Phi statistics (for 1 degree of freedom) for nominal variables and Gamma for ordinal variables were also used to specify the strength of the association between variables.

Unlike maize where most of the independent factors have an influence on the adoption behavior of respondent farmers, the independent variables have little or no significant association with the adoption behavior of dairy farmers as will be shown and discussed subsequently.

### 5.5.1 Age

Except for the two practices, ownership of cross breeds and more than 50 percent exotic blood cross breeds, age of the respondent is not found to be associated with the adoption behavior of dairy farmers in all of the thirteen practices included in dairy package (Appendix 5.20). Regarding the association between age and the adoption behavior of dairy farmers concerning ownership of cross breed animals having more than 50 percent exotic blood, for example, there is a significant and positive relationship (Gamma = 0.286, p = 0.036). This relationship is also evident from the fact that 28.3 percent of the farmers in the youngest age category (12 to 38 years) own a herd with less than 75 percent of the animals having more than 50 percent exotic blood while amongst the farmers in the oldest age category (58 to 80 years) ownership of the type of animals declines to 15.4 percent. The opposite tendency is evident regarding ownership of more than 75 percent animals within a herd having more than 50 percent exotic blood. In the youngest age category only 71.7 percent own the type of animals. This percentage increases slow but significantly with increasing age to 84.6 percent in the oldest age category (Fig. 5.15). Contrary to expectations, all remaining practices show no significant relationship.

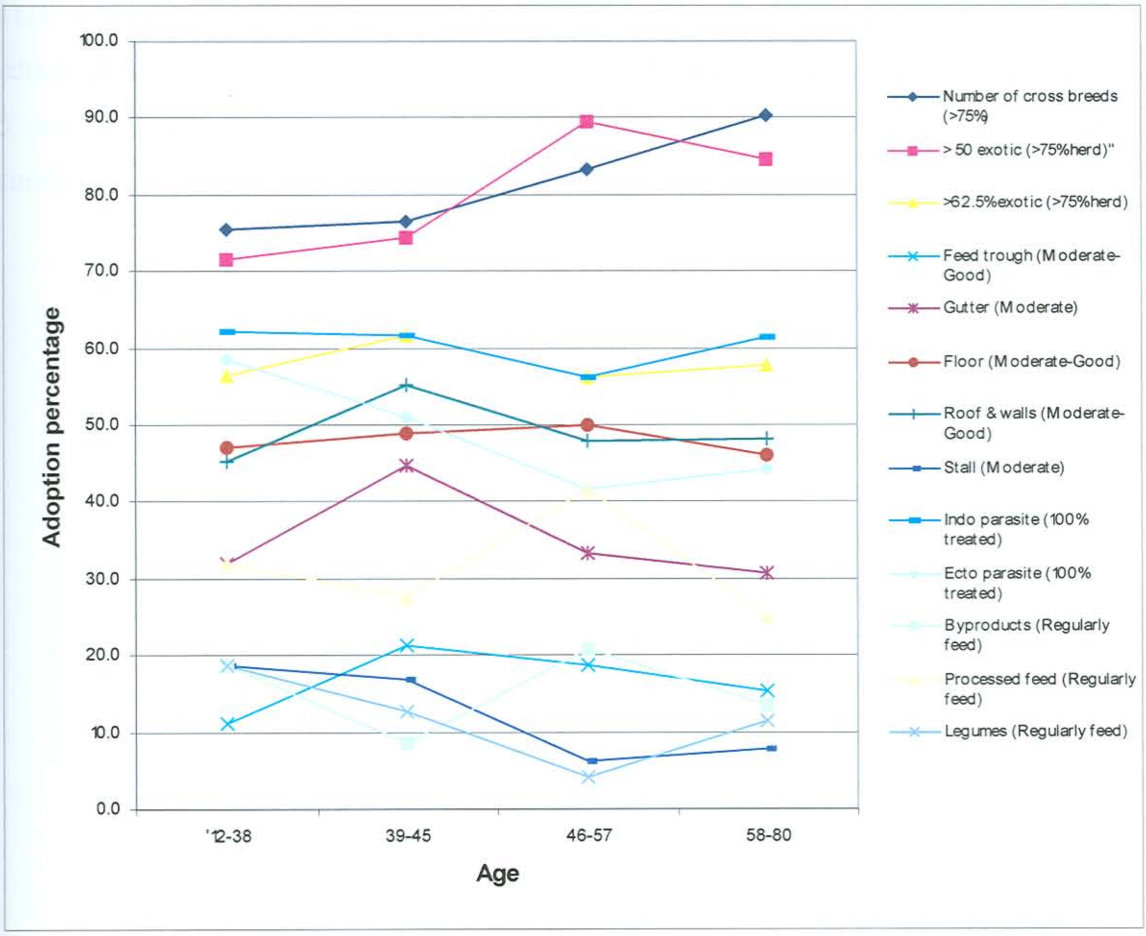


**Fig. 5.15** **Graphical illustration of the relationships between age and the percentage of farmers adopting the recommended rate of technology**

## 5.5.2 Education

The only practices where education and the adoption behavior of dairy farmers is positively associated at the less than 1 percent level of significance are treatment against internal parasites, ownership of cross breed animals, gutter (outlet of animal waste) and use of processed feeds and at the 5 percent level of significance, industrial byproducts (Appendix 5.20). The relationship between education and the adoption behavior of dairy farmers regarding the practice, treatment against internal parasites, for example, is also evident from the fact that 86.5 percent of the farmers having a tertiary level of education have treated their entire herd against internal parasites while amongst the illiterate farmers, only 43.6 percent have treated their entire animals (Fig. 5.16). Conversely, 41 percent of illiterate farmers do not have treated their herd against internal parasites at all. This percentage declines with increasing education to 13.5 percent in the highest education category (tertiary level). In some cases there are, although not significant at the 5 percent level, indications of relationships with education like in the case of floor condition.

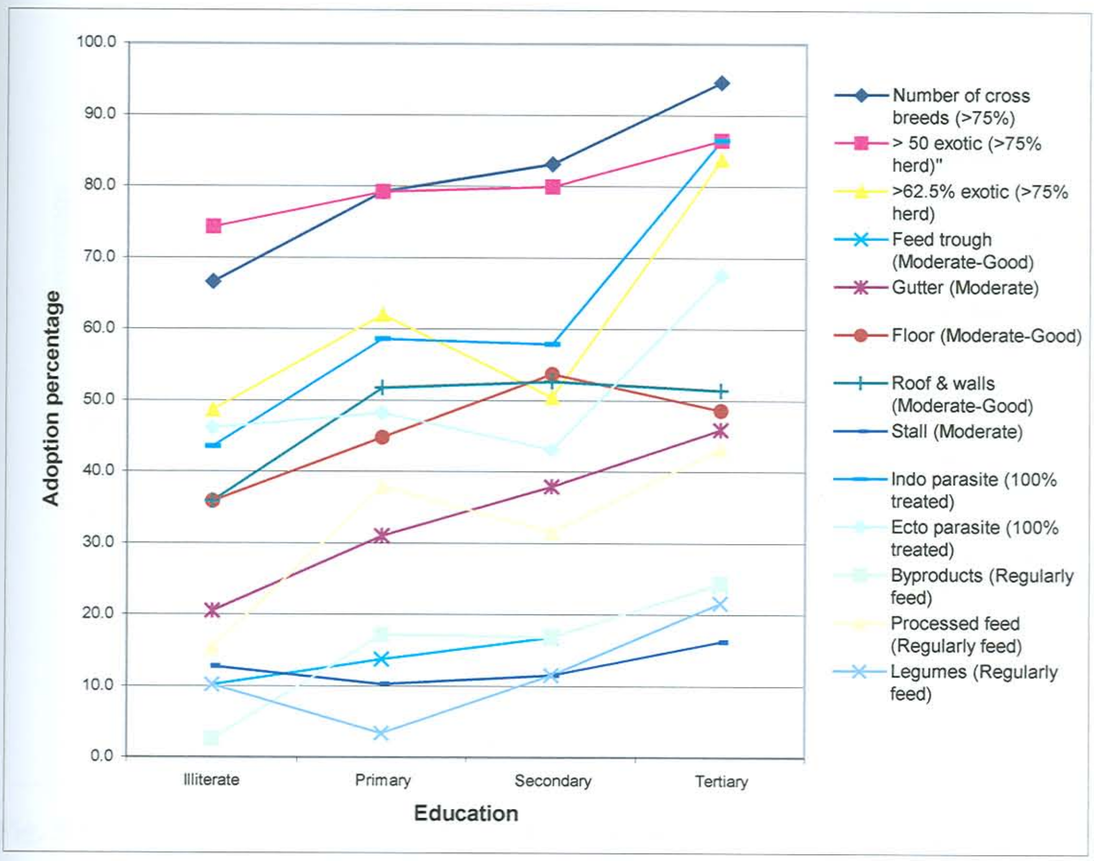


**Fig. 5.16** **Graphical illustration of the relationships between education and the percentage of farmers adopting the recommended rate of technology**

### 5.5.3 Gender

The association between gender and the adoption behavior of dairy farmers is found to be significant regarding only two practices, namely, use of forage legumes and condition of stall (Appendix 5.20). Regarding the adoption of forage legumes for example, 12.7 percent of male farmers regularly feed their animals with forage legumes while only 8.8

percent of female farmers feed their animals with forage legumes regularly (Fig. 17). The relationship, as shown in Appendix 5.20, is significant at the 1 percent level of probability ($\chi^2 = 11.09$, df = 2, p= 0.004; Cramer's V = 0.235, p = 0.004). In general it does not appear as if gender is an important factor in dairy production.

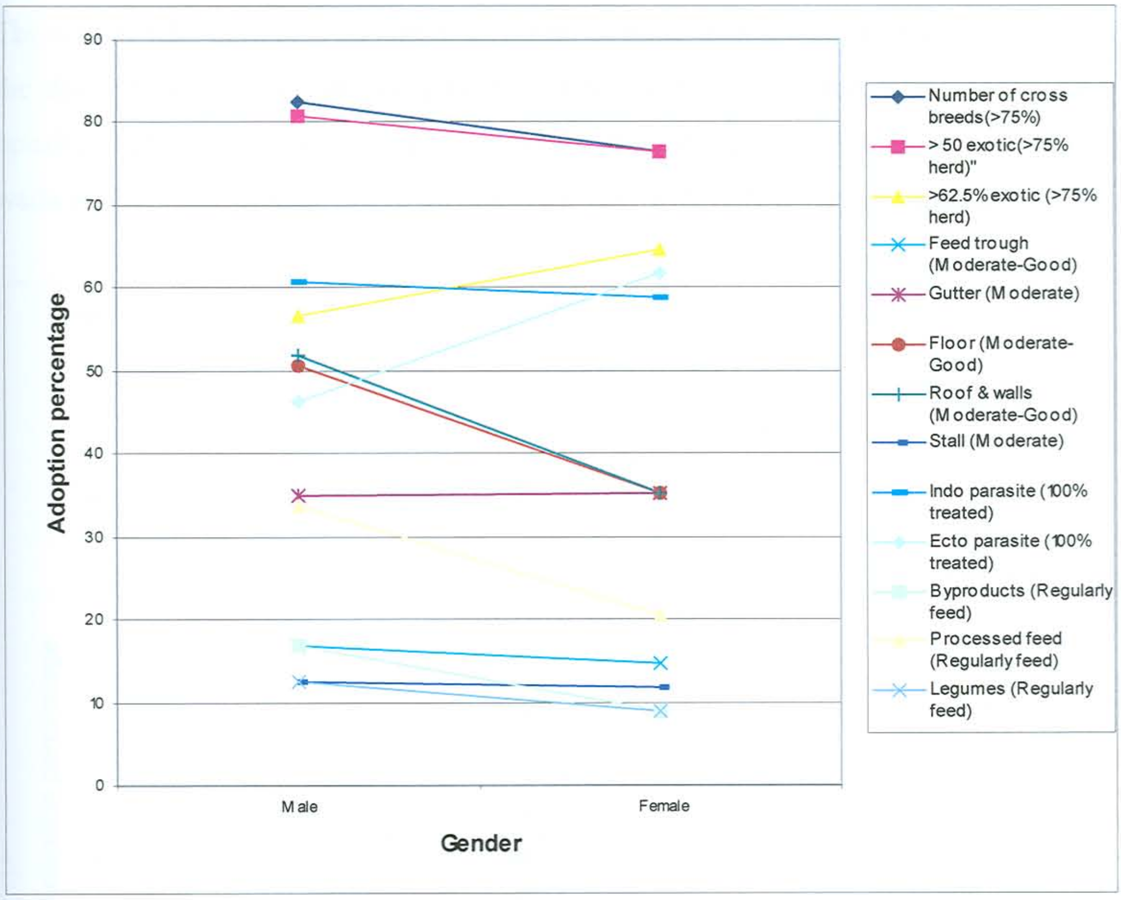


**Fig. 5.17 Graphical illustration of the relationships between gender and the percentage of farmers adopting the recommended rate of technology**

## 5.5.4 Farm size

Farm size is positively related with the adoption behavior of dairy farmers in all of the practices included in the dairy package and (Appendix 5.20). The association is, however, significant only regarding five of these practices, of which four are housing practices, namely, conditions of feed trough, gutter, floor, and roof and sidewall. The relationships between farm size and the adoption behavior of dairy farmers regarding these four housing practices are significant at the 1percent level of probability. Considering adoption of feed trough for example, while 65.7 percent of bigger farmers had a moderate to good condition feed trough, this percentage decreases to 28.4 percent in the small farmers category (Fig. 5.18). The relationship, as shown in appendix 5.20, is highly significant ($\chi^2 = 23.65$, df = 6, p = 0.001; Gamma = 0.406, p = 0.000).

The reason why farm size had more effect on housing than the other practices included in the dairy package could probably be associated with costs. Constructing costly modern housing with all facilities including a gutter, stall, good condition floor, roof and side walls is obviously less attractive for small farmers with only a very few animals.

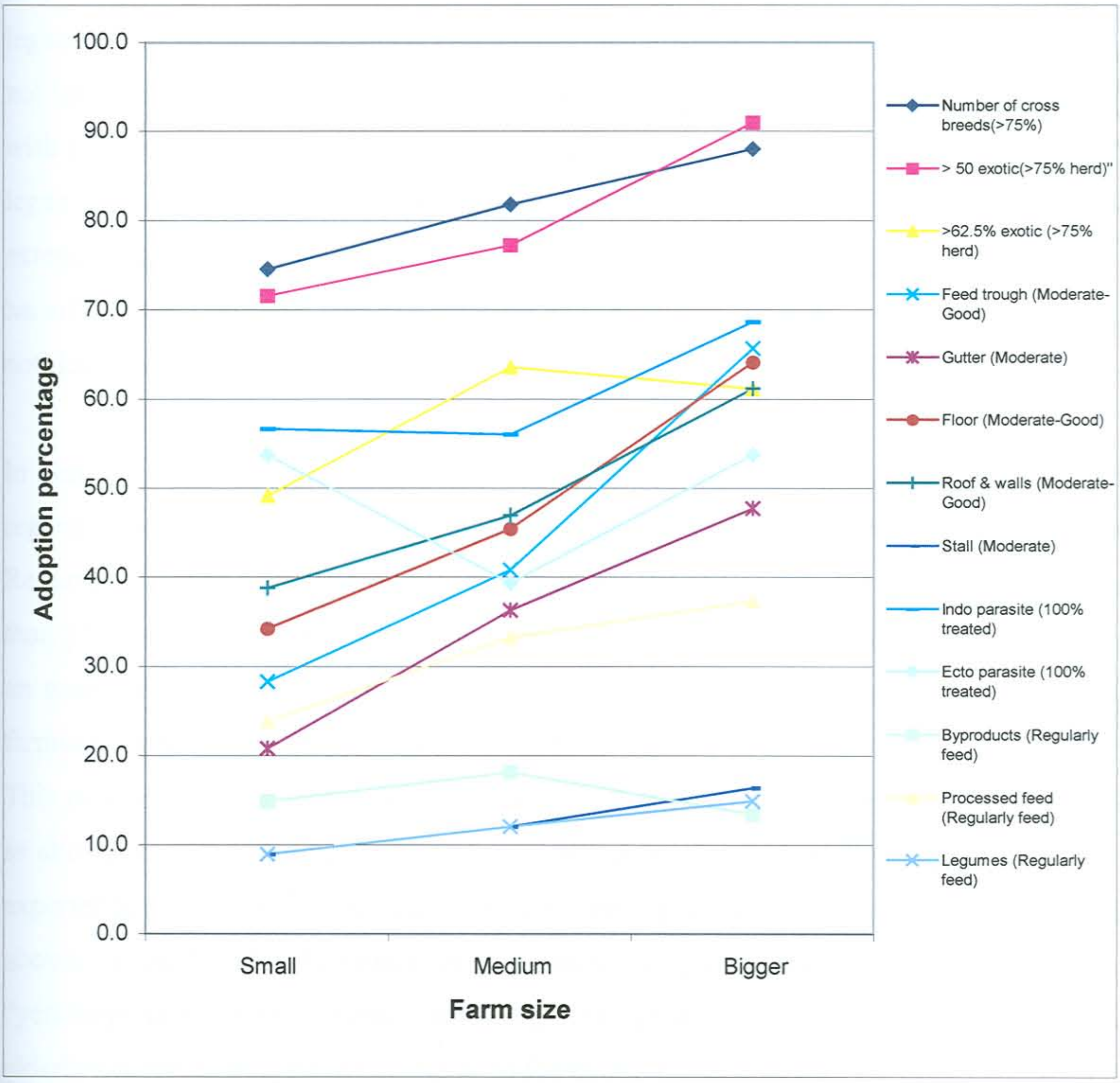


**Fig. 5.18 Graphical illustration of the relationships between farm size and the percentage of farmers adopting the recommended rate of technology**

### 5.5.5 Farming experience

Farming experience is positively associated with the adoption behavior of dairy farmers regarding almost all of the dairy practices as expected except for the use of forage legumes, conditions of gutter and stall and treatment against external parasites in which the relationships are negative though not significant (Appendix 5.21).

One interesting question that can be raised here is that when older dairy farmers with most experience had better adopted most of the practices incorporated in the package, why the associations become negative in the case of some of the practices such as forage legumes and external parasites? This phenomenon did not happen by coincidence, it is not uncommon for elderly people in Ethiopia to adopt a culture of feeding their animals with teff (type of cereal) straw and hay and are not so much motivated to seek for forage legumes, which they don't know it traditionally. They are also highly familiar with external parasites such as ticks, fleas and lice and therefore, may not count them as harmful to their animals than the younger ones with low experience where the tradition is not deep rooted.

In general, the experience of farmers is significantly related to their adoption behavior regarding only the three breeding practices at the less than 10 percent level of probability. Regarding the use of more than 50 percent exotic breed animals, for example, while more than 75 percent of the herd of 84.6 percent of the farmers with the most experience have an exotic blood level of more than 50 percent, the number of farmers with the least farming experience who possess these kinds of animals is only 69.1 percent (Fig. 5.19). This relationship is significant ($\chi^2 = 7.71$, df = 2, p = 0.021; Gamma = 0.321, p = 0.030) as shown in Appendix 5.21. The reason why dairy farmers with vast years of farming experience place more value to improved breeding practices than the rest is similar to the above, i.e. exotic blood animals are traditionally highly valued and esteemed. The term "yeferenje lam", which means technology of the white man and commonly used by elderly people, conveys the value placed for exotic blood animals.

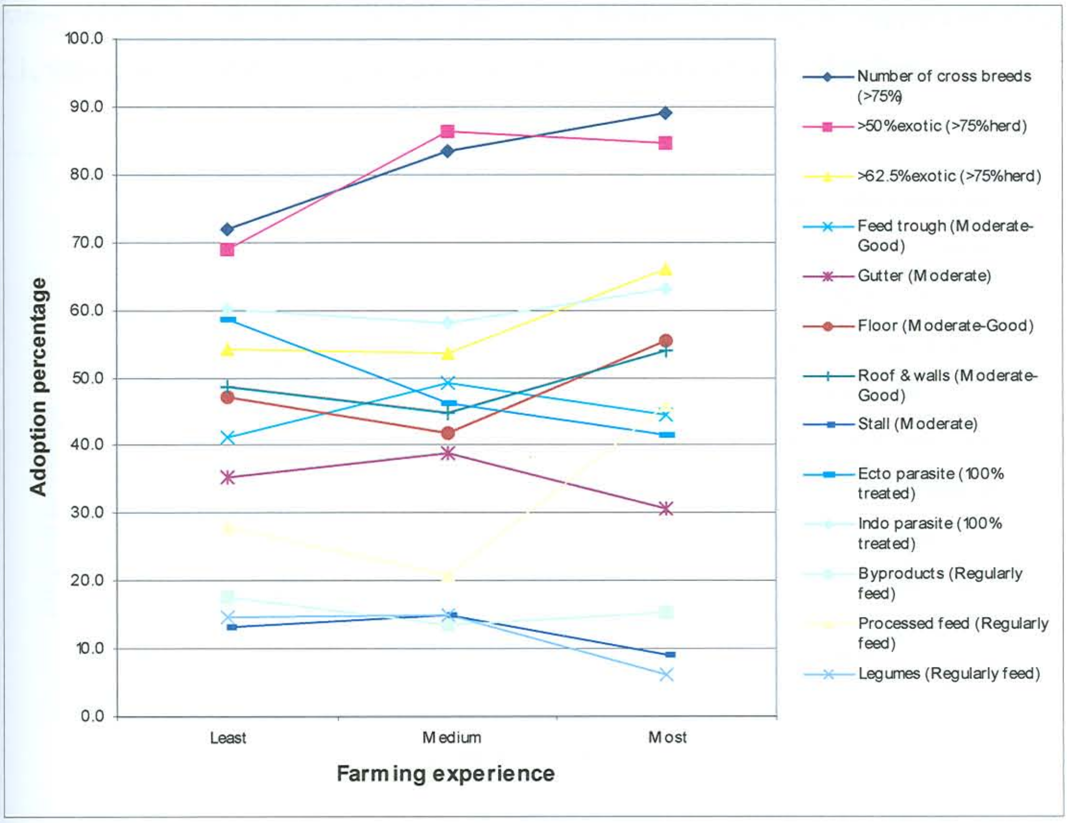


**Fig. 5.19** **Graphical illustration of the relationships between farming experience and the percentage of farmers adopting the recommended rate of technology**

## 5.5.6 Media contact

The use of media is positively related with the adoption behavior of dairy farmers in all of the thirteen practices integrated in the dairy package as expected (Appendix 5.21). The association is significant at the 1 percent level of probability regarding four practices (ownership of more than 62.5 percent exotic blood level animal, supply of byproducts and processed feed, and treatment against internal parasites) and at the 5 percent level in two practices (cross breed animals and conditions of roof and side walls). Considering the adoption of cross breed animals, for example, while 85.8 percent of those farmers having more exposure to media possess more than 75 percent cross breed animals in their herd, this percentage declines with a decrease in exposure to 72.7 percent in the least media exposure category (Fig. 5.20). This relationship is significant ($\chi^2$ =5.02, df = 1, p =

0.004; Gamma = 0.388, p= 0.037) providing further evidence in support of Hypothesis 3.1, which states that high exposure to media is correlated with adoption.

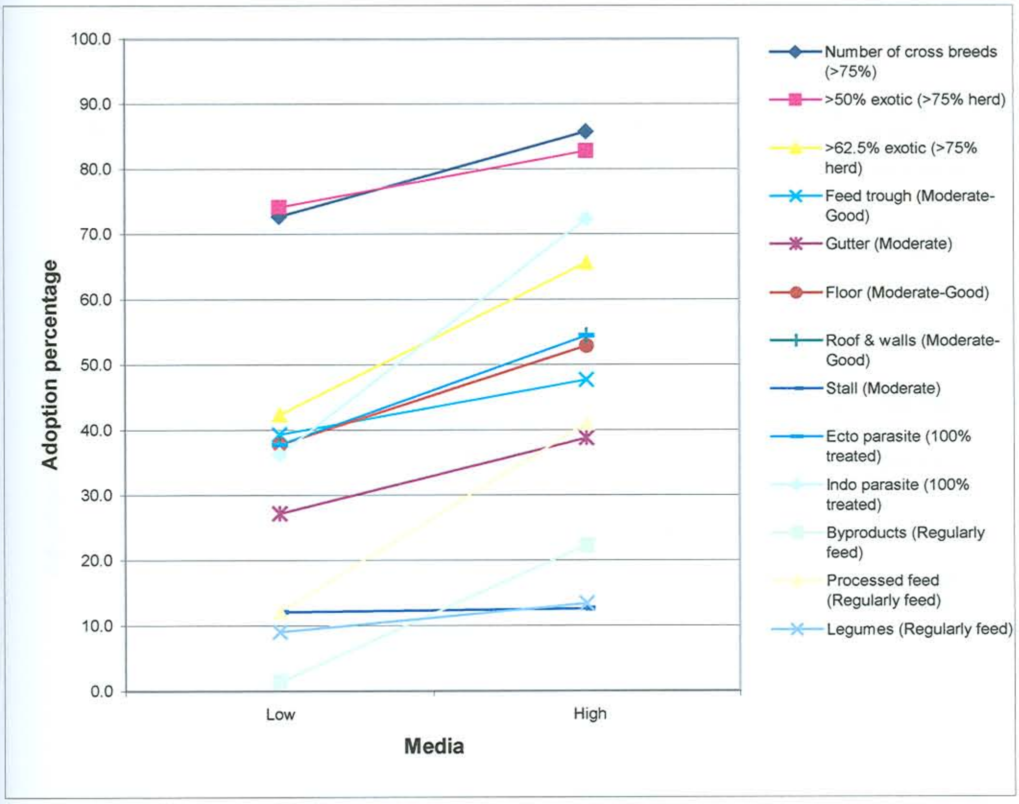


**Fig. 5.20** **Graphical illustration of the relationships between media exposure and the percentage of farmers adopting the recommended technology**

## 5.5.7 Attitudinal modernity

There are again positive relationships between modern attitudes and the adoption behavior of dairy farmers regarding almost all of the dairy practices except feed trough and floor conditions. The associations are, however, not significant regarding most of the practices except the use of cross breed animals (Appendix 5. 22). Regarding this practice, while 94.4 percent of the farmers with high attitudinal modernity score have a herd with more than 75 percent cross breed animals, only 75.4 percent of the farmers with low attitudinal modernity score possess this types of animals (Fig. 5. 21). This relationship, as shown in Appendix 5.22, is significant at the 1 percent level of probability ($\chi^2$ = 12.60, df = 2, p = 0.002; Gamma = 0.426, p = 0.001). The weak relationships between these two variables can be attributed to the parabolic relationship (see Fig. 5.21) manifested regarding most of the practices.

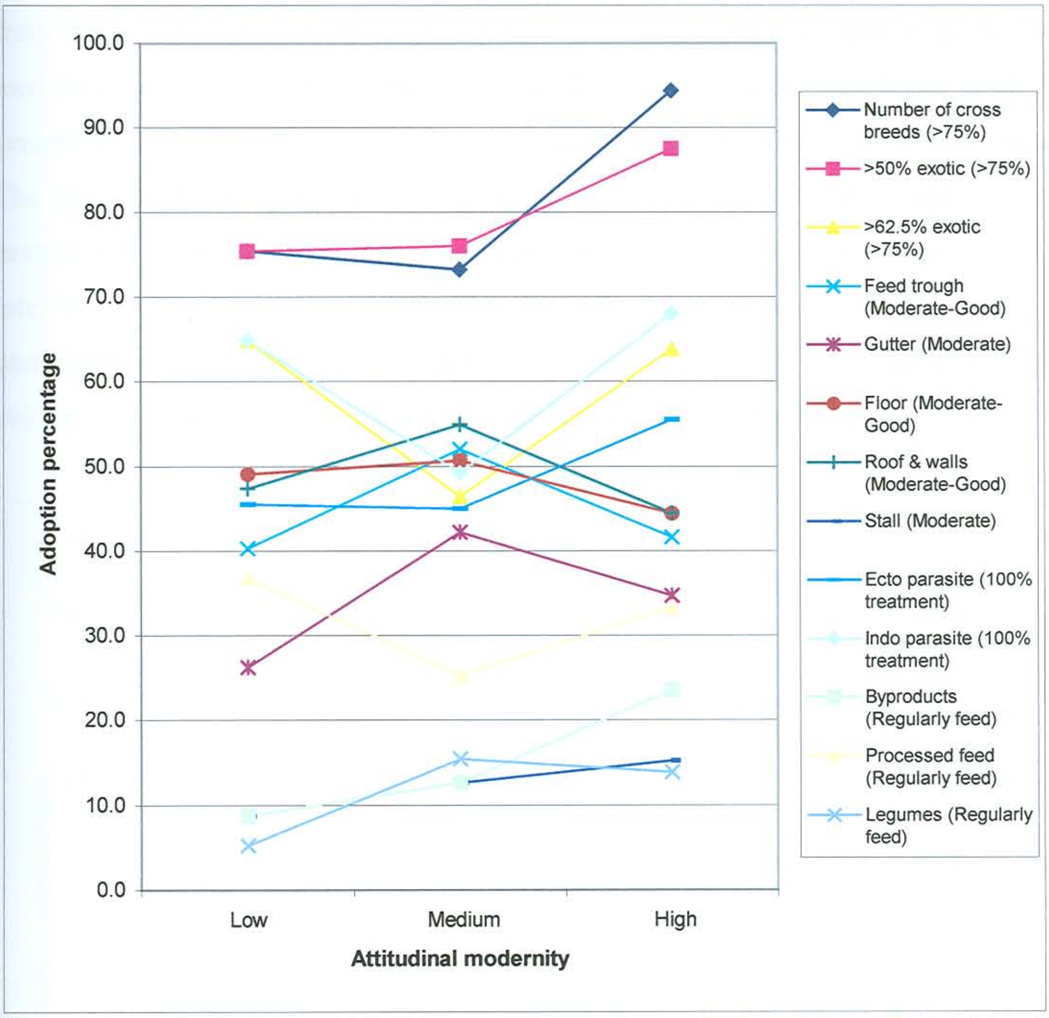


**Fig. 5.21 Graphical illustration of the relationships between attitudinal modernity and the percentage of farmers adopting recommended rate of technology**

## 5.5.8 Organizational participation

The relationship between the adoption behavior of dairy farmers of ALWDADPMA and their organizational participation is not found to be different from the other relationships found regarding the rest of the independent variables assumed to be correlated with the adoption behavior of dairy farmers. It is positively related regarding all of the practices included in the package as expected. The relationship, however, is significant only in one practice namely the use of products of feed processing plants, which is significant at the 1 level (Gamma= 0.635, p = 0.000) (Appendix 5. 22). This relationship is also evident from the Chi square statistic. 73.4 percent of the least efficient farmers do not regularly feed their herd with most of the recommended types of processed feeds while only 37 percent of the most efficient farmers do not regularly feed their herd with these feeds. The opposite tendency is evident regarding the use of recommended type of feeds. 26.6 percent of the farmers having low organizational participation feed the recommended rate. This percentage increases to 63 percent in the category of farmers having higher participation. This difference is significant ($\chi^2$= 15.17, df = 2, p = 0.001) lending further evidence in support of the hypothesized association (Hypothesis 3.1).

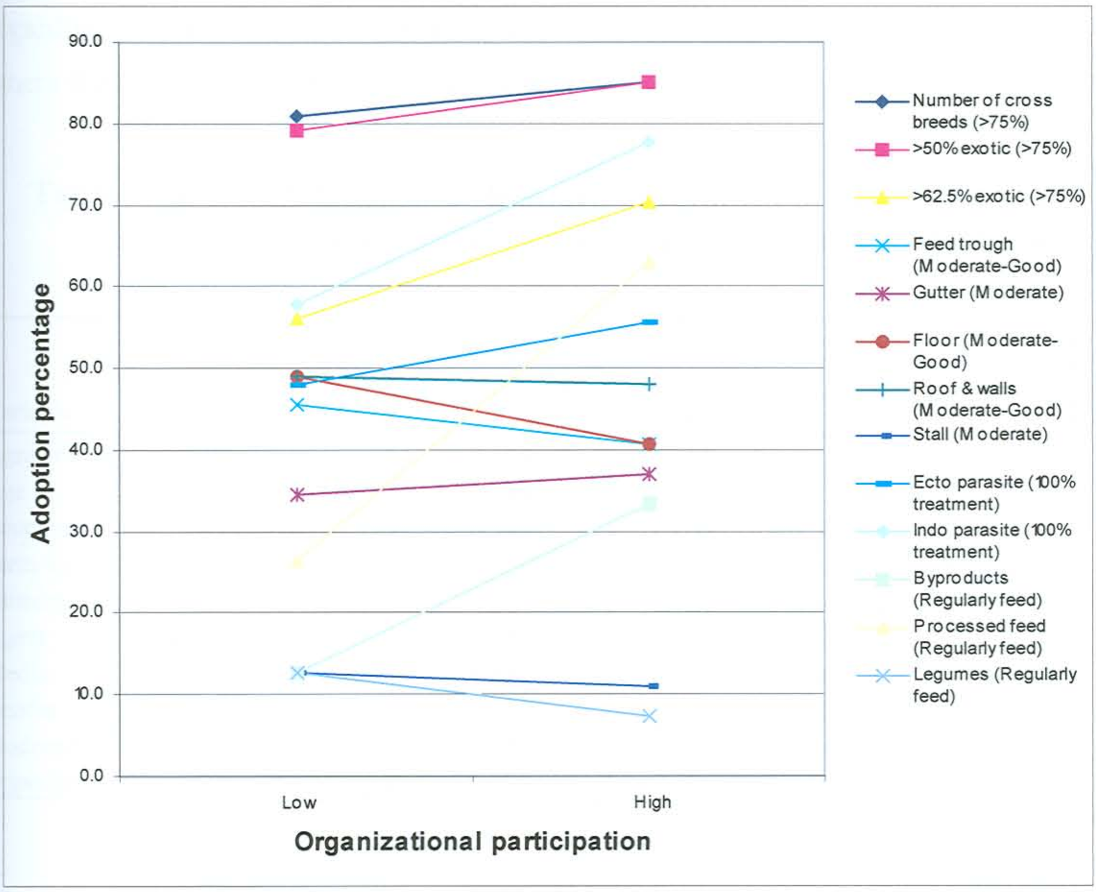


**Fig. 5.22** **Graphical illustration of the relationships between organizational participation and the percentage of farmers adopting the recommended rate of technology**

## 5.6 INFLUENCE OF INDEPENDENT VARIABLES ON THE PACKAGE ADOPTION BEHAVIOR OF MAIZE AND DAIRY FARMERS

Having assessed the relationships between independent variables and the adoption behavior of maize and dairy farmers regarding the production practices included in the maize and dairy packages in the previous sections, the influence relationships regarding the respective packages will be evaluated here. According to Table 5.16, which shows these relationships, the variables assessed to have been significantly associated with the adoption behavior of farmers regarding the practices are also found to have similar relationships regarding the two packages. Difference between the two analyses is found regarding only change agent contact in case of maize and, farming experience in dairy, where the latter analysis does not show significant relationships.

**Table 5.16 Relationship between independent variables and the package adoption behavior of maize and dairy farmers**

| Variable | Association | | | |
|---|---|---|---|---|
| | Maize | | Dairy | |
| | r | p | r | p |
| Agro ecology | 0.374 | 0.000 | - | - |
| Age | -0.288 | 0.000 | -0.068 | 0.335 |
| Education | 0.345 | 0.000 | 0.275 | 0.000 |
| Farm size | -0.172 | 0.015 | 0.241 | 0.001 |
| Farming experience | -0.267 | 0.000 | -0.003 | 0.961 |
| Agent | 0.048 | 0.499 | | |
| Media | 0.435 | 0.000 | 0.314 | 0.000 |
| Gender | - | - | 0.004 | 0.960 |
| Modernity | 0.123 | 0.084 | 0.064 | 0.371 |
| Organization | - | - | 0.082 | 0.246 |

## 5.7 CONTRIBUTIONS OF INDEPENDENT VARIABLES TO PACKAGE ADOPTION VARIANCE

In order to assess more accurately the contribution of independent variables on adoption of the maize and dairy package multiple regression analyses were used. Based on the results of the bivariate analyses presented in previous sections agro-ecology, age, education, farm size, change agent contact, media exposure, and attitudinal modernity in maize, and media exposure, farm size, farming experience, and education in dairy farming are selected for multiple regression analysis.

All the variables included in the assumed regression models have signs corresponding to their theoretical definition.

The analysis corroborates a rather limited contribution of the independent variables on the adoption behaviors of maize and dairy farmers. Only agro ecological region, education and media exposure in maize and farm size, media exposure and education in dairy are found to be the significant predictors of the adoption behavior of dairy farmers. In accordance with these limited contributions, the total variation explained by independent variables is a mere 32.4 percent ($R^2 = 0.324$) in the case of maize and 17.8 percent ($R^2 = 0.178$) in dairy farming (Table 5.17).

This is in conformity with the findings of Düvel (1975:8) and Düvel and Botha (1999:56). They reported that the correlation between independent variables and adoption (decision making) is very seldom significant and that it could be an indication for behavior to be only indirectly influenced by independent variables.

**Table 5.17 Multiple regression estimates of the effects of independent variables on adoption behavior**

| Variable | Maize | | | Dairy | | |
|---|---|---|---|---|---|---|
| | Beta | t | p | Beta | t | p |
| Constant | | 3.619 | 0.000 | - | 18.584 | 0.000 |
| Agro ecology* | 0.3412 | 4.530 | 0.000 | - | - | - |
| Age | -0.039 | -0.547 | 0.585 | - | - | - |
| Farming experience | - | - | - | 0.001 | 0.015 | 0.988 |
| Education | 0.167 | 2.090 | 0.038 | .160 | 2.208 | 0.028 |
| Farm size | 0.085 | 1.141 | 0.255 | 0.229 | 3.467 | 0.001 |
| Extension contact* | -0.080 | -1.169 | 0.244 | - | - | - |
| Media exposure* | 0.356 | 4.547 | 0.000 | 0.251 | 3.546 | 0.000 |
| Attitudinal modernity | -0.070 | -0.927 | 0.355 | - | - | - |

$R^2 = 0.324$ (Maize) $R^2 = 0.178$ (Dairy); * Dummy variable

# CHAPTER 6

# INTERVENING VARIABLES AND THEIR INFLUENCE ON PRODUCTION EFFICIENCY AND ADOPTION

## 6.1 INTRODUCTION

In view of the hypothesis that the influence of intervening variables on the adoption behavior and production efficiency of respondents is higher than that of independent variables, and having discussed the influence of the latter in chapter five, the influence of intervening variables will now be assessed in this chapter. Their influence on production efficiency will first be evaluated followed by a discussion of their influence on adoption. Comparative analyses between the two sets of variables are also made with the object of identifying the most crucial factors to be considered in extension.

Intervening variables considered in this study are either need related (perceived current efficiency, need tension and need compatibility) or perception related (perceptions of technology attributes). These variables do not exist as such, but are related to and have to be assessed in association with the specific activities, technologies or practices under investigation. The variable, need tension, for example, can refer to the need tension of respondents' overall production efficiency in a specific commodity or to the practices under consideration.

## 6.2 INFLUENCE OF THE PERCEIVED CURRENT EFFICIENCY ON PRODUCTION EFFICIENCY

Production efficiency and adoption behavior are hypothesized to be a function of personal and environmental factors, which in turn are divided into independent and intervening variables. One of the intervening variables identified by Düvel (1975) and regarded to be one of the principal casual factors among the intervening variables in behavior determination is the perceived current efficiency (PCE), which can refer to the overall production efficiency or to the technology or practice adoption. Since this aspect or variable is one dimension of the total problem perception, it is expected to have a significant influence on adoption behavior. As the concept implies, it is the individual's perception of the current efficiency. According to Koch (1987:23) there is a tendency to overrate the current efficiency and it stands to reason that the more the current efficiency is overrated, the smaller the problem scope or need tension becomes and thus the smaller the incentive to change.

The more accurately a farmer perceives his problem, the more likely he is to appreciate the improvement potential, and the more likely he is to alter his behavior and thereby improve his production efficiency. This assumption (Koch, 1987:24; Düvel and Botha, 1999:47) led to the hypothesis that the inaccuracy of PCE, expressed as the degree to which the current efficiency is overrated, is negatively related to the adoption behavior and production efficiency of farmers in the study area.

Maize and dairy farmers were assessed regarding the "correctness" of their perception in respect of their current production efficiency and the efficiency of the production practices promoted through PADETES namely improved seeds, line planting, fertilizer, and spot application in maize, and breed, feed, medical, and housing practices in dairy.

### 6.2.1 Perception regarding the current production efficiency

As shown in Table 6.1, the overwhelming majority of maize farmers (90.5 percent) do not perceive their efficiency or situation correctly in the sense that they slightly overrated (54 percent) or significantly overrated their production efficiency. In contradiction with the hypothesis, there is no relationship between the PCE and the actual production efficiency ($r = -0.075$, $p = 0.293$) although the $\chi^2$ test reflects highly significant difference between the efficiency categories ($\chi^2 = 46.76$, $df = 8$, $p = 0.000$).

**Table 6.1 Relationships between perceived current efficiency (PCE) and production efficiency as reflected in percentage distributions and a test of association**

| | | Percentage distribution of farmers per efficiency category* | | | | | | Association | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total | | | | | |
| Variable | Category | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 | $\chi^2$ | p | df | r | p |
| **Maize** | | | | | | | | | | | | |
| PCE-efficiency | No discrepancy | 22 | - | - | 3.7 | 21.1 | 9.5 | | | | | |
| | Slightly over rate | 51.2 | 29.2 | 79.1 | 44.4 | 57.9 | 54 | | | | | |
| | Over rate | 26.8 | 70.8 | 20.9 | 51.9 | 21.1 | 36.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 46.8 | 0.000 | 8 | -0.08 | 0.293 |
| PCE-fertilizer | Slightly under rate | - | 4.2 | 20.9 | 33.3 | 23.7 | 18.5 | | | | | |
| | No discrepancy | 97.6 | 83.3 | 58.1 | 40.7 | 68.4 | 66.5 | | | | | |
| | Over rate | 2.4 | 12.5 | 20.9 | 25.9 | 7.9 | 15 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 41.2 | 0.000 | 8 | -0.10 | 0.147 |
| PCE-spot | Slightly under rate | - | 17 | 26 | 26 | 24 | 19 | | | | | |
| | No discrepancy | 95 | 79 | 63 | 52 | 63 | 68.5 | | | | | |
| | Over rate | 4.9 | 4.2 | 12 | 22 | 13 | 12.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 25.2 | 0.001 | 8 | -0.06 | 0.428 |
| PCE-seed | Slightly under rate | - | 4.2 | 16 | 24 | 29 | 16 | | | | | |
| | No discrepancy | 100 | 96 | 84 | 76 | 71 | 84 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 17.7 | 0.001 | 4 | -0.17 | 0.018 |
| PCE-line planting | Slightly under rate | 7.3 | 13 | 16 | 17 | 21 | 15 | | | | | |
| | No discrepancy | 76 | 67 | 70 | 57 | 58 | 65 | | | | | |
| | Over rate | 17 | 21 | 14 | 26 | 21 | 20 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 6.4 | 0.606 | 8 | -0.03 | 0.691 |
| **Dairy** | | | | | | | | | | | | |
| PCE-efficiency | Under rate | 2.9 | 2.4 | 10 | 13 | 5.6 | 7 | | | | | |
| | Slightly under rate | 20 | 41 | 77 | 68 | 78 | 58 | | | | | |
| | No discrepancy | 77 | 56 | 13 | 20 | 17 | 35 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 57.4 | 0.000 | 8 | -0.43 | 0.000 |
| PCE-breed | Slightly under rate | 49 | 39 | 58 | 43 | 47 | 47.5 | | | | | |
| | No discrepancy | 31 | 41 | 33 | 38 | 31 | 35 | | | | | |
| | Over rate | 20 | 20 | 8.3 | 20 | 22 | 17.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 6.1 | 0.636 | 8 | 0.02 | 0.809 |
| PCE-housing | Slightly under rate | 14 | 12 | 17 | 18 | 19 | 16 | | | | | |
| | No discrepancy | 26 | 41 | 48 | 23 | 33 | 35 | | | | | |
| | Over rate | 60 | 46 | 35 | 60 | 47 | 49 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 10.0 | 0.267 | 8 | -0.02 | 0.794 |
| PCE-medical | Slightly under rate | 26 | 37 | 42 | 43 | 36 | 37 | | | | | |
| | No discrepancy | 43 | 44 | 44 | 38 | 47 | 43 | | | | | |
| | Over rate | 31 | 20 | 15 | 20 | 17 | 20 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 5.5 | 0.707 | 8 | -0.06 | 0.382 |
| PCE-feed | Slightly under rate | 31 | 27 | 35 | 35 | 36 | 33 | | | | | |
| | No discrepancy | 49 | 66 | 58 | 53 | 25 | 51 | | | | | |
| | Over rate | 20 | 7.3 | 6.3 | 13 | 39 | 16 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 25.1 | 0.002 | 8 | 0.05 | 0.508 |
| | Frequency | 35 | 41 | 48 | 40 | 36 | 200 | | | | | |

*1 = Least efficient, 5 = Most efficient

On close inspection it appears that the relationship is not linear but parabolic with the most accurate perceptions found in the most efficient and least efficient categories. The latter could be attributed to an attitude of resignation and for that reason an acceptance of the current inefficiency and consequently the more realistic assessment. Dairy farmers, on the other hand, had a better or more realistic perception of their current efficiency. 35 percent had correctly assessed their current production efficiency. 65 percent had underrated or slightly underrated their present level of efficiency. There was no single farmer who had overrated his present efficiency situation. In this case the difference is not in terms of overrating but rather the underrating of the own production efficiency ($\chi^2 = 57.37$, df = 8, p = 0.000). If the degree of overrating is intended to also include the underrating (a negative overrating value), then the hypothesized tendency or correlation is evident (r = -0.430, p = 0.000) thereby supporting a hypothesis (Hypothesis 2.2), which states that not so much the accuracy of assessment (rating) but the degree of overrating of efficiency is negatively related to the real efficiency. The fact that efficient dairy farmers had underrated rather than overrated their current level of efficiency implies that the problem was perceived to be even higher than it really was and consequently the higher incentive to improve.

### 6.2.2 Perception regarding efficiency of production practices

Maize and dairy farmers have perceived their current efficiency of production practices more accurately than their production efficiency (Table 6.1). In both maize and dairy farming, they either underrate or slightly underrate their practice adoption efficiency. Only 12.5 to 20 percent of them overrated their current adoption level of these practices. The less efficient and efficient farmers are also significantly different in their problem perception of the majority of the practices included in maize package and to a lesser degree in the dairy package. The difference lies mainly in the phenomenon that the more efficient respondents tend to underrate their efficiency more than the less efficient producers do. For example, as far as the perception of seed adoption is concerned, there is a significant negative relationship (r = -0.167, p = 0.018) between perception of the efficiency of seed used (PCE-seed) and the production efficiency of maize farmers, implying that the more the respondents underrate the effectiveness or efficiency of their seed use, the better their adoption of recommended seed and production efficiency. The $\chi^2$ analysis also reveals similar relationships. As far as perceived current efficiency regarding line planting is concerned, for example, there is significant variation among the various efficiency groups ($\chi^2 = 17.67$, df = 4, p = 0.001). While 15 percent of efficient farmers slightly underrate their efficiency, only 7.3 percent of the less efficient maize farmers slightly underrate their current line planting adoption efficiency implying that they have overrated their practice adoption efficiency more than the efficient ones.

## 6.3 INFLUENCE OF NEED TENSION ON PRODUCTION EFFICIENCY

The incentive or need related motive of a problem lies primarily in the perceived discrepancy between the current and the desired or potential situation. This problem scope is referred to as need tension (Düvel, 1991:80) and its assumed influence is based on various research findings (Koch, 1985:15; Düvel & Scholtz, 1986:4; Koch, 1987:24; Louw & Düvel, 1993:37; Botha, 1999:51; Düvel & Botha, 1999:47) and has led to the hypothesis that need tension is positively related to the adoption behavior and production efficiency of farmers in the study area.

### 6.3.1 Need tension regarding production efficiency

The need tension or need potential of maize farmers in the study area regarding production efficiency is quite appreciable, leaving some potential to be exploited. 53.5 percent of them were assessed to have a medium need tension while 30.5 percent have a high need tension or need potential. The need potential of dairy farmers on the other hand, was somewhat less in that 68 percent of the respondents were found to have a low need tension (Table 6.2). In the case of maize production efficiency there is a clear indication of a higher need tension among the low efficiency respondents ($\chi^2 = 26.44$, df = 8, p = 0.001; r = -0.329, p = 0.000). This negative correlation, also in the case of dairy farming efficiency (r = -0.234, p= 0.001) is opposite of what has been hypothesized

(Hypothesis 2.2, but could indicate that the need tension of the more efficient farmers had been higher but was partially satisfied with the subsequent increased production.

### 6.3.2 Need tension regarding production practices

As far as the need tension in respect of production practices is concerned, the same negative correlation is found with production efficiency at least as far as the great majority of maize production practices are concerned (Table 6.2). The absence of this tendency in dairy farming, namely that higher efficiency is associated with a lower need tension, may be attributable to the possible phenomenon that the practices analyzed are not perceived to be all that important in achieving higher efficiency.

Although not in accordance with the hypothesis (Hypothesis 2.2), the need tension can't be discarded as a poor predictor of production efficiency. A complication is that it is valid before behavior change, but that it disappears or decreases with need accomplishment or behavior change. Another complicating factor is that the need tension is not independent of the perceived current efficiency, which the less efficient farmers tend to overrate more than the more efficient ones, thus undermining or significantly reducing the present need tension.

**Table 6.2 Relationship between need tension (NT) and production efficiency as reflected in percentage distributions and a test of association**

| | | Percentage distribution of farmers per efficiency category* | | | | | | Association | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total | | | | | |
| Variable | Category | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 | $\chi^2$ | P | df | r | p |
| **Maize** | | | | | | | | | | | | |
| NT-efficiency | Low | 7.3 | 13 | 19 | 24 | 13 | 16 | | | | | |
| | Medium | 39 | 38 | 58 | 54 | 74 | 53.5 | | | | | |
| | High | 54 | 50 | 23 | 22 | 13 | 30.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 26.4 | 0.000 | 8 | -0.33 | 0.000 |
| NT-fertilizer | Low | 4.9 | 17 | 40 | 37 | 55 | 32 | | | | | |
| | Medium | 2.4 | 25 | 40 | 46 | 32 | 30.5 | | | | | |
| | High | 93 | 58 | 21 | 17 | 13 | 37.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 86.7 | 0.000 | 8 | -0.65 | 0.000 |
| NT-spot | Low | 7.3 | 21 | 42 | 48 | 53 | 36 | | | | | |
| | Medium | 12 | 8.3 | 37 | 39 | 39 | 29.5 | | | | | |
| | High | 80 | 71 | 21 | 13 | 7.9 | 34.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 79.7 | 0.000 | 8 | -0.52 | 0.000 |
| NT-seed | Low | 4.9 | 21 | 26 | 31 | 55 | 28 | | | | | |
| | Medium | 17 | 8.3 | 26 | 46 | 34 | 29 | | | | | |
| | High | 78 | 71 | 49 | 22 | 11 | 43 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 61.4 | 0.000 | 8 | -0.51 | 0.000 |
| NT-line planting | Low | 49 | 79 | 53 | 56 | 55 | 56.5 | | | | | |
| | High | 51 | 21 | 47 | 44 | 45 | 43.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 6.2 | 0.184 | 4 | -0.12 | 0.082 |
| **Dairy** | | | | | | | | | | | | |
| NT-efficiency | Low | 51 | 71 | 63 | 73 | 83 | 68 | | | | | |
| | High | 49 | 29 | 38 | 28 | 17 | 32 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 9.5 | 0.050 | 4 | -0.23 | 0.001 |
| NT-breed | Low | 37 | 51 | 40 | 48 | 61 | 47 | | | | | |
| | High | 63 | 49 | 60 | 53 | 39 | 53 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 5.6 | 0.231 | 4 | -0.18 | 0.010 |
| NT-housing | Low | 43 | 49 | 31 | 38 | 39 | 39.5 | | | | | |
| | Medium | 49 | 41 | 48 | 45 | 47 | 46 | | | | | |
| | High | 8.6 | 9.8 | 21 | 18 | 14 | 14.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 5.2 | 0.733 | 8 | 0.1 | 0.145 |
| NT-medical | Low | 29 | 46 | 29 | 40 | 33 | 35.5 | | | | | |
| | Medium | 37 | 34 | 46 | 38 | 47 | 40.5 | | | | | |
| | High | 34 | 20 | 25 | 23 | 19 | 24 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 6.2 | 0.621 | 8 | -0.05 | 0.472 |
| NT-feed | Low | 8.6 | 17 | 15 | 7.5 | 5.6 | 11 | | | | | |
| | Medium | 71 | 63 | 52 | 78 | 86 | 69 | | | | | |
| | High | 20 | 20 | 33 | 15 | 8.3 | 20 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 14.9 | 0.061 | 8 | -0.03 | 0.673 |
| | Frequency (N) | 35 | 41 | 48 | 40 | 36 | 200 | | | | | |

*1 = Least efficient, 5 = Most efficient

## 6.4 INFLUENCE OF NEED COMPATIBILITY (NC) ON PRODUCTION EFFICIENCY

Needs are accepted to be compatible if the realization of one will simultaneously or indirectly lead to the realization of another (Düvel, 1994:31). A specific innovation or practice is not compatible with the individual's need, if it is not perceived as need related, or a means towards achieving it (Düvel, 1991:80). Need compatibility, is therefore, assumed to be positively related with adoption behavior and the corresponding production efficiency (Hypothesis 2.2). Evidence of this relationship, namely that non-adoption or low efficiency by farmers in the study area is related to need incompatibility, has been provided by (Düvel & Botha, 1999:56).

Participants were asked what their present level of production efficiency would have been if they had adopted each of the recommended maize and dairy production practices in an attempt to determine the perceived compatibility of the recommended practices with their felt need, namely, increased production. The need compatibility score of the great majority (50-75 percent) of maize and dairy farmers ranged from medium to high on the need compatibility scale (Table 6.3). The extremely close relationship between need compatibility and production efficiency in the case of both commodities provides clear supportive evidence of hypothesis 2.2. Evidence can be found, for example, in spot application of fertilizer. Regarding this practice, while no single farmer from the efficient category was found to score low on the need compatibility scale, 64 percent of them scored high. Conversely, while 66 percent of the less efficient farmers scored low, not a single farmer scored high. The difference is highly significant ($\chi2$ = 292, df = 8, p = 0.000; r = 0.980, p = 0.000).

The close to perfect correlation as reflected in the highly significant statistical tests (chi-square and correlations) makes need compatibility an indispensable and accurate predictor of adoption behavior and the subsequent production efficiency.

**Table 6.3 Relationships between need compatibility (NC) and production efficiency as reflected in percentage distributions and a test of association**

| | | Percentage distribution of farmers per efficiency category* | | | | | | Association | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total | | | | | |
| Variable | Category | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 | $\chi^2$ | P | df | r | p |
| **Maize** | | | | | | | | | | | | |
| NC-fertilizer | Low | 100 | 41.7 | 32.6 | - | 2.6 | 33 | | | | | |
| | Medium | - | 37.5 | 62.8 | 25.9 | 2.6 | 25.5 | | | | | |
| | High | - | 20.8 | 4.7 | 74.1 | 94.7 | 41.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 201.0 | 0.000 | 8 | 0.88 | 0.000 |
| NC-spot | Low | 100 | 91.7 | 7 | - | - | 33 | | | | | |
| | Medium | - | 8.3 | 93 | 51.9 | - | 35 | | | | | |
| | High | - | - | - | 48.1 | 100 | 32 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 292.0 | 0.000 | 8 | 0.98 | 0.000 |
| NC-seed | Low | 100 | 54.2 | 4.7 | - | - | 28 | | | | | |
| | Medium | - | 45.8 | 95.3 | 59.3 | 5.3 | 43 | | | | | |
| | High | | | | 40.7 | 94.7 | 29 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 267.0 | 0.000 | 8 | 0.96 | 0.000 |
| NC-line planting | Low | 100 | 87.5 | 9.3 | 1.9 | - | 33.5 | | | | | |
| | Medium | - | 12.5 | 90.7 | 35.2 | - | 30.5 | | | | | |
| | High | | | | 63 | 100 | 36 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 282.0 | 0.000 | 8 | 0.96 | 0.000 |
| **Dairy** | | | | | | | | | | | | |
| NC-breed | Low | 80 | 34.1 | 4.2 | - | - | 22 | | | | | |
| | Medium | 20 | 63.4 | 72.9 | 52.5 | 25 | 49 | | | | | |
| | High | - | 2.4 | 22.9 | 47.5 | 75 | 29 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 149.0 | 0.000 | 8 | 0.97 | 0.000 |
| NC-housing | Low | 97.1 | 65.9 | 52.1 | 27.5 | 5.6 | 49.5 | | | | | |
| | High | 2.9 | 34.1 | 47.9 | 72.5 | 94.4 | 50.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 71.9 | 0.000 | 4 | 0.5 | 0.000 |
| NC-medical | Low | 74.3 | 48.8 | 29.2 | 32.5 | - | 36.5 | | | | | |
| | Medium | 25.7 | 51.2 | 60.4 | 32.5 | 50 | 45 | | | | | |
| | High | - | - | 10.4 | 35 | 50 | 18.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 77.3 | 0.000 | 8 | 0.53 | 0.000 |
| NC-feed | Low | 77.1 | 51.2 | 33.3 | 10 | 2.8 | 34.5 | | | | | |
| | Medium | 22.9 | 29.3 | 43.8 | 50 | 44.4 | 38.5 | | | | | |
| | High | - | 19.5 | 22.9 | 40 | 52.8 | 27 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 66.4 | 0.000 | 8 | 0.48 | 0.000 |
| | Frequency (N) | 35 | 41 | 48 | 40 | 36 | 200 | | | | | |

*1 = Less efficient, 5 = Most efficient

## 6.5 INFLUENCE OF PERCEPTIONS OF TECHNOLOGY ATTRIBUTES ON PRODUCTION EFFICIENCY

Perception is a key dimension in the process of behavior change. According to Düvel (1975:8), all causes of negative decision making as well as all the forces or potential forces of change, can be directly traced back to perception or the psychological field. Several research studies (Louw & Düvel, 1973: 37; Düvel, 1975: 8; Koch, 1985:15; Botha, 1986:29; Koch, 1986:21; Botha, 1999:51) provide evidence of this and led to the hypothesis, (Hypotheses 2.2) that production efficiency in the study area is positively related with their perception of recommended technology attributes.

Perception of technology attributes is treated as a composite variable computed by adding the difference between behavior positive and negative psychological field forces or by aggregating the net perception scores of respondents on the attributes of each and every practice of the recommended technology package including perceived relative advantages and disadvantages of fertilizer, spot application of fertilizer, improved cultivars and line planting for maize and perceived relative advantages and disadvantages of recommended breeds, housing, medical and feeding practices for dairy .

Table 6.4 provides the detail information on the overall perception profile of maize and dairy farmers. According to Table 6.4, respondents are normally distributed across all perception categories of low, medium and high. With respect to one of the causal factors, technology attributes for fertilizer, for example, the number of farmers in the three categories vary only between 32 percent and 36 percent. In contrast to expectations, however, perception is not found to be significantly associated with the production efficiency of both maize and dairy farmers in many of the practices incorporated into the packages of the two commodities. Regarding maize farmers' perception of line planting for example, while the number of efficient dairy farmers was about 30 percent both in the low and high perception categories, the number of the less efficient ones also varies only from 36.6 percent to 39 percent with changes in their perception from low to high without showing any significant variation ($\chi^2 = 8.4$, df = 8, p = 0.396; r = 0.04, p = 0.541).

**Table 6.4 Relationships between perception of technology attributes (PTA) and production efficiency as reflected in percentage distributions and a test of associations**

| | | Percentage distribution of respondents per efficiency category* | | | | | | Association | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total | | | | | |
| Variable | Category | n=41 | n=24 | n=43 | n=54 | n=38 | N=200 | $\chi^2$ | P | df | r | p |
| **Maize** | | | | | | | | | | | | |
| PTA-fertilizer | Low | 31.7 | 8.3 | 25.6 | 44.4 | 39.5 | 32.5 | | | | | |
| | Medium | 19.5 | 50.0 | 32.6 | 31.5 | 31.6 | 31.5 | | | | | |
| | High | 48.8 | 41.7 | 41.9 | 24.1 | 28.9 | 36.0 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 17.5 | 0.03 | 8 | -0.11 | 0.11 |
| PTA-spot | Low | 29.3 | 41.7 | 39.5 | 29.6 | 31.6 | 33.5 | | | | | |
| | Medium | 36.6 | 45.8 | 34.9 | 29.6 | 42.1 | 36.5 | | | | | |
| | High | 34.1 | 12.5 | 25.6 | 40.7 | 26.3 | 30.0 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 8.3 | 0.41 | 8 | -0.03 | 0.71 |
| PTA-seed | Low | 39.0 | 33.3 | 23.3 | 35.2 | 34.2 | 33.0 | | | | | |
| | Medium | 26.8 | 33.3 | 46.5 | 29.6 | 23.7 | 32.0 | | | | | |
| | High | 34.1 | 33.3 | 30.2 | 35.2 | 42.1 | 35.0 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 6.7 | 0.57 | 8 | 0.08 | 0.26 |
| PTA-line planting | Low | 36.6 | 50.0 | 44.2 | 25.9 | 28.9 | 35.5 | | | | | |
| | Medium | 24.4 | 20.8 | 27.9 | 33.3 | 39.5 | 30.0 | | | | | |
| | High | 39.0 | 29.2 | 27.9 | 40.7 | 31.6 | 34.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 8.4 | 0.40 | 8 | 0.04 | 0.54 |
| **Dairy** | | | | | | | | | | | | |
| PTA-breed | Low | 34.3 | 39.0 | 39.6 | 37.5 | 19.4 | 34.5 | | | | | |
| | Medium | 22.9 | 36.6 | 33.3 | 32.5 | 36.1 | 32.5 | | | | | |
| | High | 42.9 | 24.4 | 27.1 | 30.0 | 44.4 | 33.0 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 8.4 | 0.39 | 8 | 0.07 | 0.33 |
| PTA-housing | Low | 34.3 | 39.0 | 43.8 | 27.5 | 19.4 | 33.5 | | | | | |
| | Medium | 28.6 | 34.1 | 33.3 | 42.5 | 27.8 | 33.5 | | | | | |
| | High | 37.1 | 26.8 | 22.9 | 30.0 | 52.8 | 33.0 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 12.5 | 0.13 | 8 | 0.14 | 0.04 |
| PTA-medical | Low | 17.1 | 22.0 | 43.8 | 42.5 | 27.8 | 31.5 | | | | | |
| | Medium | 40.0 | 36.6 | 27.1 | 27.5 | 38.9 | 33.5 | | | | | |
| | High | 42.9 | 41.5 | 29.2 | 30.0 | 33.3 | 35.0 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 11.2 | 0.19 | 8 | -0.13 | 0.07 |
| PTA-feed | Low | 22.9 | 26.8 | 41.7 | 25.0 | 19.4 | 28.0 | | | | | |
| | Medium | 34.3 | 34.1 | 35.4 | 40.0 | 44.4 | 37.5 | | | | | |
| | High | 42.9 | 39.0 | 22.9 | 35.0 | 36.1 | 34.5 | | | | | |
| | Total | 100 | 100 | 100 | 100 | 100 | 100 | 8.3 | 0.41 | 8 | 0.03 | 0.67 |
| | Frequency (N) | 35 | 41 | 48 | 40 | 36 | 200 | | | | | |

*1 = Least efficient, 5 = Most efficient

The possible explanation for the unexpected finding against the hypothesized association (Hypothesis 2.2) could partly be attributed to the late development of behavior negative psychological field forces (awareness of disadvantages). Although behavior positive psychological field factors are well developed both with respect to dairy and maize practices, their power to influence the dependent variable, production efficiency is underestimated in view of the relatively large number of behavior negative psychological field forces, which could have been evoked by persuasion efforts regarding the advantages and could largely represent more knowledge or only weak forces. This also indicates at the close relationship between perception and knowledge primarily in terms of the advantages and disadvantages.

This finding would imply that knowledge in terms of its influence is a less important intervening variable and would explain why a mere dissemination of knowledge is seldom effective or why it is often maintained "knowledge does not sell itself". In other words an individual may be knowledgeable of an advantage or disadvantage but it need not have significant influence on him.

Perhaps the most likely explanation, and not unrelated to the above, is that an individual could adopt a practice because of one or more attributes perceived positively, depending on which are important for him/her. These differences were not accurately measured, and in fact this represents an important focus for future research.

## 6.6 CONTRIBUTIONS OF INTERVENING VARIABLES TO PRODUCTION EFFICIENCY VARIANCE

Multiple regression models were used to estimate the effects of the intervening variables on production efficiency of maize and dairy farmers. Predictor variables included in the model as were based on the results of the bivariate analysis of section 6.2 and are given in Table 6.5. Theoretically expected signs for the variables included in the developed regression model are also specified in this Table. Need compatibility regarding seed, line planting, and spot application of fertilizer are excluded from the regression model since they are all found to be multicollinear with need compatibility of fertilizer use.

**Table 6.5 Model specification for intervening variables affecting the production efficiency of maize and dairy farmers**

| Variable | Expected sign | Variable description (operational definition) |
|---|---|---|
| **Maize** | | |
| PCE (seed) | - | Perceived current efficiency score regarding improved seed and its sourc |
| NT (efficiency) | + | Need tension score regarding production efficiency (yield per unit) |
| NT (fertilizer) | + | Need tension score regarding the type and rate of fertilizer used |
| NT (spot) | + | Need tension score regarding spot application |
| NT (seed) | + | Need tension score regarding the use and source of improved seed |
| NC (fertilizer) | + | Need (in) compatibility score regarding the type and rate of fertilizer |
| **Dairy** | | |
| PCE (efficiency) | - | Perceived current efficiency core regarding yield per unit |
| NT (efficiency) | + | Need tension score regarding production efficiency |
| NT (breed) | + | Need tension score regarding the use of improved breed |
| NC (breed) | + | Need (in) compatibility score regarding the use of improved breeds |
| NC (housing) | + | Need (in) compatibility score regarding the use of housing practices |
| NC (medical) | + | Need (in) compatibility score regarding adoption of medical practices |
| NC (feed) | + | Need (in) compatibility score regarding the use of feed practices |
| PTA (feed) | + | Perceived total attribute regarding feed practices |

Table 6.6 provides the results of multiple regression analysis regarding the contributions of intervening variables to the variations in the production efficiency of maize and dairy farmers.

The effect of intervening variables on production efficiency of maize and dairy farmers is characterized by a high $R^2$ value where most of the variables are significantly associated with the regressand. Contribution of the intervening variables to the variance of the production efficiency of maize and dairy farmers is as high as 87.5 percent for maize and 80.9 percent for dairy (Table 6.6). The result is in agreement with the findings of earlier research (Düvel, 1975; Koch, 1986: 21; Koch, 1987:24; Düvel & Botha, 1999:47). An important observation worth mentioning here is that most of the need related factors appear to be highly significantly related with production efficiency regarding both maize and dairy farming. This indicates at the crucial role of needs in behavior determination and suggests that needs are, as defined and categorized in this study more important than perceptions. This, however, needs further verification and calls for more research

**Table 6.6 Multiple regression (standard) estimates of the effects of intervening variables on the production efficiency of maize and dairy farmers**

| Variable* | Beta | t | p | Variable | Beta | t | p |
|---|---|---|---|---|---|---|---|
| Constant | - | 5.782 | 0.000 | Constant | - | 6.59 | 0.000 |
| PCE-seed | -0.040 | -1.519 | 0.130 | PCE-efficiency | -0.128 | -3.300 | 0.001 |
| NT-efficiency | -0.048 | -1.612 | 0.109 | NT-efficiency | -0.118 | -3.224 | 0.001 |
| NT-fertilizer | -0.381 | -9.970 | 0.000 | NT-breed | -0.083 | -2.538 | 0.012 |
| NT-spot | 0.012 | 0.351 | 0.726 | NC-breed | 0.564 | 13.977 | 0.000 |
| NT-seed | 0.033 | 1.009 | 0.314 | NC-housing | 0.114 | 3.036 | 0.003 |
| NC-fertilizer | 0.749 | 24.864 | 0.000 | NC-medical | 0.221 | 5.681 | 0.000 |
| | | | | NC-feed | 0.190 | 5.160 | 0.000 |
| | | | | PTA-housing | -0.001 | -0.020 | 0.984 |
| Maize ($R^2$=0.875) | | | | Dairy ($R^2$=0.809) | | | |

*(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

Top of the list in both commodities is need compatibility (need compatibility for breed and fertilizer), which, also from a theoretical point of view and understanding of needs, is almost a precondition for change, since it is difficult to visualize an action or a behavior of an individual that is in contradiction with his/her needs.

Need tension is another significant predictor (next to need compatibility), although it's nature (whether negative or positive) is not according to expectations. This could be attributed to the fact that the perceived current efficiency, which is an integral part of the need tension, has a counter-effect in terms of influence*, and because of possible changes in the need tension after the change in adoption behavior.

A noteworthy finding is that perception does not appear to be as important as needs especially with regard to maize production. This may be attributable to the following

* There is a tendency of overrating the current level of efficiency, especially by the less efficient farmers, which lowers the need scope and ultimately distorts the findings related to need tension.

reasons. One of them has to do with measurement. The five-point scale measurement instrument employed in this study showed a lacking sensitivity and accuracy to successfully measure the more abstract concept of perception. The result is an inaccurate assessment of the psychological field or field forces, namely because of the inability to distinguish between the mere knowledge of advantages and disadvantages and those perceived to represent strong forces.

Outstanding challenges in this regard lie in employing a finer and more accurate measurement instrument to further investigate the key role of perceptions as behavior determinants. Secondly, emerging perceived negative psychological field forces are not necessarily related to the technology itself but are mostly associated with compatibility aspects such as policy issues. Based on the dynamics of forces, elimination or reduction of these forces by concerned parties could reactivate the sluggish behavior change process and redress the current problem facing farmers in the study area.

A finding emerging from this study is that need related factors seem to play a more important role in predicting production efficiency than perceptions of technology attributes, with need compatibility being the most prominent. However, these variables especially need tension, is more liable to distortions, which can be attributed to the time of assessment and is particularly relevant in ex post facto research. The reason for this is that, while the needs influence the adoption behavior and consequently the efficiency, the changed behavior will again change the need situation, which will no longer reflect what gave rise to the original change. In other words since behavior aimed at realizing the need will change the need tension, it is near impossible to accurately measure or assess the influence of need tension on an ex post facto base.

## 6.7 COMPARATIVE CONTRIBUTION OF INTERVENING VARIABLES TO VARIANCE IN PRODUCTION EFFICIENCY

Table 6.7 depicts the overall contributions of independent (1), and intervening (2) variables on production efficiency and both the independent and intervening variables (1+2). From the findings it is evident that the contribution of the intervening variables is much higher than that of all the independent variables. This applies to both maize and dairy where the value of the coefficient of determination is 87.5 percent in the case of maize and 80.9 percent in dairy. Their effect is almost equal to the combined effect of the two sets of variables, which is 88.8 percent in maize and 81.9 percent in dairy. The comparative small influence of independent variables is evident from the coefficients of variation, which are only 25.1 percent in maize and 19.3 percent in dairy.

**Table 6.7 Comparison of coefficient of determination based on standard multiple regression estimation**

| Category of variables | Maize | | | Dairy | | |
|---|---|---|---|---|---|---|
| | $R^2$ | F | Total P | $R^2$ | F | Total P |
| 1 (Independent) | 0.251 | 13.036 | 0.000 | 0.193 | 11.67 | 0.000 |
| 2 (Intervening) | 0.875 | 224.8 | 0.000 | 0.809 | 101.44 | 0.000 |
| 1+2 (independent+ intervening) | 0.888 | 135.315 | 0.000 | 0.819 | 70.00 | 0.000 |

According to standard multiple regression procedure, all variables are entered into the equation simultaneously without controlling for the possible effects of the second set of variables on the others. It is therefore required to subtract the $R^2$ values of one from the $R^2$ value of the other set of variables to determine the net contributions ($R^2$ change) of the second categories of variables and establish which category is relatively more important in predicting production efficiency. In view of this, the contribution of the intervening variables alone, when the possible effect of the independent variables is controlled, is 0.637 (0.888-0.251) in maize and 0.626 (0.819-0.193) in dairy. According to Pallant (2001:147), however, hierarchal multiple regressions procedure is used to simplify the process and answer the question "if the possible effects of a set of predictor variables (independent variables, in this case) is controlled, is our second set of variables (intervening variables) still able to predict a significant amount the variance of the dependent variable?" Hence, this procedure was applied to evaluate and compare the influences of the two sets of independent and intervening variables on production efficiency of farmers after the possible effects of the predictor independent variables were controlled (see Table 6.2 below).

**Table 6.8 Hierarchal multiple regression estimation of the comparative influence of independent and intervening variables on efficiency**

| | Maize | | | | Dairy | | | |
|---|---|---|---|---|---|---|---|---|
| Model-1 | Variable | Beta | t | p | Variable | Beta | t | p |
| | Constant | | 4.958 | 0.000 | Constant | - | 3.217 | 0.002 |
| | Agro-ecology: dummy | 0.333 | 4.345 | 0.000 | Age | 0.173 | 2.569 | 0.011 |
| | Age | -0.095 | -1.270 | 0.216 | Education | 0.243 | 3.146 | 0.002 |
| | Education | 0.200 | 2.454 | 0.015 | Farm size | 0.275 | 4.183 | 0.000 |
| | Farm size | 0.276 | 3.646 | 0.000 | Modernity | 0.069 | 0.902 | 0.368 |
| | Media: dummy | 0.196 | 2.658 | 0.009 | | | | |
| | $R^2$=0.251; $R^2$ change=0.251; F=13.04; P=0.000 | | | | $R^2$=0.193; $R^2$ change=0.193; F=11.67; P=0.000 | | | |
| Model-2 | Constant | - | 3.162 | 0.002 | Constant | - | 3.734 | 0.000 |
| | Agro ecology: dummy | 0.110 | 2.923 | 0.004 | Age | 0.031 | 0.892 | 0.373 |
| | Age | -0.032 | -1.050 | 0.295 | Education | 0.080 | 2.076 | 0.039 |
| | Education | 0.010 | 0.301 | 0.764 | Farm size | 0.052 | 1.524 | 0.129 |
| | Farm size | 0.080 | 2.601 | 0.010 | Modernity | 0.017 | 0.439 | 0.661 |
| | Media: dummy | 0.078 | 2.519 | 0.013 | | | | |
| | PCE-seed | -0.010 | -0.367 | 0.714 | PCE-efficiency | -0.128 | -3.300 | 0.001 |
| | NT-efficiency | -0.007 | 0.233 | 0.816 | NT-efficiency | -0.118 | -3.224 | 0.001 |
| | NT-fertilizer | -0.367 | -9.610 | 0.000 | NT-breed | -0.083 | -2.538 | 0.012 |
| | NT-spot | 0.048 | 1.349 | 0.179 | NC-breed | 0.564 | 13.977 | 0.000 |
| | NT-seed | 0.045 | 1.389 | 0.166 | NC-housing | 0.114 | 3.036 | 0.003 |
| | NC-fertilizer | 0.717 | 23.527 | 0.000 | NC-medical | 0.221 | 5.681 | 0.000 |
| | | | | | NC-feed | 0.190 | 5.160 | 0.000 |
| | | | | | PTA-housing | -0.001 | -0.020 | 0.984 |
| | $R^2$=0.888; $R^2$ change=0.636; F=135.3; P=0.000 | | | | $R^2$=0.819; $R^2$ change=0.626; F=70.74; P=0.000 | | | |

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

As can be seen in Table 6.8, the $R^2$ change value or the net effect of intervening variables is 0.636 (viz. 0.888-0.251) in maize and 0.626 (viz. 0.819-0.193) in dairy. The results obtained by employing hierarchical multiple regression models are similar to the results of standard multiple regression models employed earlier. The second procedure is used in this study to simplify the process, especially to assess the specific influence of each of the intervening variables when the possible effects of the independent variables are controlled.

Hierarchical multiple regression analysis showed that the contribution of intervening variables alone, 63.6 percent ($R^2$ change = 63.6) in maize and 62.6 percent ($R^2$ change = 62.6) in dairy is still higher than the direct effect of independent variables, which is 25 percent and 19 percent, respectively. Moreover, factors associated with needs (need compatibility and need tension regarding fertilizer) in maize and all of the intervening variables with the exception of perceived total attribute of housing practice in dairy, have a significantly higher contribution to the variation in production efficiency. This finding reveals the important role of needs in behavior determination when their effect is compared against the effect of the rest of the intervening variables included in the regression model.

On the other hand, the contribution of independent variables to the variance of production efficiency is not only direct. There is also an indirect influence (via the intervening variables), which can increase their total influence. Employing path analysis assesses this effect (Fig. 6.1). A path diagram is developed in order to elaborate the influence relationships of the various variables by taking the case of maize farmers as an example.

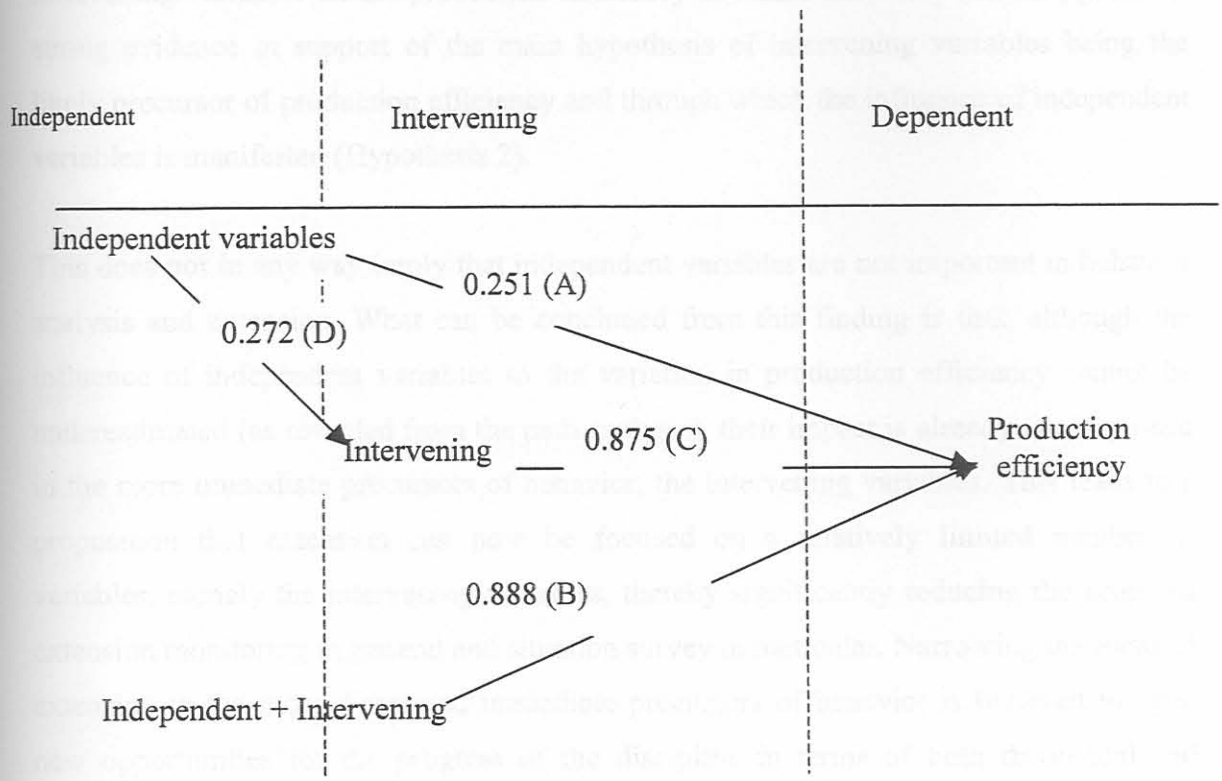


**Fig. 6.1 Path diagram showing the relationship between independent, intervening variables and production efficiency of maize farmers***

The indirect effect of independent variables on the production efficiency of maize farmers (their effect manifested through the intervening variables) is the effect of intervening variables on the dependent variable before the possible effect of independent variables is controlled less the effect of intervening variables after the influence of independent variables is controlled (87.5 percent-63.6 percent), which gives 23.9 percent. The aggregate effect of independent variables is the sum total of their indirect and direct effects (23.9 percent + 25 percent), which equals 48.9 percent. This figure is still less compared against the effect of intervening variables even after the possible effect of independent variables is controlled (63.6 percent). However, the path analysis (Fig. 6.1) shows that the effect of independent variables becomes sizeable (48.9 percent) when their indirect effect is considered. This, together with the highly significant contribution of

* The values, 'A', 'B' & 'C' are based on the regression model (Table 6.8). 'D' is obtained by calculation, i.e. D= .238/. 875= .272

intervening variables on the production efficiency of maize and dairy farmers, provides strong evidence in support of the main hypothesis of intervening variables being the likely precursor of production efficiency and through which the influence of independent variables is manifested (Hypothesis 2).

This does not in any way imply that independent variables are not important in behavior analysis and extension. What can be concluded from this finding is that, although the influence of independent variables to the variation in production efficiency cannot be underestimated (as revealed from the path analysis), their impact is already encompassed in the more immediate precursors of behavior, the intervening variables. This leads to a proposition that extension can now be focused on a relatively limited number of variables, namely the intervening variables, thereby significantly reducing the scope of extension monitoring in general and situation survey in particular. Narrowing the focus of extension to the more direct and immediate precursors of behavior is believed to open new opportunities for the progress of the discipline in terms of both theoretical and practical grounds. It provides an epistemological base and offers opportunities for a more rigorous assessment of the relevant variables associated with behavior analysis, which can be changed by extension as opposed to the more static independent variables. The shift in the emphasis of extension to the more flexible and relevant factors is also believed to reduce survey costs since the time that has been used by traditional situation surveys could now be dramatically reduced.

## 6.8 THE INFLUENCE OF INTERVENING VARIABLES ON MAIZE PRACTICE ADOPTION

Intervening factors assumed to affect the practice adoption behavior of maize farmers include perceived current efficiency and need tension regarding the overall production efficiency and perceived current efficiency, need tension, need compatibility, and perceptions of technology attributes regarding each practice. Fertilizer adoption, for example, is assumed to be affected by the perceived current efficiency and need tension regarding the overall production efficiency and perceived current efficiency, need tension, need compatibility, and perceived attributes regarding fertilizer. The influence of these factors on the adoption of each technology or production practice included in maize package i.e. seed, line planting, fertilizer and spot application of fertilizer will be analyzed in the following sections.

### 6.8.1 Influence of intervening factors on improved seed adoption

As far as the perceptions of attributes are concerned, seed adoption is affected by both positive (perceived relative advantages) and negative (perceived relative disadvantages) attributes of improved seeds. The influence of each of the perceived positive and negative improved seed attributes will first be assessed followed by evaluation of the influence of the intervening variables in general.

The perception of farmers regarding the advantages of improved cultivars is associated either with economical or technical attributes. High productivity, early maturity, quality of grain and high green cob price were some of the economical advantages attributed to the use of improved cultivars while disease resistance, lodging resistance, good husk cover, and high harvest index were regarded as technical advantages.

In an attempt to identify the critical attributes associated with improved seed, farmers were asked to choose five of the most important advantages of using improved seed and rank them in order of importance. The fact that high production is perceived to be an important attribute by both parameters, measure of association and rank (weighted score) (Table 6.9), indicates how farmers regard economical advantages as important criteria during variety choice. The highly significant association of the relative advantages, early maturity, high harvest index and high productivity to seed adoption and the fact that high productivity and early maturity are the first and second most important attributes has also an important implication for research and extension. It is evident from this that farmers are willing and eager to increase their productivity but this goal is associated with a major problem of drop in market price at time of harvest, which is the third most important among the five problems mentioned (Table 6.9). The finding, therefore, suggests that early maturing varieties are critical for farmers so that they can either sell their produce while the price is still high and/or they can sell it while it is green. They can fetch a higher price in either case. Table 6.9 and appendix 6a provide detail information on the relative importance of each of the perceived advantages of improved seeds.

**Table 6.9 Relationships between perceived technology attributes of improved seeds and adoption behavior as expressed by weighted mean and percentage scores***

| Attribute | Parameters | Distributions of scores according to seed adoption categories | | | |
|---|---|---|---|---|---|
| | | Non (N=102) | Low (N=27) | High (N=71) | Total (N=200) |
| **Relative advantages** | | | | | |
| **High productivity** | Weighted average score | 3.62 | 3.37 | 3.73 | 3.63 |
| | Weighted percentage | 72.35 | 67.41 | 74.65 | 72.50 |
| | **Association** | **$r_s = 0.091, p = 0.199$** | | | |
| **Early maturity** | Weighted average score | 2.37 | 2.81 | 2.41 | 2.45 |
| | Weighted percentage | 47.45 | 56.30 | 48.17 | 48.90 |
| | **Association** | **rs = 0.248, p = 0.000** | | | |
| **Grain quality** | Weighted average score | 1.01 | 0.30 | 0.77 | 0.83 |
| | Weighted percentage | 20.20 | 5.93 | 15.49 | 16.60 |
| | **Association** | **$r_s = 0.113, p = 0.110$** | | | |
| **Resistance to lodging** | Weighted average score | 0.65 | 0.26 | 0.04 | 0.38 |
| | Weighted percentage | 12.94 | 5.19 | 0.85 | 7.60 |
| | **Association** | **$r_s = 0.076, p = 0.286$** | | | |
| **High harvest index** | Weighted average score | 0.22 | 0.44 | 0.72 | 0.43 |
| | Weighted percentage | 4.31 | 8.89 | 14.37 | 8.50 |
| | **Association** | **$r_s = 0.295, p = 0.000$** | | | |
| **Relative disadvantages** | | | | | |
| **Low storability** | Weighted average score | 0.83 | 0.26 | 0.38 | 0.60 |
| | Weighted percentage | 16.67 | 5.19 | 7.61 | 11.90 |
| | **Association** | **$r_s = 0.113, p = 0.111$** | | | |
| **Certified seed** | Weighted average score | 1.31 | 0.33 | 0.32 | 0.83 |
| | Weighted percentage | 26.27 | 6.67 | 6.48 | 16.60 |
| | **Association** | **$r_s = 0.037, p = 0.607$** | | | |
| **Cost** | Weighted average score | 3.29 | 3.04 | 3.04 | 3.17 |
| | Weighted percentage | 65.88 | 60.74 | 60.85 | 63.40 |
| | **Association** | **$r_s = -0.020, p = 0.774$** | | | |
| **Unavailability** | Weighted average score | 0.75 | 0.89 | 1.46 | 1.02 |
| | Weighted percentage | 14.90 | 17.78 | 29.30 | 20.40 |
| | **Association** | **$r_s = -0.268, p = 0.000$** | | | |
| **Market** | Weighted average score | 0.70 | 0.89 | 0.65 | 0.71 |
| | Weighted percentage | 13.92 | 17.78 | 12.96 | 14.10 |
| | **Association** | **$r_s = 0.238, p = 0.001$** | | | |

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for 2nd position, 3 for 3rd position, 2 for 4th position, 1 for 5th position and divided by the number of farmers in that category

Perceived relative disadvantages of using improved maize cultivars are associated with either technical (inherent to the variety itself) or compatibility aspects. Low storability, low ear placement (short stalk), regular need for a certified seed and contamination or total elimination of local varieties by pollination are some of the technical disadvantages associated with the inherent characteristics of improved varieties, while drop in market price at time of harvest, high seed cost, seed unavailability (at the right time, quantity, place and type), unavailability of credit, and bureaucratic credit and input administration are some of the compatibility aspects perceived to be the relative disadvantages of using improved maize cultivars (Table 6.9 and Appendix 6.1b).

High seed cost, seed unavailability, regular need for a certified seed, drop in market price at time of harvest and low storability are rated as the five most important perceived relative disadvantages in order of their importance. The weighted average score and weighted percentage regarding some of the negative attributes of improved seed, indicate a positive relationship between perceived negative attributes and adoption. Regarding perception of seed unavailability (at the right time, place and quantity), for example, the weighted average percentage score of non-adopters is 14.9. This percentage increases in an almost linear fashion with increasing adoption to 29.3 percent in the higher adopters category. The same applies regarding the other most important attribute, which is drop in market price at the time of harvest. The findings of the weighted rank order is supported by the highly significant correlation coefficient especially concerning the attribute drop in market price at time of harvest ($r_s = 0.238$, $p = 0.001$). The implication of a positive relationship between negative attributes and seed adoption is that adopters had felt the seriousness of these problems more than the non-adopters or these problems are more important for adopters than for non-adopters.

In general, as indicated in Table 6.9, most of the perceived relative advantages and disadvantages are positively related with improved seed adoption. This positive association especially with respect to the negative attributes is an indication of the fact that adopters are more aware or knowledgeable of the negative attributes than the non-adopters. This seems to be logical since non-adopters lack the exposure to improved seeds and as a result may not know most of the disadvantages.

Having assessed the relationship between each of the specific attributes of improved seed and the adoption behavior of farmers, the influence of the net perceived total attribute of improved seed (sum of total positive lees negative attributes score-PTA), and the rest of the intervening variables assumed to have an influence on adoption is evaluated here.

The relationship between intervening variables and improved seed adoption is mostly significant and in accord wit expectations (Table 6.10), but the influence of need compatibility, perceived current efficiency and need tension regarding the practice, improved seed is comparatively higher.

**Table 6.10 Relationship between intervening variables and seed adoption**

| Intervening Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | .161 | .023 |
| Need tension regarding production efficiency | -.301 | .000 |
| Perceived current efficiency regarding improved seed | -.407 | .000 |
| Need tension regarding improved seed | -.853 | .000 |
| Need compatibility regarding improved seed | .443 | .000 |
| Perceived total attribute (PTA) regarding improved seed | .012 | .864 |

The lack of significant relationship between seed adoption and PTA is not attributable to the absence of behavior positive psychological field factors (awareness of advantages). It is rather related with an equal awareness of behavior negative psychological field factors (awareness of disadvantages). As indicated in earlier sections, the lack of relationship can also be attributed to problems in measurement (the weakness of a five-point measurement scale and failure of farmers to distinguish values in a more sensitive scale) and thus also to the inability to distinguish between the mere awareness and knowledge of advantages and disadvantages and the actual psychological forces in that regard.

### 6.8.2 Influence of intervening variables on line planting

Relative advantages of line planting are attributed to either economical advantage (high yield) or technical advantages such as ease of weeding, improving the vigor of stand, permission of good light interception, improving fertilizer use efficiency, convenience for field inspection, simplicity of shilshalo (cultivation) and controlling plant population (allowing exact seed rate application).

The correlation between adoption of line planting practice and its attributes is mostly significant and positive. The relationship between the attribute of improving vigor and adoption, for example, is positive and significant at the 1percent level of probability ($r_s$ = 0.171, p = 0.015). This result is supported by the distribution of respondents measured by the weighted average score. The average score of non-adopters regarding this attribute is 0.80 while that of the higher adopters is 1.06 indicating that adopters tend to be more aware this disadvantage. Shilshalo, yield increase and ease of weeding are comparatively more important than the other two perceived attributes namely permitting light interception and improving vigor (Table 6.11 and Appendix 6.2A), but they are not related to adoption.

Some of the perceived disadvantages attributed to line planting are wastage of land (farmers perceive that the open space between rows is a wasted land), incompatibility of line planting with beliefs and traditions (sowing by broadcasting is considered as one of the most esteemed event and important part of the whole farming practices performed by respected elderly unlike line planting which is a common practice of children) and requirement of skill. However, it is only requirement of skill, which become a major problem for not less than half of the whole sample farmers. Waste of land and incompatibility are concerns only for a very few number of farmers (Tables 6.11 and appendix 7b). As far as this particular attribute is concerned, both the correlation and distribution tests indicate a tendency of positive relationship ($r_s$ = 0.132, p = 0.062).

**Table 6.11 Relationships between perceived technology attributes of line planting and adoption behavior as expressed by weighted mean and percentage score***

| Attribute | Parameters | Distributions of scores according to line planting adoption categories | | | | |
|---|---|---|---|---|---|---|
| | | None (N=20) | Low (N=84) | Medium (N=61) | High (N=35) | Total (N=200) |
| **Relative advantages** | | | | | | |
| **Weeding** | Weighted average score | - | 1.68 | 2.00 | 0.26 | 1.35 |
| | Weighted percentage | - | 33.57 | 40.00 | 5.14 | 27.00 |
| | **Association** | **$r_s = 0.124, p = 0.080$** | | | | |
| **Vigor** | Weighted average score | 0.80 | 0.29 | 2.23 | 1.06 | 1.07 |
| | Weighted percentage | 16.00 | 5.71 | 44.59 | 21.14 | 21.30 |
| | **Association** | **$r_s = 0.171, p = 0.015$** | | | | |
| **Light** | Weighted average score | 2.15 | 0.93 | 1.77 | 1.00 | 1.32 |
| | Weighted percentage | 43.00 | 18.57 | 35.41 | 20.00 | 26.40 |
| | **Association** | **$r_s = 0.073, p = 0.307$** | | | | |
| **Shilshalo** | Weighted average score | 0.50 | 2.60 | 0.62 | 1.17 | 1.54 |
| | Weighted percentage | 10.00 | 51.90 | 12.46 | 23.43 | 30.70 |
| | **Association** | **$r_s = 0.055, p = 0.436$** | | | | |
| **Yield** | Weighted average score | 2.85 | 1.58 | 0.08 | 2.63 | 1.44 |
| | Weighted percentage | 57.00 | 31.67 | 1.64 | 52.57 | 28.70 |
| | **Association** | **$r_s = -0.141, p = 0.047$** | | | | |
| **Relative disadvantages** | | | | | | |
| **Waste land** | Weighted average score | 0.20 | - | - | - | - |
| | Percentage | 4.00 | - | - | - | - |
| | **Association** | **$r_s = -0.144, p = 0.041$** | | | | |
| **Incompatibility** | Weighted average score | - | - | - | - | - |
| | Weighted percentage | - | - | - | - | |
| | **Association** | **$r_s = 0.110, p = 0.122$** | | | | |
| **Skill** | Weighted average score | 0.35 | 1.31 | 3.10 | 0.14 | 1.56 |
| | Weighted percentage | 7.00 | 26.19 | 61.97 | 2.86 | 31.10 |
| | **Association** | **$r_s = 0.132, p = 0.062$** | | | | |

Regarding the relationships between intervening variables and the practice of line planting, the need compatibility and need tension associated with the practice and need tension associated with production efficiency are significantly related. Need compatibility being the top among the list (Table 6.12). Again, and for the reasons already mentioned, the perceptions of practice attributes show little or no relationship with adoption behavior.

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* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for the 2nd position, 3 for the 3rd position, 2 for the 4th position 1 for the 5th position and divided by the number of farmers in that category

**Table 6.12 Relationship between intervening variables and adoption of line planting practice**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | -.002 | .979 |
| Need tension regarding production efficiency | -.195 | .006 |
| Perceived current efficiency regarding line planting | -.045 | .526 |
| Need tension regarding line planting | -.146 | .038 |
| Need compatibility regarding line planting | .476 | .000 |
| Perceived total attribute regarding line planting | -.002 | .974 |

### 6.8.3 Influence of intervening variables on fertilizer adoption

The relationship between fertilizer technology attributes and fertilizer adoption is first assessed followed by analysis of the effect of intervening factors associated with fertilizer adoption.

Fertilizer application was the major and most important activity for improving productivity as perceived by all maize-producing farmers, irrespective of their level of adoption. Participant farmers are attributing the relative advantages of fertilizer application mainly to economical advantages (high grain and Stover yield) and to a lesser extent to technical advantages (facilitate maturity, and improve the crop stand to look dark and green). Most farmers' (80 percent) primary reason for using fertilizer is an increased yield. The other three are either the second, third or fourth important advantages for only about 20 percent to 40 percent of the sample farmers (See Table 6.13 and Appendix 6.3A). In general, based on the total weighted average score, yield is found to be the primary reason for almost all adoption categories of maize farmers for using fertilizer followed by it's potential to facilitate maturity, increase stover yield and improve crop stand in that order. Due to the lack in variability of distribution (most farmers value fertilizer attributes very high on the scale), the association is usually not found to be significant at the less than 5 percent level of probability.

**Table 6.13 Relationships between perceived technology attributes of fertilization and adoption of fertilization as expressed by weighted mean and percentage score***

| Attribute | Parameters | Distributions of scores according to fertilizer adoption categories | | | |
|---|---|---|---|---|---|
| | | None (N=47) | Medium (N=61) | High (N=92) | Total (N=200) |
| **Relative advantages** | | | | | |
| **Yield (grain)** | Weighted average score | 3.81 | 3.93 | 3.68 | 3.79 |
| | Weighted percentage | 76.17 | 78.69 | 73.70 | 75.80 |
| | **Association** | $r_s = 0.139, p = 0.050$ | | | |
| **Yield (stover)** | Weighted average score | 2.02 | 2.23 | 1.96 | 2.06 |
| | Weighted percentage | 40.43 | 44.59 | 39.13 | 41.10 |
| | **Association** | $r_s = 0.138, p = 0.052$ | | | |
| **Maturity** | Weighted average score | 2.60 | 1.89 | 2.60 | 2.38 |
| | Weighted percentage | 51.91 | 37.70 | 51.96 | 47.60 |
| | **Association** | $r_s = 0.033, p = 0.643$ | | | |
| **Stand** | Weighted average score | 1.57 | 1.95 | 1.76 | 1.78 |
| | Weighted percentage | 31.49 | 39.02 | 35.22 | 35.50 |
| | **Association** | $r_s = 0.100, p = 0.159$ | | | |
| **Relative disadvantages** | | | | | |
| **Cost** | Weighted average score | 3.94 | 3.84 | 3.85 | 3.87 |
| | Weighted percentage | 78.72 | 76.72 | 76.96 | 77.30 |
| | **Association** | $r_s = 0.008, p = 0.908$ | | | |
| **Access** | Weighted average score | 2.47 | 2.54 | 2.46 | 2.49 |
| | Weighted percentage | 49.36 | 50.82 | 49.13 | 49.70 |
| | **Association** | $r_s = 0.114, p = 0.100$ | | | |
| **Administration** | Weighted average score | 2.43 | 2.39 | 2.12 | 2.28 |
| | Weighted percentage | 48.51 | 47.87 | 42.39 | 45.50 |
| | **Association** | $r_s = 0.024, p = 0.732$ | | | |
| **Belief** | Weighted average score | - | - | - | 0.8 |
| | Weighted percentage | - | - | - | 17.00 |
| | **Association** | $r_s = 0.056, p = 0.431$ | | | |
| **Fraud** | Weighted average score | - | 0.18 | 0.42 | 0.19 |
| | Weighted percentage | -5.11 | 3.61 | 8.48 | 3.80 |
| | **Association** | $r_s = 0.212, p = 0.003$ | | | |

A commonly mentioned or very important perceived relative disadvantage of fertilizer use is the high cost, accessibility (at the right time, quality and space) bureaucratic credit and input administration and fraud (adulteration, scale). Another two perceived disadvantages, namely belief held by participants that fertilizer kills soil productivity and compatibility, are also mentioned by some farmers as disadvantages though their number

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for 2nd position, 3 for 3rd position, 2 for 4th position, 1 for 5th position and divided by the number of farmers in that category

is in insignificant. High fertilizer cost is a pressing and primary problem followed by accessibility, input administration (bureaucracy) and fraud (Table 6.13 and Appendix 6.3b) to all maize farmers irrespective of their level of adoption. As a result the correlation between relative disadvantages of fertilizer and fertilizer adoption is not found to be significant in most cases except fraud.

The fact that farmers keep on using fertilizer irrespective of the prevalence of all of these perceived problems indicates that fertilizer is well integrated into the farming system and farmers cannot afford to ignore this important technology. It also entail that minor interventions aimed at removing these obstacles can make tremendous difference in fertilizer consumption.

The assessment also shows that there is a strong relationship between fertilizer adoption and the associated intervening variables in most cases (Table 6.14). Need related factors are identified to closely influence fertilizer adoption, but the direction of relationship regarding need tension is negative as commonly experienced in this study.

**Table 6.14 Relationships between intervening variables and fertilizer adoption**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | .008 | .215 |
| Need tension regarding production efficiency | -.377 | .000 |
| Perceived current efficiency regarding fertilizer | -.371 | .000 |
| Need tension regarding fertilizer | -.840 | .000 |
| Need compatibility regarding fertilizer | .507 | .000 |
| Perceived total attribute regarding fertilizer | -.103 | .148 |

## 6.8.4 Influence of intervening variables on spot application

Respondents identify only two advantages in relation to spot application of fertilizer i.e. it economizes fertilizer use and improves fertilizer use efficiency by the plant. They were also requested to rate these advantages on a 5 point scale where 5 = very high and 1 =

very low with the purpose of identifying the more important between the two. Economic use of fertilizer is turned out to be the more important of the two, but unlike the use efficiency ($r = 0.175$, $p = 0.013$), does not correlate positively with adoption ($r = 0.008$, $p = 0.908$).

**Table 6.15 Relationship between perceived technology attributes of spot application and adoption behavior as expressed by weighted mean and percentage scores***

| Attribute | Parameters | Distributions of scores according to spot application categories | | | |
|---|---|---|---|---|---|
| | | None (N=57) | Low (N=78) | High (N=65) | Total (N=200) |
| **Relative Advantages** | | | | | |
| **Economy** | Weighted average score | 3.61 | 3.28 | 3.77 | 3.54 |
| | Weighted percentage | 72.28 | 65.64 | 75.38 | 70.70 |
| | **Association** | **$r_s = 0.008$, $p = 0.908$** | | | |
| **Efficiency** | Weighted average score | 3.25 | 2.92 | 3.74 | 3.28 |
| | Weighted percentage | 64.91 | 58.46 | 74.77 | 65.60 |
| | **Association** | **$r_s = 0.175$, $p = 0.013$** | | | |
| **Relative disadvantages** | | | | | |
| **Laboriousness** | Weighted average score | 2.51 | 3.08 | 1.34 | 2.35 |
| | Weighted percentage | 50.18 | 61.54 | 26.77 | 47.00 |
| | **Association** | **$r_s = -0.269$, $p = 0.000$** | | | |
| **Toxicity** | Weighted average score | 0.00 | 0.04 | 0.02 | 0.02 |
| | Weighted percentage | 0.00 | 0.77 | 0.31 | 0.40 |
| | **Association** | **$r_s = 0.070$, $p = 0.325$** | | | |

As it is elaborated in Table 6.15, some farmers believe that toxicity of seed is associated with spot application unlike broadcasting. Some were conscious and believe that this happens only when it is not carefully applied at the right spacing but both the distribution and correlation tests do not indicate any kind of association between adoption and the perception of this attribute. About 2 percent to 20 percent of sample farmers perceive laboriousness of fertilizer application to be an acceptable problem while about 25 percent to 30 percent of them claim it to be a very important problem (Appendix 6.4b). Non-adopters are more concerned about this constraint than adopters as reflected in the negative relationship between the two factors ($r_s = -0.269$, $p = 0.000$). The negative

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 2 for 1st position, 1 for 2nd position and divided by the number of farmers in that category

relationship concerning laboriousness suggest that though adopters are more aware of the disadvantage of the practice they are still using it probably because they found it to be more acceptable than other methods of fertilizer application. In general, laboriousness is found to be the most important problem followed by toxicity.

The relationship between intervening variables and adoption of spot application (Table 6.16) is strongly significant in many cases except perceived current efficiency regarding overall production. The relationship regarding need tension is significant but turns out be negative against expectations. Perceived need compatibility regarding the practice is the top among the behavior determining factors. In other words farmers who think that the use of spot application method would increase yield are more motivated to adopt spot application.

**Table 6.16 Relationship between intervening variables and adoption of spot application**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | .053 | .458 |
| Need tension regarding production efficiency | -.204 | .004 |
| Perceived current efficiency regarding spot application | -.246 | .000 |
| Need tension regarding spot application | -.745 | .000 |
| Need compatibility regarding spot application | .539 | .000 |
| Perceived total attribute regarding spot application | .235 | .001 |

## 6.9 THE INFLUENCE OF INTERVENING VARIABLES ON DAIRY PRACTICE ADOPTION

As in the case of maize, the intervening factors assumed to influence the adoption behavior of dairy farmers include perceived current efficiency and need tension regarding overall production efficiency, perceived current efficiency, need tension, need compatibility, and perceptions of technology attributes regarding each practice included in the dairy package. Adoption of recommended feed practice, for example, is assumed to be influenced by the perceived current efficiency and need tension regarding the overall production efficiency and perceived current efficiency, need tension, need compatibility and perceived attributes regarding improved feed.

### 6.9.1 Influence of intervening variables on breed adoption

Based on the above preamble, intervening factors that affect the improved breed adoption behavior of farmers in the study area are assumed to include perceived current efficiency and need tension regarding overall production (efficiency), and perceived current efficiency, need tension, need compatibility, and perceptions of attributes regarding the practice under consideration, improved breed.

As far as the perceptions of attributes are concerned, improved breed adoption is influenced by both positive (perceived relative advantages) and negative (perceived relative disadvantages) attributes of improved breed. The influence of each of the perceived positive and negative improved breed attributes will be first assessed followed by an assessment of the influence of all of the intervening variables including the total perception of attributes (sum total of relative advantages lees the disadvantages) on improved breed adoption.

Both economical and technical aspects are recognized as rewards of using an improved breed. High yield, fast growth rate, employment creation, additional income generation (compost, fuel wood), fast cost recovery rate, high price of culled animals, status associated with a head and internal satisfaction (hobby) are perceived to be some of the economic returns. The technical advantages on the other hand are, short calving interval, short open days, limited number of services, early first calving age and long lactation period. Technical advantages do, however, not feature among the five most important relative advantages mentioned. There is, however, little significant association between most of these factors and breed adoption (Table 6.17). An exception is employment creation, which is other than expected negatively related. High productivity, for example, does not have a significant relationship with breed adoption behavior of dairy farmers (r

= -0.012, p = 0.810), though the weighted average score of higher adopters (2.37) is a bit higher than that of the medium adopters (1.68), which is an indication of some sort of positive relationship.

**Table 6.17 Relationship between perceived technology attributes of improved breeds and adoption behavior as expressed by weighted mean and percentage scores***

| Attributes | Parameters | Distributions of scores according to improved breed adoption categories: Medium (N=47) | High (N=153) | Total (N=200) |
|---|---|---|---|---|
| **Relative advantages** | | | | |
| Productivity | Weighted average score | 1.68 | 2.37 | 2.21 |
| | Weighted percentage | 33.62 | 47.5 | 44.2 |
| | **Association** | **$r_s$ = -0.012, p = 0.810** | | |
| Fast growth | Weighted average score | 1.04 | 1.55 | 1.43 |
| | Weighted percentage | 20.85 | 31 | 28.6 |
| | **Association** | **$r_s$ = -0.024, p = 0.733** | | |
| Employment | Weighted average score | 1.32 | 0.9 | 0.100 |
| | Weighted percentage | 26.38 | 17.9 | 19.9 |
| | **Association** | **$r_s$ = -0.194, p = 0.006** | | |
| Income | Weighted average score | 0.17 | 0.75 | 0.615 |
| | Weighted percentage | 3.404 | 15 | 12.3 |
| | **Association** | **$r_s$ = 0.083, p = 0.240** | | |
| Hobby | Weighted average score | 0.57 | 1.56 | 1.33 |
| | Weighted percentage | 11.49 | 31.2 | 26.6 |
| | **Association** | **$r_s$ = 0.003, p = 0.646** | | |
| Relative disadvantages | | | | |
| Initial cost | Weighted average score | 0.83 | 1.86 | 1.62 |
| | Weighted percentage | 16.6 | 37.3 | 32.4 |
| | **Association** | **$r_s$ = -0.008, p = 0.804** | | |
| Skill | Weighted average score | 0.83 | 1.67 | 1.47 |
| | Weighted percentage | 16.6 | 33.3 | 29.4 |
| | **Association** | **$r_s$ = -0.119, p = 0.094** | | |
| Shortage | Weighted average score | 1.11 | 1.92 | 1.73 |
| | Weighted percentage | 22.13 | 38.3 | 34.5 |
| | **Association** | **$r_s$ = -0.050, p = 0.481** | | |
| Incompatibility | Weighted average score | 0.83 | 1.16 | 1.08 |
| | Weighted percentage | 16.6 | 23.1 | 21.6 |
| | **Association** | **$r_s$ =- 0.115, p = 0.106** | | |
| Credit | Weighted average score | 0.32 | 0.37 | 0.36 |
| | Weighted percentage | 6.38 | 7.32 | 7.1 |
| | **Association** | **$r_s$ = -0.211, p = 0.003** | | |

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for 1st position, 4 for the 2nd position, 3 for the 3rd position, 2 for the 4th position, 1 for the 5th position and divided by the number of farmers in that category

Even though dairy farmers name quite a number of advantages, some disadvantages, mostly associated with compatibility aspects are also mentioned such as high initial cost, requirement for higher management skill, inability to maintain the required blood level of F2 generation, lack of breeding stock (crossbreed heifer or AI service), incompatibility with environment (susceptibility to disease, parasite and climatic strain), lack of access to production credit, lack of favorable market infrastructure, incompatibility of product with taste of consumers and requirement of high quality feed.

No significant relationships are found between most of the perceived relative advantages and adoption of improved breeds (Table 6.17). The fact that most of the disadvantages, such as shortage of breeding stock, high initial cost and requirement of high management skill are equally perceived to be critical by both the medium and high breed adoption categories, as indicated in the slight variation between their weighted average score provides supportive evidence for the lack of significant association between these attributes and the dependent variable. On the other hand, in ability to maintain blood level of F2 generation and incompatibility of dairy and dairy products with taste of consumers are the least of all the problems mentioned only by a very few number of farmers (see Appendix 6.5b).

As far as the relationship between intervening variables and the adoption behavior of dairy farmers regarding improved breed is concerned, all of the intervening variables are found to be significantly associated with breed adoption (Table 6.18). The result is in agreement to the hypothesized association (Hypothesis 3.2) except the unexpected but commonly occurring negative relationship of need tension regarding production efficiency and the practice itself, which is probably caused due to behavior change attained as a result of the extension program.

**Table 6.18 Relationship between intervening variables and adoption of improved dairy breed**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | -.196 | .005 |
| Need tension regarding production efficiency | -.242 | .001 |
| Perceived current efficiency regarding improved breed | -.261 | .000 |
| Need tension regarding improved breed | -.183 | .010 |
| Need compatibility regarding improved breed | .182 | .010 |
| Perceived total attribute regarding improved breed | .219 | .002 |

### 6.9.2 Influence of intervening factors on adoption of housing practices

Some of the notable behavior positive psychological field forces with regard to the use of improved housing include prevention of feed wastage, provision of comfort and protection for animals, convenience for management, saving of time and keeping animals tidy and healthy.

No significant associations are found between most of the perceived relative advantages and the adoption behavior of dairy farmers regarding this practice (Table 6.19). This is reflected in the very similar rank order distributions and the non-significant correlations. Of all the advantages, prevention of feed wastage and keeping animals tidy and healthy are the most prominent, but only management convenience appears to have had limited influence on adoption behavior (r = 0.165, p = 0.02).

**Table 6.19 Relationships between perceived technology attributes of improved housing and adoption behavior as expressed by weighted mean and percentage scores***

| Attributes | Parameters | Distributions of scores according to housing practices adoption categories: None (N=58) | Low (N=72) | Medium (N=70) | Total (N=200) |
|---|---|---|---|---|---|
| **Relative advantages** | | | | | |
| **Avoid feed wastage** | Weighted average score | 2.97 | 2.72 | 2.90 | 2.86 |
| | Weighted percentage | 59.31 | 54.44 | 58.00 | 57.10 |
| | **Association** | **$r_s = -0.002$, p = 0.762** | | | |
| **Comfort & protection** | Weighted average score | 1.60 | 1.97 | 1.56 | 1.72 |
| | Weighted percentage | 32.07 | 39.44 | 31.14 | 34.40 |
| | **Association** | **$r_s = 0.005$, p = 0.943** | | | |
| **Convenience** | Weighted average score | 1.02 | 1.18 | 1.19 | 1.14 |
| | Weighted percentage | 20.34 | 23.61 | 23.71 | 22.70 |
| | **Association** | **$r_s = 0.165$, p = 0.020** | | | |
| **Labor/time saving** | Weighted average score | 1.69 | 1.38 | 1.56 | 1.53 |
| | Weighted percentage | 33.79 | 27.50 | 31.14 | 30.60 |
| | **Association** | **$r_s = 0.045$, p = 0.530** | | | |
| **Keep animals healthy** | Weighted average score | 2.72 | 2.75 | 2.80 | 2.76 |
| | Weighted percentage | 54.48 | 55.00 | 56.00 | 55.20 |
| | **Association** | **$r_s = 0.034$, p = 0.630** | | | |
| **Relative disadvantages** | | | | | |
| **Installation cost** | Weighted average score | 2.98 | 3.28 | 3.14 | 3.15 |
| | Weighted percentage | 59.66 | 65.56 | 62.86 | 62.90 |
| | **Association** | **$r_s = 0.017$, p = 0.813** | | | |
| **Labor** | Weighted average score | 2.40 | 2.81 | 2.87 | 2.71 |
| | Weighted percentage | 47.93 | 56.11 | 57.43 | 54.20 |
| | **Association** | **$r_s = 0.207$, p = 0.003** | | | |

Only two factors are identified as disadvantages, namely, high installation cost and labor requirement. Participants were solicited to rate the disadvantages on a five-point scale, 5 being the highest disadvantage. According to this assessment high installation costs are found to be the most vital problem for about 40 percent of the sample farmers who assessed it 5 on the rating scale (Table 6.19 and Appendix 6.6b). Very few farmers reported these disadvantages as unimportant. However, only the labor requirements show a significant relationship with adoption (r = 0.207, p = 0.000) implies that the better

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 5 for the 1st position, 4 for the 2nd position, 3 for the 3rd position, 2 for the 4th position, 1 for the 5th position and divided by the number of farmers in that category

adopters tend to be more aware or knowledgeable about the disadvantage of higher installation costs.

Regarding the relationship between intervening variables and adoption of housing practices, significant relationships are only found in the case of problem perception discrepancy and need tension with regard to the practice. In both cases the relationships are significantly negative, and in accordance with the same trend already observed previously.

**Table 6.20 Relationship between intervening variables and adoption of improved housing practice**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | .082 | .251 |
| Need tension regarding production efficiency | .111 | .117 |
| Perceived current efficiency regarding improved housing practice | -.509 | .000 |
| Need tension regarding improved housing practice | -.381 | .000 |
| Need compatibility regarding improved housing practice | .010 | .888 |
| Perceived total attribute regarding improved housing practice | .003 | .966 |

### 6.9.3 Influence of intervening variables on adoption of medical practice

Perceived relative advantages or behavior positive psychological field factors of dairy farmers regarding medical practices include prevention (specifically related with vaccination), disease curing and contribution to milk production increase. The mean weighted values indicate that disease curing and prevention are the first and second most important advantages (Table 6.21 and Appendix 6.7a) for dairy farmers of ALWDADPMA. Only in the case of prevention is there a linear relationship with adoption behavior ($r = 0.133$) but only at 5 percent level of probability implying that adopters tend to be more aware of these advantages than the non- or poor adopters.

**Table 6.21 Relationships between perceived technology attributes of recommended medical practices and adoption behavior as expressed by weighted mean and percentage scores***

| Attributes | Parameters | Distributions of scores according to medical practice adoption categories | | | |
|---|---|---|---|---|---|
| | | Low (N=62) | Medium (N=52) | High (N=86) | Total (N=200) |
| **Relative advantages** | | | | | |
| **Prevention (advantage in reference to vaccination)** | Weighted average score | 0.806 | 1.12 | 1.5 | 1.185 |
| | Weighted percentage | 16.13 | 22.3 | 30 | 23.7 |
| | **Association** | **$r_s = 0.133, p = 0.061$** | | | |
| **Disease curing** | Weighted average score | 1.387 | 1.31 | 0.965 | 1.185 |
| | Weighted percentage | 27.74 | 26.2 | 19.3 | 23.7 |
| | **Association** | **$r_s = -0.093, p = 0.189$** | | | |
| **Productivity (refers to increase in milk yield)** | Weighted average score | 0.806 | 0.58 | 0.535 | 0.63 |
| | Weighted percentage | 16.13 | 11.5 | 10.7 | 12.6 |
| | **Association** | **$r_s = 0.053, p = 0.622$** | | | |
| **Relative disadvantages** | | | | | |
| **Cost** | Weighted average score | 1.226 | 1.87 | 1.36 | 1.45 |
| | Weighted percentage | 24.52 | 37.3 | 27.21 | 29 |
| | **Association** | **$r_s = 0.098, p = 0.169$** | | | |
| **Effectiveness (refers to disease curing ability of available medicine)** | Weighted average score | 1.145 | 0.65 | -0.17 | 0.45 |
| | Weighted percentage | 22.9 | 13.1 | -3.49 | 9 |
| | **Association** | **$r_s = -0.183, p = 0.010$** | | | |
| **Specialist (unlike others, medical practices are operated by technicians)** | Weighted average score | 1.742 | 1.46 | 2.07 | 1.81 |
| | Weighted percentage | 34.84 | 29.2 | 41.4 | 36.2 |
| | **Association** | **$r_s = -0.215, p = 0.002$** | | | |
| **Vaccine (there is shortage of vaccine)** | Weighted average score | 0.048 | -0.19 | -0.05 | -0.055 |
| | Weighted percentage | 0.968 | -3.85 | -0.93 | -1.1 |
| | **Association** | **$r_s = 0.048, p = 0.499$** | | | |
| **Medicine (there is shortage also)** | Weighted average score | -0.02 | 0.29 | 0.721 | 0.38 |
| | Weighted Percentage | -0.32 | 5.77 | 14.42 | 7.6 |
| | **Association** | **$r_s = -0.072, p = 0.276$** | | | |

Incurring additional cost, lack of efficiency, skill or specialist requirement, shortage of vaccines, shortage of medicine and inconvenience of sprayer handling are some of the disadvantages mentioned by dairy farmers of ALWDADPMA. Requirement of specialist is the most important problem for about 40 percent of sample farmers followed by additional costs and lack of effectiveness, which are rated the 2nd and 3rd most important problems for a substantial (10 to 30 percent) number of respondents (Table 6.22 and Appendix 6.7b). Shortages of medicine and vaccines are not perceived to be a serious

* Weighted score is the sum of the rank order frequencies multiplied respectively by 4 for the 1st position, 3 for the 2nd position, 2 for the 3rd position, 1 for the 4th position and divided by the number of farmers in that category

problem. There is, however, no significant relationship between most of the perceived attributes of medical practice and adoption except lack of effectiveness ($r = -0.0183$, $p = 0.010$) and requirement of specialists ($r = -0.215$, $p = 0.002$). In both cases the relationship is highly significant and negative implying that the non- or poor adopters tend to be more aware of these constraints.

As far as the relationship between intervening variables and the adoption behavior of recommended medical practices is concerned, significant and expected relationships are found only regarding two factors. The relationship between need compatibility and perceived current efficiency with adoption of medical practices is significant and is in agreement with the expected. The rest of the intervening variables are beyond expectations either due to lack of significant relationship or direction of association (Table 6.22).

**Table 6.22 Relationship between intervening variables and adoption of recommended medical practice**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | .088 | .217 |
| Need tension regarding production efficiency | .010 | .892 |
| Perceived current efficiency regarding medical practice | -.412 | .000 |
| Need tension regarding medical practice | -.570 | .000 |
| Need compatibility regarding medical practice | .272 | .000 |
| Perceived total attribute regarding medical practice | -.078 | .271 |

### 6.9.4 Influence of intervening variables on adoption of feed practices

High nutritive value, palatability and high dry matter content are some of the perceived relative advantages of recommended feed practices mentioned by respondents. High nutritive value is rated the most important advantage by more than 75 percent of respondents followed by palatability and dry matter content rated as the 2$^{nd}$

and 3rd most important advantages respectively by between 10 to 75 percent of the respondents (Table 6.23 and Appendix 6.8a). The similarity between the various adopter categories in terms of the weighted average rank order position and the correlation analyses indicate at some form of association between attributes of feed and adoption behavior, but with the exception of the advantage of high dry matter ($r = 0.144$, $p = 0.041$) the findings do not provide evidence in support of the hypothesis that the perception of practice attributes contribute toward their adoption.

**Table 6.23 Relationships between perceived technology attributes of feed practices and adoption behavior as expressed by weighted mean and percentage score***

| Attributes | Parameters | Distributions of scores according to feed practice adoption category: Low (N=85) | Medium (N=44) | High (N=71) | Total (N=200) |
|---|---|---|---|---|---|
| **Relative advantages** | | | | | |
| **Nutritive value** | Weighted average score | 1.80 | 1.57 | 1.62 | 1.69 |
| | Weighted percentage | 36.00 | 31.36 | 32.39 | 33.70 |
| | **Association** | $r_s = -0.263$, $p = 0.000$ | | | |
| **Palatability** | Weighted average score | 1.02 | 1.07 | 1.20 | 1.10 |
| | Weighted percentage | 20.47 | 21.36 | 23.94 | 21.90 |
| | **Association** | $r_s = -0.027$, $p = 0.709$ | | | |
| **Dry-matter** | Weighted average score | 0.18 | 0.36 | 0.18 | 0.22 |
| | Weighted percentage | 3.53 | 7.27 | 3.66 | 4.40 |
| | **Association** | $r_s = 0.144$, $p = 0.041$ | | | |
| **Relative disadvantages** | | | | | |
| **Cost** | Weighted average score | 2.82 | 3.27 | 3.01 | 2.99 |
| | Weighted percentage | 56.47 | 65.45 | 60.28 | 59.80 |
| | **Association** | $r_s = 0.093$, $p = 0.191$ | | | |
| **Shortage** | Weighted average score | 2.46 | 2.59 | 2.18 | 2.39 |
| | Weighted percentage | 49.18 | 51.82 | 43.66 | 47.80 |
| | **Association** | $r_s = -0.068$, $p = 0.340$ | | | |
| **Land (shortage for feed production)** | Weighted average score | 3.06 | 2.93 | 3.18 | 3.08 |
| | Weighted percentage | 61.18 | 58.64 | 63.66 | 61.50 |
| | **Association** | $r_s = 0.053$, $p = 0.453$ | | | |
| **Labor** | Weighted average score | 1.96 | 2.02 | 1.99 | 1.99 |
| | Weighted percentage | 39.29 | 40.45 | 39.72 | 39.70 |
| | **Association** | $r_s = 0.071$, $p = 0.317$ | | | |

The associated high cost, shortage in supply (especially forage seeds), lack of land (for hay making) and laboriousness are some of the shortcomings of improved feed perceived

* Weighted average score is the sum of the rank order frequencies multiplied respectively by 4 for the 1st position, 3 for the 2nd position, 2 for the 3rd position, 1 for the 4th position divided by the number of farmers in that category

by dairy farmers. When asked to rate the drawbacks on a five-point scale (5 = highest), lack of land for hay making is found to be the most important problem for almost 60 percent of the sample farmers, followed by high cost and shortage in supply which are also rated high by about 30 t and 20 percent of respondents, respectively (Appendix 6.8b).

With respect to the relationship between intervening variables and adoption, need compatibility and perceived current problem regarding the practice are found to be strongly related with the feed adoption behavior of dairy farmers (Table 6.24). Need tension and perceived total attribute regarding this practice are not significantly related. On the other hand, need tension and perceived current efficiency regarding the overall production efficiency are significantly related with behavior though the association is not as strong as that of the other intervening variables associated with this practice.

**Table 6.24 Relationship between intervening variables and adoption of recommended feed practice**

| Variable | $r_s$ | p |
|---|---|---|
| Perceived current efficiency regarding production efficiency | .135 | .057 |
| Need tension regarding production efficiency | .231 | .001 |
| Perceived current efficiency regarding improved feed practice | -.640 | .000 |
| Need tension regarding improved feed practice | -.061 | .390 |
| Need compatibility regarding improved feed practice | .285 | .000 |
| Perceived total attribute regarding improved feed practice | -.072 | .309 |

In general, analysis of the relationships between the various intervening variables assumed to influence the adoption behavior of maize and dairy farmers regarding each of the practices included in the packages of the two enterprises showed that most of the need related factors (need compatibility and perceived current efficiency) regarding the practices are significantly related with adoption as expected. This very high and consistent relationship suggest that needs are reliable factors in predicting the adoption behavior of farmers

The relationship between need tension regarding the practices and adoption is usually significant but the direction is negative. This unexpected result can be associated to need satisfaction and/or the likelihood of overrating own efficiency by the least efficient category of farmers.

Perceptions of technology attributes are, in most cases, not found to be significantly related with the adoption behavior of farmers due to the possible reasons provided.

## 6.10 THE INFLUENCE OF INTERVENING FACTORS ON MAIZE AND DAIRY PACKAGE ADOPTION

In the earlier section, the influences of the intervening factors on the adoption behavior of farmers in relation to each practice (fertilizer, spot application of fertilizer, seed, line planting in maize) and (breed, housing, medical and feed practices in dairy) were assessed. This section is interested in evaluating the influence of these variables on the package as a whole. Factors affecting the adoption behavior of maize and dairy farmers, as pointed out previously are perceived current efficiency, need tension, need compatibility, and perceptions of technology attributes with respect to the above-mentioned practices and the overall production efficiency.

### 6.10.1 Maize

Unlike the independent variables, the influence of intervening variables on maize package adoption is significant in all of the 18 causal variables except in perceptions of technology attributes regarding seed (Table 6.25). With the exceptions of perceived current efficiency regarding spot application and line planting, which are significant at the 10 percent level of probability, the rest are significant at the 1percent (12 factors) and 5 percent (4 factors) level. All of the variables have the expected sign or the nature or direction of influence except those associated with need tension for reasons already explained in the preceding chapter. This represents strong evidence in support of Hypothesis 3.2. Need related factors (need tension and need compatibility) are the top among the list while factors associated with technology attributes are relatively less important as indicated in the comparatively lower correlations.

**Table 6.25 Correlation between intervening variables and package adoption**

| Variable | r | p | Variable | r | p |
|---|---|---|---|---|---|
| Maize | | | Dairy | | |
| PCE-efficiency | 0.110 | 0.120 | PCE-efficiency | 0.011 | 0.872 |
| PCE-fertilizer | -0.282 | 0.000 | PCE-breed | 0.088 | 0.215 |
| PCE-spot | -0.125 | 0.078 | PCE-housing | -0.442 | 0.000 |
| PCE-seed | -0.338 | 0.000 | PCE-medical | -0.178 | 0.012 |
| PCE-line planting | -0.136 | 0.056 | PCE-feed | -0.337 | 0.000 |
| NT-efficiency | -0.348 | 0.000 | NT-efficiency | 0.074 | 0.295 |
| NT-fertilizer | -0.785 | 0.000 | NT-breed | -0.234 | 0.001 |
| NT-spot | -0.738 | 0.000 | NT-housing | -0.272 | 0.000 |
| NT-seed | -0.747 | 0.000 | NT-medical | -0.506 | 0.000 |
| NT-line planting | -0.157 | 0.026 | NT-feed | -0.106 | 0.136 |
| NC-fertilizer | 0.563 | 0.000 | NC-breed | -0.144 | 0.043 |
| NC-spot | 0.677 | 0.000 | NC-housing | 0.075 | 0.291 |
| NC-seed | 0.590 | 0.000 | NC-medical | 0.181 | 0.010 |
| NC-line planting | 0.754 | 0.000 | NC-feed | 0.258 | 0.000 |
| PTA-fertilizer | -0.155 | 0.029 | PTA-breed | 0.048 | 0.500 |
| PTA-spot | 0.144 | 0.043 | PTA-housing | -0.010 | 0.893 |
| PTA-seed | 0.044 | 0.050 | PTA-medical | 0.113 | 0.111 |
| PTA-line planting | 0.180 | 0.011 | PTA-feed | 0.106 | 0.136 |

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

## 6.10.2 Dairy

Strong associations are also found between intervening factors on the adoption behavior of dairy farmers though the number of causal factors significantly associated with the dependent variable is not as high as in the case of maize. While 7 factors, mainly those related to need tension are significant at the 1percent level, perceived current efficiency regarding medical practices and need compatibility regarding breed are significant at the 5 percent level (Table 6.25). The relationships between factors associated with the variables need compatibilisty and perceived current efficiency and the adoption behavior of dairy farmers are significant in most cases providing further evidence for the validity of Hypothesis 3.2. All factors associated with perceptions of technology attributes are not significantly related with package adoption and appear to contradict the hypothesis (Hypothesis 3.2). The variables associated with need tension have very significant relationships, but the nature (direction) is not as hypothesized but for reasons already discussed.

## 6.11 CONTRIBUTIONS OF INTERVENING VARIABLES TO PACKAGE ADOPTION VARIANCE

In order to assess more accurately and determine the contributions of intervening variables on maize and dairy package adoption behavior of respondents, multiple regression analysis were used (Table 6.26).

Only those factors, which were significantly associated with the dependent variable, adoption (section 6.7), are included in the multiple regression model.

**Table 6.26 Standard multiple regression estimates of the contribution of intervening variables on package adoption**

| Maize | | | | Dairy | | | |
|---|---|---|---|---|---|---|---|
| Variable | Beta | t | p | Variable | Beta | t | p |
| Constant | - | 9.383 | 0.000 | Constant | - | 33.354 | 0.000 |
| PCE-fertilizer | -0.101 | -3.166 | 0.002 | PCE-housing | -0.433 | -10.121 | 0.000 |
| PCE-seed | -0.118 | -3.963 | 0.000 | PCE-medical | -0.208 | -4.686 | 0.000 |
| NT-efficiency | 0.052 | 1.534 | 0.127 | PCE-feed | -0.209 | -4.681 | 0.000 |
| NT-fertilizer | -0.375 | -9.261 | 0.000 | NT-breed | -0.063 | -1.491 | 0.138 |
| NT-spot | -0.280 | -7.977 | 0.000 | NT-housing | -0.350 | -8.087 | 0.000 |
| NT-seed | -0.305 | -8.386 | 0.000 | NT-medical | -0.414 | -9.205 | 0.000 |
| NT-line planting | -0.062 | -2.000 | 0.047 | NC-breed | -0.052 | -1.129 | 0.260 |
| NC-fertilizer | 0.126 | 3.959 | 0.000 | NC-medical | 0.039 | 0.848 | 0.390 |
| PTA-fertilizer | -0.047 | -1.626 | 0.127 | NC-feed | 0.197 | 4.173 | 0.000 |
| PTA-spot | -0.009 | 0.242 | 0.809 | | | | |
| PTA-line planting | 0.006 | 0.157 | 0.875 | | | | |
| $R^2$=0.872 | | | | $R^2$=0.683 | | | |

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

Intervening variables explain 87.2 percent ($R^2$=0.872) and 68.3 percent ($R^2$=0.683) of the variation in the adoption behavior of maize and dairy farmers, respectively. The greatest contribution comes from need related factors (need tension and need compatibility) in both enterprises, once again indicating the fact that needs are indispensable factors in behavior determination. Perceptions of technology attributes, which were significantly correlated with adoption, namely, perceptions of the attributes of fertilizer use, spot application of fertilizer, and line planting are not found to be significant predictors of the adoption behavior of maize farmers as previously observed in this study.

## 6.12 THE COMPARATIVE CONTRIBUTION OF INTERVENING VARIABLES TO THE VARIANCE IN PACKAGE ADOPTION BEHAVIOR

In order to obtain a better perspective of the relative importance of the various factors in explaining adoption behavior of respondents, a comparison was made between the contribution of independent and intervening factors. Table 6.27 illustrates the overall contributions of independent and intervening variables and the combined effect of the two sets of variables on adoption. It is apparent from the table that the input from independent variables is very small both in case of maize (32.4 percent) and dairy (17.8 percent) when compared to the much bigger contribution of the intervening variables where the value of the coefficient of determination is 0.872 (87.2 percent) in maize and 0.683 (68.3 percent) in dairy. This contribution is almost equal to the total effect of the two sets of variables, namely 0.891 (89.1 percent) in maize and 0.737 (73.7 percent) in dairy.

**Table 6.27 Comparison of coefficient of determination based on standard multiple regression estimations**

| Category of variables | Maize | | | Dairy | | |
|---|---|---|---|---|---|---|
| | $R^2$ | F | Total P | $R^2$ | F | Total P |
| 1. Independent | 0.324 | 13.17 | 0.000 | 0.178 | 10.56 | 0.000 |
| 2. Intervening | 0.872 | 116.135 | 0.000 | 0.683 | 45.557 | 0.000 |
| 3. 1+2 | 0.891 | 81.79 | 0.000 | 0.737 | 40.088 | 0.000 |

Hierarchical multiple regression estimations were also made to compute the differential contribution of the intervening variables and determine the critical factors influencing adoption behavior as depicted in Table 6.28.

**Table 6.28 Comparative influence of independent and intervening factors based on hierarchical multiple regression estimation in maize and dairy production**

| | Maize | | | | Dairy | | | |
|---|---|---|---|---|---|---|---|---|
| Model-1 | Variable | Beta | t | p | Variable | Bteta | t | p |
| | Constant | - | 3.619 | 0.000 | Constant | - | 18.584 | 0.000 |
| | Age | -0.039 | -0.547 | 0.585 | Farm size | 0.229 | 3.467 | 0.001 |
| | Education | 0.167 | 2.090 | 0.036 | Experience | 0.001 | 0.015 | 0.988 |
| | Farm size | 0.085 | 1.145 | 0.255 | Education | 0.160 | 2.203 | 0.028 |
| | Media: dummy | 0.356 | 4.547 | 0.000 | Media: dummy | 0.251 | 3.546 | 0.000 |
| | Ecology: dummy | 0.341 | 4.530 | 0.000 | | | | |
| | Extension: dummy | -0.080 | -1.169 | 0.244 | | | | |
| | Modernity: dummy | -0.070 | -0.927 | 0.355 | | | | |
| | **$R^2$=0.324, $R^2$ change=0.324, F=13.17, p=0.00** | | | | **$R^2$=0.178, $R^2$ change=0.178, F=10.56, p=0.000** | | | |
| Model-2 | Constant | | 8.580 | 0.000 | Constant | - | 26.060 | 0.000 |
| | Age | -0.043 | -1.383 | 0.168 | Farm size | 0.091 | 2.168 | 0.031 |
| | Education | 0.005 | 0.130 | 0.897 | Experience | 0.010 | 0.244 | 0.807 |
| | Farm size | 0.052 | 1.594 | 0.113 | Education | 0.063 | 1.352 | 0.178 |
| | Media: dummy | 0.053 | 1.477 | 0.141 | Media: dummy | 0.107 | 2.325 | 0.021 |
| | Ecology: dummy | 0.199 | 4.576 | 0.000 | | | | |
| | Extension: dummy | -0.034 | -0.965 | 0.336 | | | | |
| | Modernity | 0.009 | 0.254 | 0.800 | | | | |
| | PCE-fertilizer | -0.121 | -3.866 | 0.000 | NT-breed | -0.018 | -0.465 | 0.642 |
| | PCE-seed | -0.093 | -3.187 | 0.002 | NT-housing | -0.347 | -8.457 | 0.000 |
| | NT-efficiency | 0.003 | 0.099 | 0.921 | NT-medical | -0.392 | -8.987 | 0.000 |
| | NT-fertilizer | -0.381 | -9.488 | 0.000 | NC-breed | -0.097 | -2.218 | 0.028 |
| | NT-spot | -0.199 | -5.222 | 0.000 | NC-medical | 0.056 | 1.270 | 0.206 |
| | NT-seed | -0.292 | -8.257 | 0.000 | NC-feed | 0.152 | 3.330 | 0.001 |
| | NT-line planting | -0.108 | -3.402 | 0.001 | PCE-housing | -0.421 | -10.205 | 0.000 |
| | NC-fertilizer | 0.084 | 2.671 | 0.008 | PCE-medical | -0.196 | -4.669 | 0.000 |
| | PTA-fertilizer | -0.014 | -0.484 | 0.629 | PCE-feed | -0.200 | -4.849 | 0.000 |
| | PTA-spot | 0.030 | 0.733 | 0.464 | | | | |
| | PTA-line planting | -0.061 | -1.563 | 0.120 | | | | |
| | **$R^2$=0.89, $R^2$ change=0.566, F=81.79, p=0.000** | | | | **$R^2$=0.737, $R^2$ change=0.559, F=43.9, p=0.000** | | | |

(PCE = Perceived current efficiency, NT = Need tension, NC = Need compatibility, PTA = Perceived total attribute)

According to Table 6.28, the differential contribution ($R^2$change) in maize, for example, is 0.566. This implies that 56.6 percent of the variation in the adoption behavior of maize farmers is explained by the intervening variables alone when the influence of the independent variables is controlled. This, in other words, means that the balance, (87.2 percent-56.6 percent), which is 30.6 percent is an indirect effect of independent variables, explained via the intervening ones (Fig. 6.2).

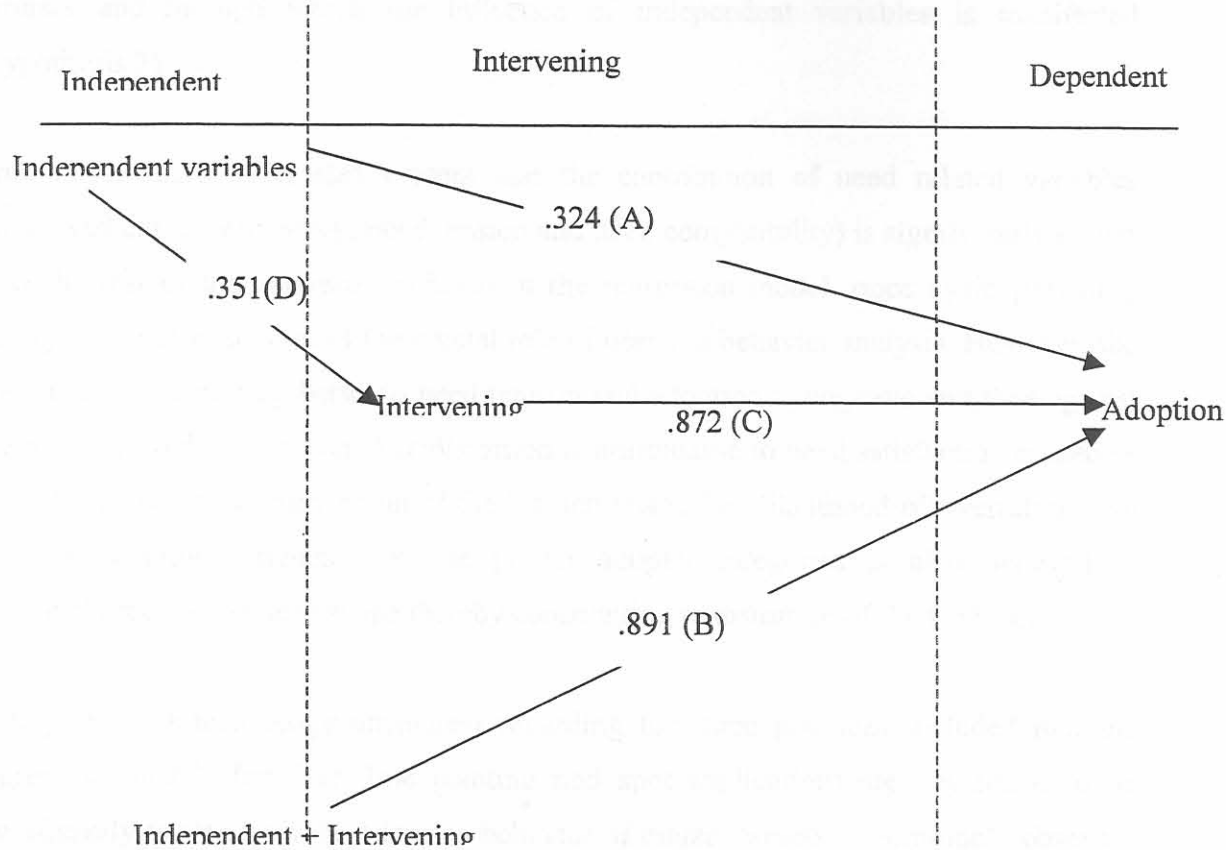



**Fig. 6.2 Path diagram showing the relationship between independent, intervening variables and adoption behavior of maize farmers***

The total effect of independent variables will now increase to 63 percent when the indirect effect of independent variables is considered, since the total effect of independent variables is the sum of their direct effect (32.4 percent) and indirect effect (30.6 percent),

* Values 'A', 'B', and 'C' are obtained from the regression model (Table 6.27). 'D' is determined by calculation i.e. 0.306/0.872=0.351

which is 63 percent. In other words the fact that almost half of the cumulative effect of independent variables is manifested via the intervening variables indicates that the effect of independent variables is noticeable only when their impact is assessed along with the intervening variables. This together with the very high contribution of intervening variables to the variation in the adoption behavior of farmers in the study area once again provides strong evidence in support of the main hypothesis of intervening variables being the likely precursor of the adoption or decision-making behavior of maize and dairy farmers and through which the influence of independent variables is manifested (hypothesis 3).

From Table 6.28, it is also evident that the contribution of need related variables (perceived current efficiency, need tension and need compatibility) is significantly higher than the rest of the variables included in the regression model, once again providing strong evidence in support of the crucial role of needs in behavior analysis. However, the direction of relationship between need tension and adoption is negative and thus against the hypothesized expectation. The distortion is attributable to need satisfaction caused as a result of extension intervention of the last ten years. The likelihood of overrating own practice adoption efficiency by the poorer adopter categories is also believed to drastically reduce the need scope thereby contributing to distortion of the findings.

Perceptions (of technology attributes) regarding the three practices included into the regression model (fertilizer, line planting and spot application) are not found to be significantly related with the adoption behavior of maize farmers as commonly observed in this study. Possible reasons for this, as discussed in the previous sections, can be attributed to the undermining effect of vigorously developed negative psychological field factors, lack of a five-point measurement scale to adequately measure the strength or importance of the attributes (valence) and an overlap between the various concepts of intervening variables, especially perceptions and knowledge, which play a less important role in behavior analysis.

In conclusion, analysis of the behavior of farmers regarding maize and dairy farming in the study area shows that intervening variables are the most crucial factors. On top of the very high contributions of intervening variables to the variation in the adoption behavior of respondent farmers in the study area, the implication of the fact that 50 percent of the influence of independent variables is encompassed by intervening variables (as shown in example above) is that an assessment of the intervening variables alone can produce sufficient results in behavior analysis. This in turn makes provision for the drastic reduction of the very great number of variables to have been associated in behavior analysis. The focus of extension can now, therefore, shift to the more direct and immediate precursors of behavior, intervening variables, which pave the way for the emergence of a more flexible, sensitive, and participatory extension approaches, which above all emphasize the needs or problems and perceptions of the development actors, the people.

# CHAPTER 7

# SUMMARY CONCLUSION AND RECOMMENDATIONS

## 7.1 INTRODUCTION

Since about 1957, different development strategies and extension approaches have been tested and implemented to promote sustainable development and improve the socio-economic condition of the rural population.

The most recent extension strategy, PADETES is characterized by the introduction of recommended agricultural technologies commonly presented in a form of packages. With the introduction of these packages, the productivity of some major crops has been increased significantly (SG 2000: 1994). Encouraged by the promising results, the government increased the number of participant farmers to about 4 million by 1999. However, in some quarters there are still doubts regarding the impact of the introduced technology practices or packages on yield improvement. According to these groups the impact of introduced practices is largely impaired by a chain of constraints in the production process such as higher input price, unavailability of credit, bureaucratic input and credit administration, low prices for agricultural produce, poor marketing services, land fragmentation caused by government land ownership policy and weak research and extension services.

Previous studies (e.g., Zegeye and Tesfaye, 2001; Zegeye *et al,* 2001; Elias, 1999) that tried to assess this program with the intent of answering the above questions are scanty and have failed to explain much of the variation in behavior (practice adoption) and the resulting production efficiency. This study endeavors to shed more light on the critical behavior determinants, which are, according to Lewin (1951) and Düvel (1991), associated with the cognitive field.

The overall objective of this study was to identify and compare the different categories of variables in regard to their influence on the adoption behavior and production efficiency as it pertains to maize growers in the Shashemene District and dairy farmers of ALWDADPMA and more specifically

- to review past development theories and behavior change models with a view to assess their potential use as conceptual models appropriate for behavior analysis and intervention;
- to assess the differences in technology use between program participant farmers as compared against the different efficiency classes;
- to provide a description of the maize and dairy farmers in the study area regarding their profile or characteristics;
- to identify the most important factors responsible for the adoption of the technology packages promoted through PADETES and the production efficiency thereof, and finally
- to highlight the implication of the findings for future policy, research and extension interventions.

The study was conducted in the Southern part of Ethiopia, or more specifically in the Shashemene district and Debrezeit town (ALWDDPMA) of Oromia Regional State during the period Februrary to December 2002. Shashemene is located some 275 km South of Addis Ababa consisting a total of 36 and 28 maize growing peasant associations (PAs). Each PA has an average farmhouse hold of 530 people. A random sampling technique was employed to choose 4 among the 28 maize growing PAs. Finally 50 farmers from each of the 4 PAs or a total of 200 farmers were randomly chosen. This represents a sample size of 10 percent and is assumed to be large enough to represent the 2120 farm households residing in the 4 PAs.

ALWDADPMA is located 45 km South East of Addis Ababa. It is known in supplying the surrounding urban and peri-urban areas especially Addis Ababa with their daily milk demands. It also works towards fulfilling one of its principal objectives of being a technology promotion center for the surrounding rural and urban communities. It has about 430 standing members out of which 200 (46 percent) farmers are similarly selected at random. The fact that respondents are residing in one town reduced travel costs and time and has allowed for a large sample within the available time and budget.

The principal techniques employed for data analysis included a) frequency distribution and summary statistics together with the use of graphs, tables and charts. These were used to prepare data for further higher level analyses and facilitate its presentation b) correlation analyses and significant tests including Pearson's correlation, none parametric correlation techniques (Gamma, Cramer's V), one way analysis of variance and Chi-square test of independence were also used. They were used to test the existence of significant relationships between the various causal factors and the dependent variables c) The OLS method was employed to evaluate the aggregate effect of the different categories of variables on the variance of adoption behavior and production efficiency. This helped to select or identify the crucial category of variables affecting adoption behavior.

## 7.2 SUMMARY AND CONCLUSIONS

In view of the purposeful and scientifically accepted approach to advance research hypotheses and to test and verify them, it is appropriate to summarize against the background of the hypotheses.

*Hypothesis 1: The adoptions of recommended technologies or production practices contribute significantly to production efficiency.*

Assessments of the current production efficiency of farmers in the study area reveal the existence of a very high variability in yield among the various efficiency classes of maize and dairy farmers. In maize, the productivity ranges between 0.8 and 6.0 tons per hectare. This yield is very high compared to the national average of 1.6 tons per hectare. There is, however, much room for improvement when it is compared against the optimum possible yield of 12 tons per hectare, which is achievable only if the complete recommended package is implemented and the agro ecology is favorable for maize production like in the Shashemene area (research site). The production efficiency of dairy farmers ranges from 4 to 16 liters per cow, the mean production being 10 liters. This production level is again within the expected range of 10 to 12 liters per cow, which is achievable with full adoption of the recommended dairy package.

Table 7.1 summarizes the adoption status of respondent maize and dairy farmers regarding the recommended maize and dairy production technology practices.

According to Table 7.1 though a lot remains to be done, the current adoption status is already significant. The state of adoption regarding most of the major practices such as improved variety and fertilizer regarding maize and breed regarding dairy farming are encouraging. The mean adoption of all practices is 52 percent for maize and 54 percent for dairy farming. However, it varies from as low as 12 percent in the case of forage legumes to 96 percent regarding vaccination. This information as such can be useful as a basis for focusing extension programs for the further diffusion of the recommended practices.

As far as the relationships between the adoption behavior and the production efficiency of respondent maize and dairy farmers are concerned, significant differences are found regarding almost all of the recommended maize production practices (Table 7.1). Considering one of the most important maize production practice, fertilizer, for example, there is significant difference between the least efficient and most efficient maize growers. The difference lies in the fact that with increasing efficiency there is a tendency to use more fertilizer. While only 4.9 percent of the farmers in the lowest efficiency category use fertilizer, this percentage increases in an almost linear fashion to about 95 percent in the most efficient category. Corresponding with this highly significant association, 55.6 percent of the variance in production efficiency of maize growers is explained by adoption of recommended maize practices.

**Table 7.1 The percentage adoption of recommended maize and dairy farming practices in the least and highest production efficiency categories**

| Technology/practice | Adoption status | Efficiency categories: Least efficient | Efficiency categories: Most efficient | Total |
|---|---|---|---|---|
| **Maize farming** | | | | |
| Improved variety | Use BHB-3253, BHB-660, BHB-540, BHB-140 and A511 | 0 | 49.5 | 49.5 |
| Certified seed | Use certified seed | 0 | 81.6 | 41 |
| Coverage | More than 75 percent plot covered by improved seed | 8.3 | 76.3 | 39 |
| Plant spacing | Use 25 cm-1seed/hill | 12.2 | 76.3 | 47 |
| Line spacing | Use 80 cm-2 seeds/hill | 4.9 | 34.2 | 19.5 |
| Spacing measurement | Use foot steps | 85.4 | 97.4 | 95.5 |
| Fertilizer type | Use both DAP and urea | 4.9 | 94.7 | 62.5 |
| Fertilizer rate | Use 100 kilograms of each DAP and urea | 0 | 73.7 | 46 |
| Fertilizer measurement | Use Coca Cola cup or judgment | 7.3 | 89.5 | 89.5 |
| Fertilizer placement | Apply besides seed | 0 | 52.6 | 33.5 |
| **Dairy farming** | | | | |
| Cross breed animals | More than 75 percent of herd | 65.7 | 91.7 | 81.5 |
| 50 percent exotic crosses | More than 75 percent of herd | 68.6 | 94.4 | 80 |
| 62.5 percent exotic crosses | More than 75 percent of herd | 48.5 | 69.4 | 58 |
| Feed trough | Moderate to good condition feed trough | 40 | 45 | 45 |
| Gutter | Moderate condition gutter | 28.6 | 38.9 | 35 |
| Floor | Moderate to good condition floor | 37.1 | 55.6 | 48 |
| Roof and side walls | Moderate to good condition roof and side walls | 48.5 | 47.2 | 49 |
| Stall | Moderate condition stall | 5.7 | 8.3 | 12.5 |
| Industrial byproducts | Feed regularly | 14.3 | 22.2 | 15.5 |
| Processed feeds | Feed regularly (most feed types) | 25.7 | 38.9 | 31.5 |
| Forage legumes | Feed regularly (some forage legumes) | 5.7 | 11.1 | 12 |
| Anthrax | All animals vaccinated | 91.4 | 100 | 96 |
| Black leg | All animals vaccinated | 91.4 | 100 | 96 |
| Rinder pest | All animals vaccinated | 91.4 | 100 | 96 |
| Ecto parasites | All animals treated | 37.1 | 52.8 | 49 |
| Indo parasite | All animals treated | 48.6 | 63.9 | 60.5 |

In dairy, all of the breeding practices are significantly associated with production efficiency. The variation regarding the rest of the three practices included into the package is limited. All the farmers, viz the efficient and less efficient, farmers have either fully adopted (medical practice) or moderately adopted (housing and feeding practices). The lack of relationship between the causal variable, adoption and production efficiency regarding these three practices is largely because of a lack of variation but also seems to indicate that the practices are not critical for dairy farming. The use of more refined measurement scales, especially regarding the feeding practices is likely to shed more light on the impact of adoption of recommended dairy practices on the production efficiency of producers.

In general the analyses suggest that there are significant and positive relationships regarding most of the practices included into the package program. This clear relationship between the adoption behavior and the production efficiency of maize and dairy farmers regarding the majority of the practices included in the package program provides strong evidence in support of Hypothesis 1. This contradicts the claim that there is no significant difference between adopters and non-adopters (use of technology packages did not influence yield) as far as their production efficiency is concerned.

*Hypothesis 2: Production efficiency is determined by independent and intervening variables of which the influence of the former is indirect and only becomes manifested in production efficiency via intervening variables, which are the direct precursors of production efficiency.*

Support for the above hypothesis can be found in evidence indicating that

*Hypothesis 2.1: There is a significant relationship between independent personal and environmental factors and production efficiency*

One of the objectives of this study was to describe the characteristics of respondent maize and dairy farmers or answer the question "who are the maize and dairy farmers?" The assumption was that these attributes are related to production efficiency.

The attributes included in this study can be divided into personal (age, experience, gender, education, attitudinal modernity), communication (change agent contact, access to media), environmental and socio economic (agro-ecology, farm size, organizational participation) characteristics. The characteristics of respondents regarding these variables and their influence on production efficiency are briefly the following.

About three quarter of both maize and dairy farmers belong to an active age group of between 15 and 60 years. In accordance with the hypothesized association younger farmers appear to be more efficient than older ones regarding maize farming while significant age differences are not found between the different efficiency classes of dairy farmers.

Dairy farmers are, in general, more educated than maize farmers. Evidence of this fact is that 18.5 percent and 47.5 percent of respondent dairy farmers have a secondary and tertiary level of education respectively, while there is no single maize farmer with a tertiary level of education. In addition, the number of those who attended secondary school education is only 16 percent. In both maize and dairy farming the finding tend to support Hypothesis 2.1, namely that higher education is correlated with higher production efficiency.

As far as maize farming is concerned, land holding has been diminished to economically meaningless unit where the average holding size is less than 1.0 hectare. 25 percent of the respondents have less than 0.75 hectare of land holding and only 28 percent have a farm size of between 1.25 and 2.0 hectare. The bigger dairy farmers supply an average of 282 liters of milk per fortnight while the production of the small farmers is only 67 liters. There is, in accordance with Hypothesis 2.1, a positive relationship between farm size and production efficiency in the case of both farming types.

Dairy farmers with more farming experience (13-30 years) are more efficient than those who have less experience (1-4 years). However, the relationship regarding maize farming is significant but, other than hypothesized, of a negative nature, which does suggest that experience is of value up to a certain point. Thereafter it tends to have a negative influence, which however could be attributed to its close relationship with age.

Public gatherings (meeting), the radio, the TV, and the print media are the available communication media used by both maize and dairy farmers. Dairy farmers have more exposure to the media than maize farmers. For example 67 percent have a high exposure as compared to only 37.5 percent of the maize farmers. While radio and meetings are, in order of importance, the most commonly used media by both maize and dairy farmers, print media is the least used. Maize farmers, who have higher exposure to media tend to be more efficient than those who have low exposure, which again supports the hypothesis. However, the association is not significant in dairy farming.

As far as information sources are concerned, fellow farmers, private veterinary drug shops, the PA, and Demonstration plots are some of the most frequently used (about twice a week) and important sources. 54, 51, 39 and 13 maize farmers use fellow farmer, the PA, the DA and the EMTP, respectively about once or twice a week. Dairy farmers mostly use fellow farmers and private veterinary drug shops. 37 and 20 dairy farmers, respectively use these sources at least once a week. However, there is no evidence indicating that there is a relationship between the frequency of contact and production efficiency.

The great majority of the respondent households (92 percent in maize) and (83 percent in dairy) are male headed. There is, however, insufficient evidence to suggest that male-headed households are more efficient than their female counterparts.

Attitudinal modernity, which encompasses the attitude of the farm operator toward science, religion, education, credit, technology, etc. was one of the factors assumed to have an influence on maize and dairy farmers' adoption behavior and efficiency. Comparatively speaking, dairy farmers are found to be attitudinally more modern (61 percent) than maize farmers (27 percent). How ever, attitudinal modernity, does not explain production efficiency in maize farming but only in dairy farming.

The most common institutions with which both maize and dairy farmers interact are members of WAC, PA, marketing cooperatives, and school and religious institutions. In general the level of organizational participation in both maize and dairy farming is quite low and no evidence is found showing the existence of significant difference in production efficiency attributable to differences in organizational participation.

More maize farmers residing in the middle agro ecological zone are found in the higher efficiency category than those residing in the lower altitude areas, which is supportive of Hypothesis 2.1.

In general, the relationship between independent variables and the production efficiency of maize and dairy farmers is characterized by a week and limited relationship. Only agro ecological region, age, education, farm size and media exposure in maize and age, education, farm size and attitudinal modernity in dairy farming are significantly related to the production efficiency of respondents.

*Hypothesis 2.2: There is a significant relationship between intervening factors and production efficiency.*

Intervening factors are those variables mediating between the independent and the dependent variable (production efficiency). The variables considered in this study refer to need tension, need compatibility, perceived current efficiency and perceptions of technology attributes regarding the overall production efficiency (Productivity) and the recommended practices.

Among the intervening variables considered, need compatibility is found to be an indispensable factor almost perfectly related with the production efficiency of both the maize and dairy farmers with regard to all of the production practices included in the package program.

Factors related to need tension regarding almost all of the maize and dairy practices analyzed are significantly related with production efficiency. However, in contrast to expectations, the direction of relationship is found to be negative regarding almost all of the maize and some of the dairy practices, which is of course attributable to need satisfaction. In other words the problem discrepancy or need tension vanishes as production efficiency progresses resulting in a seemingly negative association.

Perceived current efficiency is not found to be significantly related with production efficiency regarding many of the practices and the overall production. Perceived current efficiency regarding seed and overall production (yield) are the only exceptions where it is found to be significantly related.

No significant relationships are found between perceptions of technology attributes and production efficiency with regard to most of the practices included in maize and dairy packages.

In general, strong associations characterize the relationship between the production efficiency of maize and dairy farmers and the intervening factors, need related factors being the most important. This very high and significant association supports Hypothesis 2.2.

*Hypothesis 2.3: Intervening variables are the most important predictors and taken together, will account for a significantly greater proportion of the variance of production efficiency than the independent variables.*

The contribution of independent variables to the total variation in production efficiency is, 25.1 percent in maize and 19.3 percent in dairy farming. Intervening variables, on the other hand, explained 87.5 percent ($R^2 = 0.875$) and 80.9 percent ($R^2 = 0.809$) of the variance of production efficiency in maize and dairy farming respectively. This very high difference in the coefficient of determination value of the two sets of variables indicates that intervening variables are the crucial or the most important variables in behavior determination.

In a further analysis to establish whether the intervening variables still able to sufficiently predict production efficiency if the possible effects of independent variables are controlled, it is found that the contribution of intervening variables alone to the variance in production efficiency is 63.6 percent and 62.6 percent as opposed to that of the independent variables, which is 25.1 percent, and 19.3 percent in maize and dairy respectively. This very high net effect ($R^2$ change) together with the very high contribution of intervening variables ($R^2$) provides strong evidence in support of the validity of Hypothesis 2.3.

The contributions of independent variables become substantial only when their effect, which is manifested via the intervening variables (the indirect effect), is considered. The indirect effect of independent variables on efficiency variation is 23.9 percent in maize and 18.3 percent in dairy. This highly significant indirect contribution provides strong evidence in support of the main hypothesis namely that the intervening variables with the strongest influence are the likely immediate and direct precursor of decision-making and the resulting production efficiency and it is through them that the influence of independent variables is manifested in decision- making and production efficiency (Hypothesis 2).

These findings indicate that the influence of independent variables on the production efficiency of respondent farmers is encompassed in the intervening variables. This in turn implies that the focus of extension can be narrowed down to that of the intervening variables, and has both epistemological and practical relevance for the extension discipline. It is now possible to drastically reduce the great number of variables traditionally considered in behavior analysis thereby decreasing monitoring and evaluation costs and allowing for a more in-depth study of the more relevant variables.

*Hypothesis 3: Adoption behavior is determined by independent and intervening variables of which the influence of the former is indirect and only becomes manifested in behavior via intervening variables, which are the immediate and direct precursors of decision-making and adoption behavior.*

Support for the above hypothesis can be found in evidence indicating that

*Hypothesis 3.1: There is a significant relationship between independent personal and environmental factors and adoption behavior.*

As far as the relationship between independent variables and the adoption behavior of maize farmers is concerned, almost all of the independent variables hypothesized to be associated with the adoption behavior of respondents (agro-ecological region, media exposure, education, age, farm size, extension contact, farming experience and attitudinal modernity) are significantly associated with the adoption behavior of farmers, thereby supporting Hypothesis 3.1. But only education, farm size, farming experience and media exposure are significantly associated with the adoption behavior of dairy farmers. The strength of association is however very week in both farming types as discovered from their low correlation value.

*Hypothesis 3.2: There is a significant relationship between intervening variables and adoption behavior.*

Variables associated with need compatibility and need tension have again proven to have the biggest potential influence on the behavior of respondents in the study area. These variables are found to be highly correlated with the adoption behavior of farmers regarding almost all of the recommended maize and dairy practices. Need compatibility with regard to housing and need tension regarding the overall dairy production and feed practices are the only exceptions where the influence of intervening variables is low. The direction of relationship regarding need tension, is however, negative as commonly observed in this study. The reason for this is associated with need satisfaction and the possibility of overrating own efficiency especially by the poorer adopting respondents.

Although it is not as pronounced as in the case of production efficiency, factors associated with perceptions of technology attributes are again not found to be significantly related with adoption behavior regarding most of the recommended maize and dairy practices. Perceived total attribute regarding line planting and medical practices are the only exceptions where the association is found to be significant. Vigorously developing psychological field factors are expected to undermine the influence of the net perception score to the variation in adoption behavior. The five-point scale measurement instrument employed in this study is also suspected to contribute to the apparent lack of significant association. It lacks the capacity to sufficiently measure the valence or strength of the attributes. The overlap between the different concepts of intervening variables may be another dimension contributing towards the weak relationship. The overlap with especially the intervening variable, knowledge is worth mentioning. Knowledge is regarded as a less important variable in behavior analysis, if it does not include what is regarded as perception in this study.

In general, strong associations as reflected in high correlations characterize the relationship between the intervening variables and the adoption behavior of maize and dairy farmers providing evidence in support of Hypothesis 3.2.

*Hypothesis 3.3: Intervening variables are the most important predictors, and taken together, will account for a significantly greater proportion of adoption behavior.*

The contribution of the intervening variables to the variance in the adoption behavior of maize and dairy farmers is as high as 87.2 percent in maize and 68.3 percent in dairy. In comparison the contribution of independent variables is rather scanty, namely 32.4 percent in maize and 17.8 percent in dairy. This finding once again proves that intervening variables are the most important factors in behavior determination and prediction (Hypothesis 3.3).

The contribution of intervening variables alone to the variance in adoption behavior, when the effect of independent variables is controlled, is 56.6 and 55.9 against that of the independent variables, which is 32.4 and 17.8 in maize and dairy farming respectively. This highly significant contribution to adoption behavior provides further evidence in support of Hypothesis 3.3

On the other hand, the contributions of independent variables to the variation in adoption behavior also include their indirect effect, which is 12.4 percent ($R^2 = 0.124$) in dairy and 30.6 percent ($R^2 = 0.306$) in maize. The total effect of independent variables increases to 30.2 percent in dairy and 63 percent in maize when their indirect effect (manifested via the intervening variables) is taken into account, providing strong evidence in support of the main hypothesis of intervening variables being the likely precursor of decision-making and through which the influence of independent variables is manifested (Hypothesis 3).

In conclusion the study established that the intervening variables, as manifested in their high $R^2$ value, are the most important and crucial variables in behavior analysis, especially if compared to the limited influence of independent variables. This is deduced from their respective contributions to the variance in the adoption behavior and production efficiency of the two enterprises analyzed in this study. Secondly, the study revealed that the contributions of independent variables is noticeable only when their indirect effect encompassed by the intervening variables is considered. This together with the very high contribution of intervening variables to the variation in the adoption behavior and production efficiency of respondent farmers provides strong evidence in support of the main hypotheses, namely that adoption behavior and production efficiency are determined by independent and intervening variables, of which the influence of the former is indirect and only becomes manifested via intervening variables, which are the direct precursors of adoption behavior and production efficiency.

This finding leads to an inference that extension can basically focus on a relatively limited number of variables, namely the intervening variables. This has both epistemological and or practical relevance for the extension discipline. The scope of survey research aimed at evaluation and monitoring of extension programs can now be drastically reduced to only the very relevant variables as opposed to traditional survey methods characterized by the collection of bulky data usually not directly related to behavior change, and is difficult to analyze. This is assumed to improve the efficiency of survey research both in terms of time and use of scarce financial resources. It also allows for an in-depth assessment of the more relevant variables.

Unlike the independent variables, which are usually given and unchangeable, the intervening variables can be changed. Directing the focus of extension on the more intervening variables will make extension more purposeful and provide it with a scientific basis, because the causal behavior focus are identified and addressed, as opposed to the traditional "hit-or-miss" approach.

Another important finding of this study is the prominent role of needs as causal factors among the intervening variables, but this must be seen in the context of current definitions and also the need for improvement regarding more accurate measures.

The study, in general, provides clear evidence in support of Düvel's behavior analysis and intervention model, which provided the conceptual framework and theoretical foundation for this study and appears a sound and practical analytical tool for behavior analysis. Nevertheless, the study is the first of its kind to test and verify the model in a completely different social and environmental setting. Since the situations of other countries could definitely be different from the conditions where this study has been conducted, similar research is recommended for different environments to compliment the findings and further verify the value of the model.

Lastly the study has shown the presence of a strong relationship between the adoption behavior and production efficiency of farmers in the study area. The relationship is found to be highly significant and suggests that the claim of some groups against the package based extension program is unfounded. Program participant farmers do not seem to have withdrawn using the recommended practices with significantly increased yields.

## 7.3 RECOMMENDATIONS

Since research is not an end in itself, but rather a means of improving the current situation, it is appropriate to propose some recommendations based on the findings of this study.

### 7.3.1 Focusing on intervening factors

The study has indicated that the intervening variables encompassing the various categories of variables associated with needs and perceptions are the most important driving forces of behavior change. These factors explain about 87.2 percent and 68.3 percent of the variance in adoption and 87.5 percent and 80.93 percent of the variance in production efficiency of farmers in maize and dairy farming, respectively.

These findings need to be verified by future research, but there is already sufficient evidence supported by sound theoretical reasoning, to justify a change in emphasis and focus of extension approaches. The mere fact that the intervening variables as opposed to the large majority of independent variables, can be changed, make them the logical focus of extension, and at the same time also the most appropriate criteria for monitoring.

### 7.3.2 Removing constraints hindering the behavior change process

The fact that even the adopters of the various technologies are as conscious of the disadvantages or negative forces as the non-adopters seems to indicate that in the case of adopters, the so-called constraints or disadvantages have been largely overcome but are becoming critical especially in view of the progressive development of the negative forces or disadvantages. As far as the practice, improved seed is concerned, for example, a lot of disadvantages including low storability and marketability of output, high price and unavailability of certified seed and bureaucratic credit and input administration are critically constraining and slowing the adoption process. Concerted measures needs to be taken by responsible bodies to disturbing the apparently created equilibrium in behavior of farmers and speed up this sluggish behavior change process.

According to Düvel (1995: 10), a change in existing equilibrium can (based on the dynamics of forces) be brought about by:

1) Addition or strengthening of positive or driving forces
2) Elimination or reduction of negative or restraining forces and/ or

3) Changing the direction of negative forces to positive

Assessment of the nature of the perceived technology attributes of the maize and dairy farmers give the impression that top-level policy makers such as extension and research institutions can best address these constraints in accordance with the above mentioned remedial measures. Bureaucratic credit and input administration, for example, is a policy issue whose solution, according to this study, can be found in the liberalization of the input marketing system (elimination of a negative force). Only 16 percent of respondent farmers who use improved maize varieties in the Shashemene district purchase their seed from the government despite the fact that the price of seed from private seed dealers is almost twice as high.

This example indicates the willingness and ability of farmers to purchase agricultural inputs even with a higher price provided that it has been made available at the right time, the right place and in sufficient quantities, which is usually achievable only by private dealers. Strengthening the already introduced measures such as reinstating service cooperatives and fostering the pilot SG 2000's attempt of networking banks to production through inventory credit schemes can, also reduce the negative force of bureaucratic credit and input administration. The provision of agricultural inputs by the currently operating credit and input institution is not regularly found to be well synchronized with the planting time of farmers, which is the very critical period of the whole farming operation. Since inputs are not made available at the right time and/or farmers are not allowed to purchase inputs before they settle arrears, which is usually caused by inefficiencies of credit administrators themselves, they usually prefer to plant their seed without having the required input or buy from private dealers. Farmers are conscious of what a one day delay in planting time would mean as far as its impact on ultimate yield is concerned.

The solutions for some barriers (perceived negative attributes), on the other hand, call for an integrated intervention by different stakeholders. The problem of storability and marketability, for example, necessitates interventions by policy makers, extension agencies, and research institutions. Systematic actions should be undertaken to disturb the existing equilibrium and change it to a clear imbalance of positive and negative forces so as to insure positive change.

### 7.3.3 Creating and exploiting potential needs

The study has revealed that various forms of misperceptions regarding both maize and dairy farmers have suppressed potential needs. There are still many farmers who either overrate the level of their current production efficiency and practice adoption or do not know the optimum or what can be accomplished. In maize farming, for example, 90.5 percent of the respondents overrate their current level of production efficiency, while 26 to 35.5 percent of them do overrate their current adoption status of recommended technologies.

The implication of the finding for extension is far reaching and requires reexamination of the current extension strategy. It was indicated from the outset, when the extension package program was designed, that it has been necessary for the program to pass through two phases namely the extension and production phases. The objective of the extension phase was to create more needs that would be exploited during the successive program (the production phase). But luckily or unluckily, the government rushed to launch the production phase before the necessary pre condition namely the extension phase takes place and creates potential needs. As a result, farmers were pushed to use more technologies while still have all sorts of misperceptions and doubts.

The study has shown the important role of needs in the process of behavior change. They are almost a precondition for changes in adoption behavior. In other words it is almost impossible to change or influence the adoption behavior of farmers by mere knowledge dissemination without creating needs or finding link-ups with needs, which appear to be the major deriving force for change. It is, therefore, strongly recommended that the extension strategy be re-oriented from its present “campaign approach” (production phase) to a more professional purposeful and planned approach (extension phase) where needs can readily be created and exploited. The package strategy, which showed promising and commendable achievements, should not end up with a failure, like the past extension approaches, resulting in the country failing to attain its noble objective of food self-sufficiency.

### 7.3.4 Enhancing the organizational participation of farmers

The finding that the organizational participation of neither the maize nor dairy farmers is good is a cause for concern. None of the maize farmers and only 13.5 percent of the dairy farmers had some kind of organizational participation, but that only as members and not in a leadership capacity. Negative impressions are created towards cooperatives due to coercive and involuntary activities of past socialistic collectivization policy, which probably have been the cause for the present low level of participation. This is, however, indicative of an attitude that is not conducive to participatory development, and especially where the goals of empowerment and ownership are of the development process pursued.

It is, therefore, imperative to identify and circumvent the barriers hindering the organizational participation of farmers in particular and the rural people in general. Without farmers' active participation, the very fundamental and primary goal of rural development, empowerment of the local community in order to help them achieve their own development endeavor, will be largely impaired.

### 7.3.5 Targeting agricultural extension services towards the educated and the youth

Educated and young farmers are assessed to be more efficient than the non-educated and old ones especially with regard to maize farming. The finding suggest that policies and strategies promoting rural education and extension programs, especially targeted towards the young farmers are instrumental to improve agricultural productivity both at the micro and macro levels. Based on this finding, it is recommended that the regular rural education and the technical vocational education and training (TVET) programs of the government be supported to maintain and even increase momentum. It is strongly recommended that the TVET program, which has currently placed its focus on the training of extension workers need to be reoriented and be engaged more with the creation of the future farmers, who are more receptive to new technologies and favor change. Rural development institutions including international organizations and NGOs should also be encouraged to invest in rural education especially in the TVET program, which at its present state lacks the quality but can have a tremendous impact in transforming agriculture if adequately supported and implemented in a more planned way.

### 7.3.6 Promoting the use of mass media in rural extension

The study has indicated that rural maize farmers who have more exposure to media are more efficient. But the current level of media use in rural extension is very low. Regular media transmission guided by well thought out plans and programs could serve to speed up and enhance the emergence of more efficient commercial farmers at the rural setting. It is, therefore, recommended to foster existing programs and improve their coverage. The rural extension program can for example be launched in an integrated manner with the rural education program currently under way. The rural radio stations of the Ministry of Education can serve both purposes.

### 7.3.7 Providing equal opportunity for urban and peri-urban dairy farmers

One of the major development objectives of the present government in agriculture is the attainment of food self-sufficiency both at the grassroots and the national levels. The term "food" may imply anything related with plants and animals and does not necessarily refer only the crop sector.

It is natural for commercial agricultural production to emerge and flourish around places where demands are high. It is therefore, not uncommon for livestock enterprises like dairying, poultry and fattening of livestock to be concentrated around urban and peri-urban areas. The situation is not different in Ethiopia and as a result the enterprises are found in a colony around big cities. This means that, as far as livestock production is concerned, the envisaged food self-sufficiency has to be realized in these areas, which places a tremendous challenge on research and extension.

The results of this study seem to indicate that dairy farmers' needs are not met. Dairy farmers appear not to have any place to go for agricultural information. 50 to100 percent of the survey farmers reported that they never had any form of formal contact with any organization as far as agricultural information is concerned. Agricultural information sources available to dairy farmers are only the private veterinary service and their own fellow farmers. The Woreda BoA is reported to see them only on rare occasions and did not assign even a part time extension worker or a single development agent to them. From informal chats, people at the leadership position of the co-operative, however, did pay credit to the informal and dedicated effort of some experts from nearby institutions like ILRI and Oromia Bureau of agriculture. They personally helped them in writing project documents and provided the necessary consultations when required.

What is more surprising and rather paradoxical is that there are 2 to 3 livestock experts and several development workers assigned for each rural district, being responsible for a very few and insignificant numbers of crossbreed animals, while not a single agent is assigned to look after a district dairy cooperative with its big contribution of 5,000 to 10,000 liters of milk per day for commercial use only. It appears as if it's location, being an urban area, disqualifies it from being served by the Ministry of Agriculture. This should call for a serious redressing of the extension services, particularly if the serious problem of food deficit is taken seriously.

### 7.3.8 Transferring title deeds in rural land ownership

The study has made it obvious that, as far as maize growers in the Shashemene district are concerned, land holding has been diminished to an economically low and meaningless level. The significant and positive correlations between farm size and production efficiency contradict the current public land ownership policy, which holds that productivity increases, as farms get smaller in size.

If national food security and self-sufficiency is still the main goal, the government may have to revisit its present land policy. An enabling environment has to be created for the transfer of land ownership rights so that economically viable farm sizes will emerge. The present land policy, which may definitely lead to a further reduction in the size of holding, can only exacerbate poverty.

### 7.3.9 Revising the dairy extension package

It is recommended that the research and extension system revisit its current blanket recommendation as far as dairy production technology package is concerned. The recommendation of using 50 percent cross breed animals by all peasant farmers, for example, needs special emphasis. As mentioned earlier in chapter four, except for the modern and commercial farmers, the recommended blood level for smallholder dairy farmers is to use a 50 percent crossbreed animal. However, the exotic blood level of the herds of dairy farmers is 50 percent and above and the great majority animals have even more than 75 percent exotic blood. On top of this, of all practices recommended by the extension package program, it is only the technology-improved breed, which significantly differentiated the herders into their various efficiency classes. This implies that the rest of the recommended practices are of little value for herders. It is, therefore, imperative for the research and extension organizations to come up with a better recommendation that can address the needs and problems of dairy farmers

### 7.3.10 Improving scale of operation in dairy farming

Farm size is found to be an indispensable factor contributing substantially to the adoption behavior of dairy farmers, particularly in regard to housing practices. Farmers with bigger herds are more inclined to build modern housing for their dairy herd. In other words a small farm size appears to be a restraining force in the adoption behavior. Farm size is also found to be positively and significantly associated with production efficiency. Based on these findings dairy farmers should be encouraged towards increasing the scale of their operation in pursuit of their ultimate objective of increasing milk yield.

### 7.3.11 Further research on the relationship between practice adoption and production efficiency

It is logical that the adoption of better technologies should lead to improvement in the production efficiency of producers. In this study, nonetheless, while the effect of adoption on production efficiency of maize farmers is significant (55.6 percent), the contribution of adoption to production efficiency is far less in dairy. This could be attributable to the limitation of one-year data, which may not reflect the true production efficiency level of dairy farmers, which is sensitive to changes in the environment or to inadequacies in adoption measures. The measurement employed to evaluate the adoption of feeding practices, for example, is very crude. More sensitive measures capable of more accurate measurement of the various feed formulations might shed more light on the effect of adoption of feeding practices on the production efficiency of dairy farmers. It is, therefore, recommended that this issue be addressed in future studies.

### 7.3.12 Further research on the relationship between perceptions and behavior

This study clearly indicated that perceptions of technology attributes both in maize and dairy farming are not significantly related to the adoption behavior and the production efficiency of farmers in most cases. This is in part suspected to happen due to the weakness of a five-point scale measurement instrument employed in this study to accurately measure the valence or strength of psychological field forces. Current measuring instruments are not also yet capable to effectively distinguish between the strength of forces or between mere awareness and real force or between knowledge and perceptions. For example, the fact that even the adopters of the various technologies are as conscious of the disadvantages or negative forces as the non-adopters (and is the reason for the absent correlation between perception and adoption behavior) seems to indicate that in the case of adopters, the so-called constraints or disadvantages have been largely overcome, and probably represent more disadvantages rather than strong negative forces. This is indicative of a shortcoming in the accurate measurement of strength of forces, and should receive attention by researchers.

### 7.3.13 Further verification study

Since the study is the first of its kind to test and verify the conceptual model, which lay the ground for this study, in a different social and environmental setting, more verification is necessary under still more varying conditions to further test the model. The search for further potentially important intervening variables needs to continue and, above all, the refinement of measuring techniques and scales is of relevance.

## Abstract

The impact of the package based extension program in Ethiopia in terms of its influence on yield improvement is not well known. The objectives of this study have been to assess the relationships and determine the factors responsible for behavior change and production efficiency of farmers participating in the program. Identification and analysis of the critical factors affecting adoption or non-adoption is believed to assist in the formulation of policy in the areas of research and extension aimed at alleviating production constraints of small-scale farmers and thereby improves agricultural productivity.

It was hypothesized that there is a significant difference among participant farmers in their technology use and production efficiency. Based on this assumption, it was also hypothesized that adoption behavior is determined by independent and intervening variables, of which, the influence of the former is indirect and only becomes manifested in behavior via intervening variables, which are the immediate and direct precursors of decision making and adoption behavior.

Independent variables included in this study are age, education, gender, farming experience, attitudinal modernity, organizational participation, contact with extension, media contact, farm size, and agro ecology. The intervening variables, on the other hand, refer to the farm operators' needs as manifested in their problem perception, and the need compatibility of the production practices and the perception regarding advantages and disadvantages of the recommended practices.

In order to test the hypotheses, the Ordinary Least Squares (OLS) method i.e. standard and hierarchical multiple regression analyses were employed on data from a survey of 200 maize and 200 dairy farming households in the Southern and Central Ethiopia.

The study reveals that, in general, maize farmers using recommended technologies are more efficient than those who do not use them. In dairy, clear differences are found only

with regard to breeding practices suggesting that the rest of the practices included in dairy package were not very important for dairy farmers.

Independent factors responsible for the difference in the adoption behavior of maize farmers include agro ecology, media exposure, education, age, farm size, extension contact, and attitudinal modernity. As far as dairy farming is concerned, education, farm size, farming experience, and media exposure are found to be significant predictors of adoption behavior. While all of the need related factors are significantly related with adoption behavior, perceptions of farmers towards production practices included in both of the maize and dairy packages are not found to be significantly associated with adoption behavior.

In general, although both the independent and intervening variables are significant predictors of the adoption behavior of farmers in the study area, the latter are much more prominent. In support of the hypothesized association, the contribution of intervening variables to the variance in the adoption behavior of maize and dairy farmers is as high as 87.2 percent in maize and 68.3 percent in dairy compared to the significantly lower contribution of independent variables, which is 32.4 percent in maize and 17.8 percent in dairy. The contribution of intervening variables is significantly higher even after the possible effect of independent variables is controlled, which is 56.6 percent in maize and 55.9 percent in dairy as opposed to 32.4 percent and 17.8 percent respectively in the case of independent variables.

Finally, this study raises issues that call for immediate policy interventions and have implications for further research.

## Appendix 3.1 Survey instrument

# THE COMPARATIVE INFLUENCE OF INTERVENING VARIABLES IN THE ADOPTION BEHAVIOR OF MAIZE AND DAIRY FARMERS IN SHASHEMENE AND DEBREZEIT, ETHIOPIA

## MAIZE QUESTIONNAIRE

Respondent's Name.........................................................................................
Enumerator's Name......................................................................................

PA/Kebele ..........................................................................................................

Village ...............................................................................................................

## PART 1: INDEPENDENT VARIABLES

1. **Age** (How old are you?) No. of Years ☐

2. **Educational level**
   What level of education did you attain? No. of years ☐

3. **Literacy level** ☐
   Can you read in any one language?
   - No (1)
   - Yes, but with difficulty (2)
   - Yes, fairly well (3)
   - Yes, very well (4)

4. **Gender** ☐
   - Male (1)
   - Female (2)

5. **Are you the head of the household?** ☐
   - No (1)
   - Yes (2)

**6. Marital status**

| | |
|---|---|
| Single | (1) |
| Married | (2) |
| Divorced | (3) |
| Widow | (4) |
| Widower | (5) |

**7. Social status**

7.1 Number of oxen

7.2 Number of Milking Cows

7.3 Number of Draught Animals

7.4 Housing

| | |
|---|---|
| Grass roof | (1) |
| Corrugated iron roof (no partition) | (2) |
| Corrugated iron - roof (with partition) | (3) |

**8. Farm size**

8.1 Total land holding (ha).

8.2 Arable land (ha)

**9. Farming experience** Number of years

**10. Attitude toward credit**

10.1 What is your attitude on the importance of credit for farm improvement?........................................................................

......................................................................................

10.2 Would you rate your feeling on the following five point scale?

Less important → 1 ... Highly important → 5

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

**11. Social participation (Organizational participation and leadership)**

What was your level of participation in the following social organizations during the last five years? (If he/she was a member and served also as a leader during this period, take the second option)

11.1 List of social organizations

1. Woreda Council
2. Kebele/PA Council
3. Kebele/PA Development Council
4. Kebele/PA Soil Conservation team
5. Marketing Co-operative
6. Irrigation Association
7. Religious Club
8. School Council

11.2 Level of participation

| | |
|---|---|
| Non | (1) |
| Member | (2) |
| Leader | (3) |

**12. Change agent contact**

How often do you use the following information sources per season?

12.1 List of information sources

1. DA
2. Fellow farmer
3. EMTP
4. Field day
5. Wereda BoA
6. AI Center
7. Woreda Council
8. NGO
9. PA

12.2 Frequency of contact

| | |
|---|---|
| Never | (1) |
| Rarely | (2) |
| Occasionally (at critical activities) | (3) |
| Often (once or twice a month) | (4) |
| Quite often (once or twice a week) | (5) |

12.3 Choose the 5 most important sources and place them in rank order

12.3.1 Rank

| | |
|---|---|
| 1st | |
| 2nd | |
| 3rd | |
| 4th | |
| 5th | |

12.3.2 Information sources (Refer 12.1)

## 13. Mass media exposure

How often do you make use of the following media facilities?

13.1 List of media facilities

| | |
|---|---|
| 1. Radio | |
| 2. Television | |
| 3. Printed media | |
| 4. Public gatherings (meeting, market place, church, watering Point, mosque, edir) | |

13.2 Frequency of listening

| | |
|---|---|
| Never | (1) |
| Rarely | (2) |
| Occasionally | (3) |
| About once or twice a month | (4) |
| At least once or twice a week | (5) |
| Daily | (6) |

13.3. Rank the above mass media sources in their order of importance

13.3.1 Rank

| | |
|---|---|
| $1^{st}$ | |
| $2^{nd}$ | |
| $3^{rd}$ | |
| $4^{th}$ | |

13.3.2 Types of media (Refer 13.1)

13.4 To which Radio program do you listen most?

13.4.1 Rank of programs

| | |
|---|---|
| $1^{st}$ | |
| $2^{nd}$ | |
| $3^{rd}$ | |
| $4^{th}$ | |
| $5^{th}$ | |

13.4.2 List of programs

1. Agricultural program
2. News
3. Drama
4. Music
5. General knowledge

13.5 If not agricultural program why not?……………………………………………………..

13.6 To which Television program do you listen most?

13.6.1 Rank of programs

| | |
|---|---|
| $1^{st}$ | |
| $2^{nd}$ | |
| $3^{rd}$ | |
| $4^{th}$ | |
| $5^{th}$ | |

13.6.2 List of programs (Refer 13.4.2)

13.7 If not agricultural program why not?..............................................................

**14. Attitude toward education**

To what extent do you agree on the following statements?

14.1 List of statements

1. Education is a key for development
2. Educated people lead their life better than non-educated
3. Education is the base for present advances in science and technology
4. Education shall be regarded as a good measure of quality of life and is a basic human right

14.2 Degree of agreement

| | |
|---|---|
| Strongly agree | (5) |
| Agree | (4) |
| Neutral | (3) |
| Disagree | (2) |
| Strongly disagree | (1) |

**15. Fatalism**

To what extent do you agree on these statements?

15.1 List of statements

1. What we achieve in life is a mere result of fate
2. The No. of children one has is predestined
3. The time when one dies is predestined

15.2 Degree of agreement

| | |
|---|---|
| Strongly agree | (5) |
| Agree | (4) |
| Neutral | (3) |
| Disagree | (2) |
| Strongly disagree | (1) |

**16. Attitudinal modernity scale**

16.1 How often do you get involved in issues concerning the community, like problems of education and health services, and participate in efforts for their resolution?

| | |
|---|---|
| Never | (1) |
| Sometimes | (2) |
| Many times | (3) |
| Always | (4) |

16.2 From which sources do boys learn most of the truth about life?

| | |
|---|---|
| From old people | (1) |
| From books and schools | (2) |

16.3 If education is available, and there are no obstacles of any kind, what education should be received by the sons of people like you?

| | |
|---|---|
| No education is important | (1) |
| Few years in traditional schools | (2) |
| Elementary school | (3) |
| High school | (4) |
| University studies | (5) |

16.4 What is the best job you aspire to have for yourself?
Name of job: ..........................................................................

16.5 Do you trust merchants in general?

| | |
|---|---|
| Never | (1) |
| Sometimes | (2) |
| Most times | (3) |
| Always | (4) |

16.6 How often should an irresponsible boy be excused?

Always (1)
Many times (2)
Few times (3)
Never (4)

16.7 Two twelve year-old boys took time out from farm work and sat down talking about how to grow crops with fewer hours of work.

The father of one of the boys said to them, " the way to grow crops is the same way we are growing them. To sit down and talk about how to grow crops is a waste of time". (1)

The father of the other boy said, "this is a good thing to think about. Tell me how to grow crops with fewer hours of work" (2)
Who of the two fathers said the wiser words?

16.8 To which advice should one give more weight?

To advices from religious men (1)
To advices from governmental officials (2)

16.9 What qualifies a man to high office?

Distinguished family (1)
Respect for traditions (2)
Popularity among people (3)
Education and special knowledge (4)

16.10 To whom should the government grant a petition?

To the man who is in most need (1)
To the man who has influence in the community (2)

To the man who has the right (3)

16.11 Do you have a desire to posses a camera?

No (1)
Little desire (2)
Some desire (3)
Much desire (4)

16.12 Have you ever possessed a camera?

No (1)
Yes (2)

16.13 Is it good or bad to strive for money over and above comfortable living?

Bad (1)
Good (2)

16.14 How would you treat a person you defeated in an argument or a competition, if he attacks you?

Harshly (1)
Kindly (2)

16.15 Which of the following statements is closer to your own thinking?

What man gets in life is determined by fate (1)
What man gets in life depends on his own effort (2)

16.16 Which of the following is most important for the future of this country?

Good luck (1)
God's help (2)
Good government planning (3)
Hard work by the people (4)

16.17 Scientists are interested in exploring natures' secrets. Some of them want to know the things that determine whether a pregnant Woman will give birth to a boy or a girl. Others try to find what things inside a seed make it grow into a plant. And some of them explore the skies to know from what materials the planets and the stars are made.

What do you think of such studies by scientists?

Ungodly/bad/very harmful (1)
Some what harmful (2)
Some what beneficial (3)
Good and very beneficial (4)

16.18 What is the ideal number of children for someone like you?

16.19 Some people say that it is necessary for men and wife to limit the number of children by use of birth control methods so that they can take better care of the few children they will have. Other people say it is wrong to limit the number of children. With which of the two opinions do you agree?

It is wrong to limit (1)
It is necessary to limit (2)

16.20 How many people do you think have opinions, which are different than yours?

Non (1)
Few (2)
Many (3)

16.21 Who should speak for the family?

Husband only (1)
Husband and wife (2)

16.22 With which citizenship do you identify yourself most?

| | |
|---|---|
| Citizenship of your village/town | (1) |
| Citizenship of your district | (2) |
| Citizenship of your province | (3) |
| Citizenship of your country | (4) |

16.23 To whom should a man feel closer?

| | |
|---|---|
| To his mother/father/brothers/sisters | (1) |
| To his wife | (2) |

16.24 What news interests you most?

| | |
|---|---|
| News about your village (district) | (1) |
| News about your province | (2) |
| National news (about your nation) | (3) |
| World News | (4) |

16.25 If it is guaranteed that your income will increase 100 percent (will double) if you are asked to go to work in another place away from here would you go?

| | |
|---|---|
| No, I prefer to stay in my community | (1) |
| Yes, I will go | (2) |

16.26 Do you understand the way of thinking of people from other countries?

| | |
|---|---|
| No | (1) |
| Yes | (2) |

16.27 Do you plan in advance for things you want to do?

| | |
|---|---|
| Never | (1) |
| Sometimes | (2) |
| Most times | (3) |
| Always | (4) |

16.28 Who of the following deserves to be admired more by people?

A man devoted to religion (1)
A factory owner (2)

16.29 Can man be good without religion?

No (1)
Yes (2)

16.30 After how long would you regard a person you are waiting for late for an appointment made with you? (Number of minutes)

16.31 How much pay should an employed woman get for doing the same type of jobs done by fellow men employees?

Less pay (1)
Same pay (2)

16.32 To whom should a man get married?

To a woman that suits his parents (1)
To a woman that suits him (2)

16.33 Illicit sexual relationships may develop between men and women working together in the same office or factory. How much does this worry you?

Much worry (1)
Some worry (2)
Little worry (3)
No worry (4)

**17. Attitude toward change**

To what extent do you agree on these statements?

17.1 Statements

1. We should do farming the way our ancestors did.
2. Farming shall be considered as a way of life and not as business
3. Change is always damaging and shall not be encouraged
4. Today is better than tomorrow

17.2 Degree of agreement

| | |
|---|---|
| Strongly agree | (1) |
| Agree | (2) |
| Neutral | (3) |
| Disagree | (4) |
| Strongly disagree | (5) |

# PART II: INTERVENING FACORS - MAIZE

## PARODUCTION EFFICIENCY

**18 Level of efficiency**

18.1 What was your base line productivity of maize in q/ha? (That was obtainable before involvement in package program)

18.2 What is your current level of production?

18.3 How do you rate the maize production efficiency level of this farmer in the community? (to be rated by panel of village elders)

| | |
|---|---|
| Very low | (1) |
| Low | (2) |
| Medium | (3) |
| High | (4) |
| Very high | (5) |

**19 Problem perception**

19.1 Perceived current efficiency /PCE

19.1.1 Rate on a 5 point scale (your current yield level estimated at 18.2)

Very high → 5, very low → 1

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

19.1.2 The research average optimum yield estimate is 120 q/ha enumerator rating of farmers productivity based on this bench mark is

Very high → 5, very low → 1

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

19.2 Need tension

19.2.1 To what yield level are you striving for?

19.2.2 How do you rate this yield level on a five-point scale?

Very high — very low

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

19.3 Self image

19.3.1 What do you think would the average productivity of the village fellow farmers be?/q/ha.

19.3.2 How do you rate the present average level of productivity of your fellow village farmers compared to that of yourself (19.1.1)?

Very high — very low

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

**Practice 1-improved variety**

**20 Adoption**

20.1 Which improved maize variety do you normally grow?

| | |
|---|---|
| Not applicable | (0) |
| A-511 | (1) |
| BH-660 | (2) |
| BH-140 | (3) |
| BH-540 | (4) |
| Pioneer 3253 | (5) |

20.2 What percent of your plot is usually planted with improved seed?

20.2.1 Actual percentage

20.2.2 Range

| | |
|---|---|
| Not applicable | (0) |
| <50percent | (1) |
| 50-75percent | (2) |
| >75percent | (3) |

20.3 What is your source of seed?

| | |
|---|---|
| Local variety | (0) |
| Own improved seed | (1) |
| Own + fresh | (2) |
| Fresh | (3) |

20.4 General level of adoption of improved variety (out of 7 points) (To be field by enumerator)

| | |
|---|---|
| No adoption (0 points) | (1) |
| Low adoption (<=3 points) | (2) |
| Partial adoption (4-5 points) | (3) |
| Full adoption (6-7 points) | (4) |

20.5 Use the 7 point scale below and show how your choice is superior over the other varieties; if the average point for others is determined to be 4 on the following parameters?

20.5.1 Parameters

1. Yield
2. Grain quality
3. Early maturity
4. Pest and disease resistance
5. Lodging
6. Storability

20.5.2 Measurement scale

Very high    other varieties    very low

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**21 Problem perception**

21.1 Perceived current efficiency/PCE
In equation 20.1-20.3 you have determined your present level of use of improved variety, how do you rate this on a 5 point scale below?

21.1.1 Farmer's rating
Very high    very low

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

21.1.2 Enumerators/researcher's rating based on 20.4 above

21.2 Need tension

What is your goal (what are you striving for) regarding the use of improved variety of maize?

21.2.1 Percentage of your holding to be covered by improved seed

| | |
|---|---|
| Not applicable | (0) |
| <50percent | (1) |
| 50-75percent | (2) |
| >75percent | (3) |

21.2.2 Source of seed

| | |
|---|---|
| Local variety | (0) |
| Own improved seed | (1) |
| Own + fresh | (2) |
| Fresh | (3) |

21.2.3 How do you rate your goal of use of improved variety on a five-point scale?

| Very high | | | | very low |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

21.3 Self image

How do you rate the present average level of use of improved variety of maize of your village fellow farmers compared to that of your own scale of 21.1.1?

| Very high | | | | very low |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

21.4 Need compatibility

Your current yield as you have put it to me is…………… quintals/ha.
What do you think it would have been without the use of recommended variety?

**22 Perception of technology attributes**

22.1 What are the advantages of using improved variety of maize?

22.1.1 List of advantages

Relative advantages

A. Economic aspects

| | |
|---|---|
| 1. High productivity/ yield advantage | |
| 2. Early maturity | |
| 3. Quality grain | |
| 4. Higher green cob price | |

B. Technical

| | |
|---|---|
| 5. Disease resistance | |
| 6. Insect Pest resistance | |
| 7. Resistance to lodging | |
| 8. Long harvest time (hanging down of ear) | |
| 9. Good husk cover | |
| 10. High harvest index | |

22.1.2 Scale / 5= v. high, 1= v. low/

22.2 Take five most important advantages of improved seed and rank them in order of importance

22.2.1 Rank of advantages

| 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|
| | | | | |

22.2.2 List of advantages (Refer to 22.1.1)

22.3 What are the disadvantages of using improved variety of maize?

22.3.1 Parameters of disadvantages
Relative advantages

1. Low storability
2. Drop in market price, at time of harvest
3.low ear placement (short)
4.Regular need for fresh seeds
5. Contamination

Compatibility

6 High seed cost
7. Seed unavailability (at right time, quality, place & type)
8. Incompatibility with taste
9. Unavailability of credit
10. Bureaucratic credit and input administration
11. Low productivity

22.3.2 Rate the disadvantages on five point scale
(5= v. high, 1= v low)

22.4 Choose five most important constraints and rank them in order of importance

22.4.1 Rank

| 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|
| | | | | |

22.4.2 List of disadvantages (Refer 22.3.1)

## Practice 2- spacing/ row planting

**23 Adoption**

23.1 What spacing do you use between plants?

23.1.1 Actual spacing (CM)

23.1.2 Range

| | |
|---|---|
| Not applicable | (0) |
| <25cm(drilling) | (1) |
| 25cm, 1 seed/hill | (2) |
| 50cm, 2 seeds/hill | (3) |

23.2 What spacing do you use between rows?

23,2.1 Actual spacing (CM)

23.2.2 Range

| | |
|---|---|
| Not applicable | (0) |
| <50cm | (1) |
| 50-80cm, 1 seed/hill | (2) |
| 80cm, 2 seeds/hill | (3) |

23.3 What is your yardstick?

| | |
|---|---|
| Not applicable | (0) |
| Stick | (1) |
| Foot steps | (2) |
| judgement/estimation | (3) |

23.4 General level of adoption of spacing (to be field by enumerator out of 9 point)

| | |
|---|---|
| No adoption (0 points) | (0) |
| Low adoption (<=3 points) | (1) |
| Partial adoption (<=6 points) | (2) |
| Full adoption (<=9 points) | (3) |

**24 Problem perception**

24.1 Perceived current efficiency/PCE

24.1.1 How do you rate on a 5 point scale your current level of spacing or row planting (23.1-23.3)

Best Very
Poor

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

24.1.2 Enumerator/researchers rating based on 23.4

Best Very Poor

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

24.2 Need tension

What is your goal (are you striving for) regarding the appropriate use of spacing?

24.2.1 Actual spacing (b/n plants)

24.2.2 Range (b/n plants)

| | |
|---|---|
| Not applicable | (0) |
| <25 cm | (1) |
| 25cm 1 seed/hill | (2) |
| 50cm2seed/hill | (3) |

24.2.3 Actual spacing (b/n rows)

24.2.4 Range (b/n rows)

| | |
|---|---|
| Not applicable | (0) |
| <50 cm | (1) |
| 50-80cm | (2) |
| 80cm | (3) |

24.2.5 Yard stick

| | |
|---|---|
| Not applicable | (0) |
| Stick | (1) |
| Footsteps | (2) |
| Imagination | (3) |

24.2.6 How do you rate your goal of application of appropriate plant spacing on a five-point scale?

Best — very poor

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

24.3 Self image

How do you rate the average present level of use of plant spacing of your fellow village farmers?

Best — v. poor

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

24.4 Need compatibility

Your current yield as you have put it to me is………. Quintals/ha. What do you think it would have been without the use of recommended spacing?

## 25 Perception of technology attributes

25.1 What are the advantages of applications of row planting?

25.1.1 List of advantages

1. Ease of weeding
2. Vigor of stand
3. Good light interception
4. Improve efficiency of fertilizer use
5. Convenience for field inspection
6. Ease of 'shilshalo'
7. Exact seed rate can be used
8. Plant population density kept
9. Provision for intercropping
10. Increase yield

25.1.2 Scale

Very high → Very low

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

25.2 Take five most important advantages and rank them in order of importance

25.2.1 Rank (first to fifth)

| 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|
| | | | | |

25.2.2 List of advantages (Refer 25.1.1)

25.3 What are the disadvantages of row planting?

25.3.1 List of disadvantages

Relative disadvantages
1. Waste of land
Compatibility
2. Incompatibility with beliefs and traditions
3. Requires skills

25.3.2 Scale / 5= v. high, 1= v. low

25.4 How do you rank the disadvantages?

25.4.1 Rank (first to third)

| 1st | 2nd | 3rd |
|---|---|---|
| | | |

25.4.2 List disadvantages / Refer 25.3.1 /

## Practice 3 rate and type of fertilizer application

### 26 Adoption

26.1 Which fertilizer type do you normally use?

| | |
|---|---|
| Non | (0) |
| Urea | (1) |
| DAP | (2) |
| Both | (3) |

26.2 At what rate? (Kg/ha.)

26.2.1 Actual rate DAP

26.2.2 Actual rate Urea

26.2.3 Range

| | |
|---|---|
| Not applicable | (0) |
| <= 100 kg of one | (1) |
| 50-100kg of each | (2) |
| 100kg of each | (3) |

26.3 General level of adoption of recommended type and rate of fertilizer (out of 6 = by enumerators)

| | |
|---|---|
| No adoption (0 point) | (0) |
| Low adoption (<=2 point) | (1) |
| Partial adoption (<=4 point) | (2) |
| Full adoption (<=6 point) | (3) |

**27 Problem perception**

27.1 Perceived current efficiency/PCE

27.1.1 In question 26.1 and 26.2 you have determined the present level of the type and amount of fertilizer you use. How do you rate this on a five-point scale?

Very high → 5 | Very low → 1

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

27.1.2 Enumerators/ researchers rating based on 26.3 above

27.2 Needs tension

What is your goal (what are you striving for) regarding the type and the amount of fertilizer to be used/

27.2.1 Type

| | |
|---|---|
| No applicable | (0) |
| Urea | (1) |
| DAP | (2) |
| Both | (3) |

27.2.2 Rate

| | |
|---|---|
| Non | (0) |
| ≤ 100kg of one | (1) |
| <=100kg of each | (2) |
| 100kg of each | (3) |

27.2.3 How do you rate your goal on a five-point scale?

Very high ↓ Very low ↓

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

27.3 Self image

How do you rate the present average level of the type and amount of fertilizer use of your fellow village farmers compared to your present level of 27.1.1?

Very high ↓ Very low ↓

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |

27.4 Need Compatibility

Your current yield as you put it to me is ----- Q/ha. What do you think it would have been without the use of recommended type and rate of fertilizer?

**28 Perception of technology attributes**

28.1 What are the advantages of using recommended type and rate of fertilizer?

28.1.1 List of advantages

A. Economical
1. High grain yield
2. High Stover yield

B. Technical
3. Facilitate maturity
4. Dark green looking stand

28.1.2 Scale (5= v. high, 1= v. low)

28.2 How do you rank the advantages (5 highest)

28.2.1 Rank

| 1st | 2nd | 3rd | 4th |
|---|---|---|---|
| | | | |

28.2.2 List of advantages (Refer 28.1.1)

28.3 What are the disadvantages of using recommended type and rate of fertilizer? on a 5 point scale (5 = highest)

28.3.1 List of disadvantages

Relative disadvantages
1. High cost
Compatibility
2. Compatibility with believes (fertilizer kills soil productivity)
3. Access (Time, Quality, Place)
4. Bureaucratic input & and credit administration
5. Belief that fertilizer burns seed
6. Fraud

28.3.2 Scale (if 5= v. high, 1= v. low)

28.4 Rank the disadvantages in their order of importance

28.4.1 Rank

| 1st | 2nd | 3rd | 4th |
|---|---|---|---|
| | | | |

28.4.2 List of disadvantages (Refer 28.3.1)

## Practice 4 - Spot application of fertilizer

### 29 Adoption

29.1 How do you judge the quantity when you spot apply fertilizer?

Not applicable (0)
Coca Cola cup (1)
Imagination (2)

29.2 How do you apply the seed?

Not applicable (0)
Together with the fertilizer (1)
Besides the fertilizer (2)

29.3 General level of adoption of spot application technique (out of4- by enumerators)

No adoption (0 point) (0)
Low adoption (<=2) (1)
Partial adoption (3 points) (2)
Full adoption (4 points) (3)

**30 Problem perception**

30.1 Perceived current efficiency/PCE

30.1.1. In question 29.1-29.3 you have determined your present level of spot application, how do you rate this on a 5point scale below?

v. high → 5 ... v. low → 1

| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

30.1.2 Enumerators/ researchers rating based on 29.3 above

30.2 Need tension

What is your goal (what are you striving for) regarding spot application?

30.2.1 Judgment of quantity

Not applicable (0)
Use of coca cola cup (1)
Imagination (2)

30.2.2 Methods of seed application

Not applicable (0)
Together with fertilizer (1)
Besides the fertilizer (2)

30.2.3 How do you rate your goal of level of spot of application on a five-point scale? (5= very high, 1= very low)

30.3 Self image

How do you rate the present average spot application level of your fellow village farmers compared to yours of 30.1.1? (5= highest, 1= lowest)

30.4 Need compatibility

Your current yield as you put it to me is______Q/ha. What do you think it would have been without the use of spot application technique?

**31 Perception of technology attributes**

31.1 What are the advantages of spot application of fertilizer?

31.1.1 Parameters of advantages

Relative advantages

1. Economic use of fertilizer and seed
2. Increase fertilizer use efficiency by the plant

31.1.2 Scale (5= v. high, 1= v. low)

31.2 What are the disadvantages of spot application fertilizer?

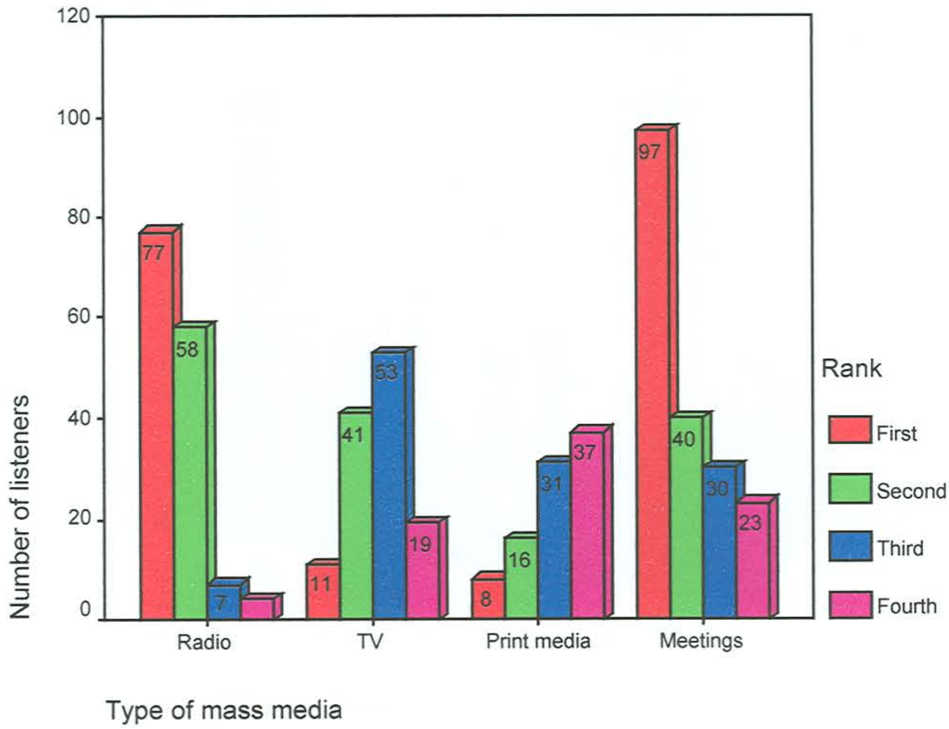
31.2.1 Parameters of disadvantages

Relative disadvantages

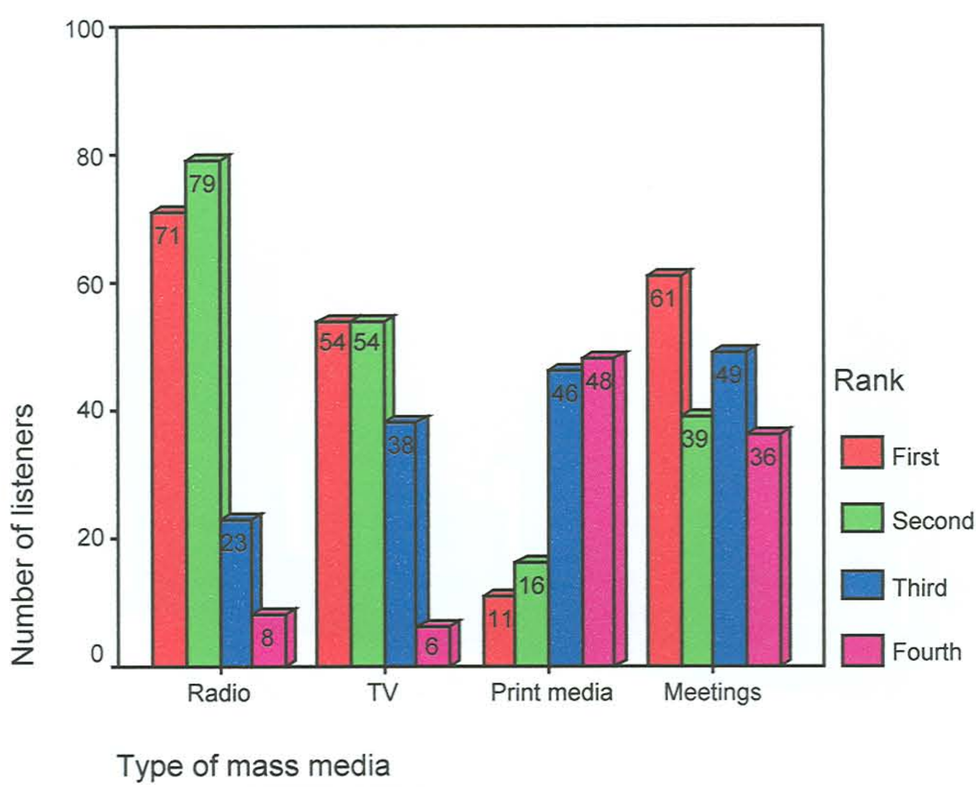
1. Laborious
2. Toxic to seed

31.2.2 Scale / 5= v. high, 1= v. low

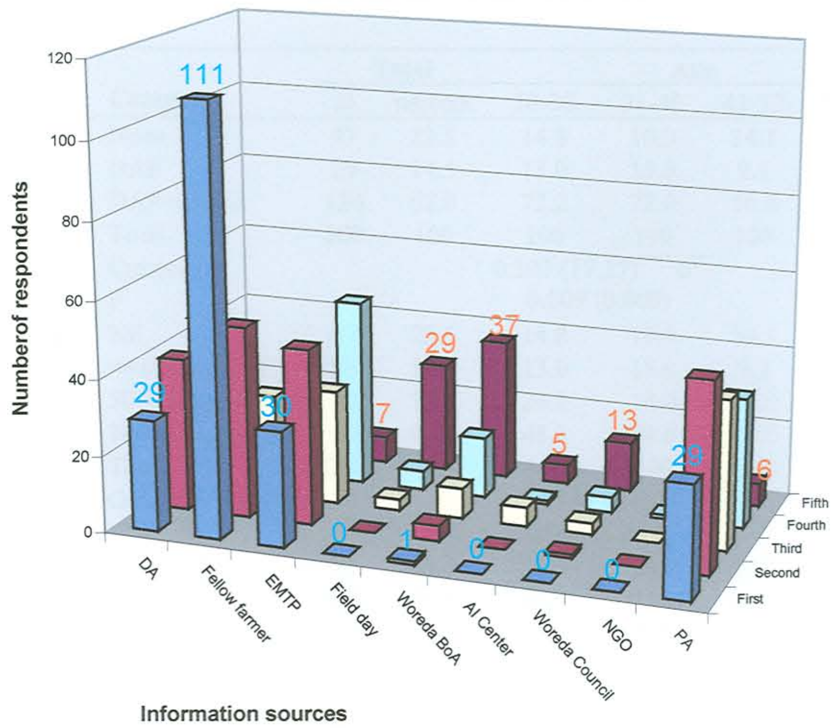
**Appendix 5.1** **Rank order position of different media by maize farmers**



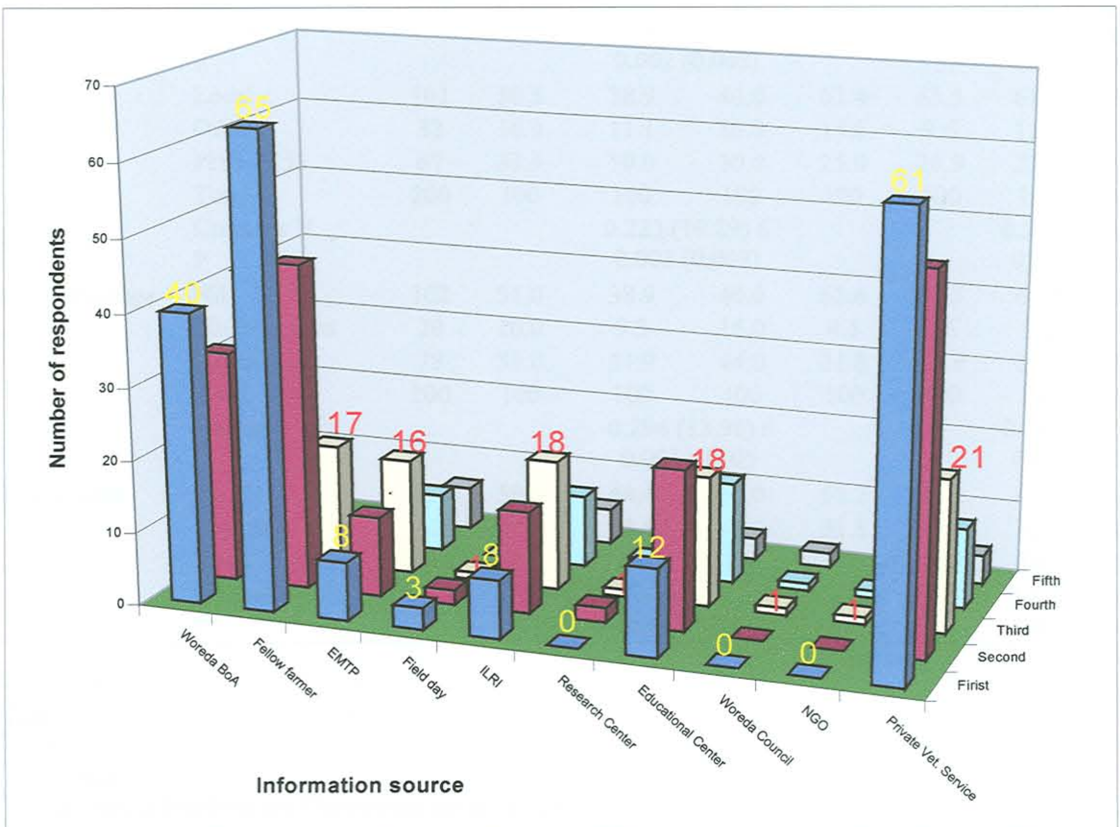

**Appendix 5.2** **Rank order position of different media by dairy farmers**



Appendix 5.3 Rank order position of different information sources by maize farmers




Appendix 5.4 Rank order position of different information sources by dairy farmers



**APPENDIX 5.5 The percentage distribution of maize farmers according to age, education and adoption behavior**

| Practice | Category | Total | | Age | | | | Education | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | percent | 18-30 | 31-40 | 41-52 | 55-85 | I* | P** | S*** |
| **Fertilizer type** | None | 47 | 23.5 | 14.8 | 10.0 | 34.1 | 36.5 | 34.7 | 15.7 | 6.3 |
| | DAP | 29 | 14.5 | 13.0 | 18.0 | 9.1 | 17.3 | 16.3 | 15.7 | 6.3 |
| | DAP+UREA | 124 | 62.0 | 72.2 | 72.0 | 56.8 | 46.2 | 49.0 | 68.6 | 87.5 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.207 (17.17)**** 6[D] | | | | 0.220 (19.40) 4 | | |
| | P | | | 0.009 (0.009) | | | | 0.001 (0.000) | | |
| **Fertilizer rate** | Nil | 47 | 23.5 | 14.8 | 10.0 | 34.1 | 36.5 | 34.7 | 15.7 | 6.3 |
| | <=100 kg DAP | 29 | 14.5 | 13.0 | 18.0 | 9.1 | 17.3 | 16.3 | 15.7 | 6.3 |
| | 50-100 kg each | 32 | 16.0 | 24.1 | 14.0 | 18.2 | 7.7 | 12.2 | 21.4 | 15.6 |
| | 100 kg each | 92 | 46.0 | 48.1 | 58.0 | 38.6 | 38.5 | 36.7 | 47.1 | 71.9 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.218 (20.63) 9 | | | | 0.395 (21.54) 6 | | |
| | P | | | 0.008 (0.014) | | | | 0.000 (0.001) | | |
| **Measurement** | Nil +drill | 87 | 43.5 | 33.3 | 26.0 | 54.5 | 61.5 | 52.0 | 40.0 | 25.0 |
| | Estimation | 113 | 56.5 | 66.7 | 74.0 | 45.5 | 38.5 | 48.0 | 60.0 | 75.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.291 (17.57) 3 | | | | 0.196 (7.71) 2 | | |
| | P | | | 0.001 (0.001) | | | | 0.021 (0.021) | | |
| **Method** | Nil | 57 | 28.5 | 14.8 | 16.0 | 43.2 | 42.3 | 37.8 | 24.3 | 9.4 |
| | With fertilizer | 76 | 38.0 | 48.1 | 36.0 | 34.1 | 32.7 | 34.7 | 44.3 | 34.4 |
| | Besides | 67 | 33.5 | 37.0 | 48.0 | 22.7 | 25.0 | 27.6 | 31.4 | 56.3 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.230 (21.16) 6 | | | | 0.192 (14.68) 4 | | |
| | P | | | 0.002 (0.002) | | | | 0.005 (0.005) | | |
| **Variety** | Local | 101 | 50.5 | 38.9 | 40.0 | 61.4 | 63.5 | 61.2 | 50.0 | 18.8 |
| | Others | 32 | 16.0 | 11.1 | 30.0 | 13.6 | 9.6 | 11.2 | 20.0 | 21.9 |
| | PHB-3253 | 67 | 33.5 | 50.0 | 30.0 | 25.0 | 26.9 | 27.6 | 30.0 | 59.4 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.223 (19.89) 6 | | | | 0.219 (19.09) 4 | | |
| | P | | | 0.003 (0.003) | | | | 0.001 (0.001) | | |
| **Area coverage** | Nil | 102 | 51.0 | 38.9 | 40.0 | 63.6 | 63.5 | 61.2 | 50.0 | 21.9 |
| | 50-75percent | 20 | 10.0 | 9.3 | 16.0 | 4.5 | 9.6 | 9.2 | 11.4 | 9.4 |
| | >75percent | 78 | 39.0 | 51.9 | 44.0 | 31.8 | 26.9 | 29.6 | 38.6 | 68.8 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.294 (13.98) 6 | | | | 0.389 (17.05) 4 | | |
| | P | | | 0.001 (.030) | | | | 0.001 (0.002) | | |
| **Seed source** | Local | 118 | 59.0 | 44.4 | 52.0 | 68.2 | 73.1 | 68.4 | 57.1 | 34.4 |
| | Certified | 82 | 41.0 | 55.6 | 48.0 | 31.8 | 26.9 | 31.6 | 42.9 | 65.6 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.240 (11.53) 3 | | | | 0.242(11.67) 2 | | |
| | P | | | 0.009 (0.009) | | | | 0.003 (0.003) | | |

* Illiterate
** Primary
*** Secondary
**** Numbers in brackets are Chi-square and p values
D Numbers next to Chi-square value stands for degree of freedom

## Appendix 5.5 continued...

| Practice | Category | Total | | Age | | | | Education | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | percent | 18-30 | 31-40 | 41-52 | 55-85 | I | P | S |
| **Plant spacing** | Broadcast | 106 | 53.0 | 48.1 | 34.0 | 61.4 | 69.2 | 60.2 | 48.6 | 40.6 |
| | 25-1seed/hill | 94 | 47.0 | 51.9 | 66.0 | 38.6 | 30.8 | 39.8 | 51.4 | 59.4 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100.0 | 100.0 | 100.0 |
| | Gamma | | | -0.291 (14.49) 3 | | | | 0.257 (4.56) 2 | | |
| | P | | | 0.004 (0.002) | | | | 0.031 (0.102) | | |
| **Raw spacing** | <50cm-1seed/hill | 161 | 80.5 | 88.9 | 60.0 | 84.1 | 88.5 | 84.7 | 84.3 | 59.4 |
| | 50-80 cm-2seed/hill | 39 | 19.5 | 11.1 | 40.0 | 15.9 | 11.5 | 15.3 | 15.7 | 40.6 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.096 (18.27) 3 | | | | 0.333 (10.83) 2 | | |
| | P | | | 0.398 (0.000) | | | | 0.038 (0.004) | | |

## Appendix 5.6 The percentage distribution of maize farmers according to farm size, media and agro ecology, and adoption behavior

| | | Total | | Farm size | | | Media | | Agro ecology | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Practice** | **Category** | N | percent | Small | Medium | Better-off | Low | High | Low | Middle |
| **Fertilizer type** | None | 47 | 23.5 | 26.0 | 17.0 | 32.1 | 32.0 | 9.3 | 33.0 | 14.0 |
| | DAP | 29 | 14.5 | 6.0 | 17.0 | 17.9 | 20.0 | 5.3 | 19.0 | 10.0 |
| | DAP+UREA | 124 | 62.0 | 68.0 | 66.0 | 50.0 | 48.0 | 85.3 | 48.0 | 76.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.148 (8.76)[*] 4[D] | | | 0.372(27.7) 2 | | 0.290 (16.8) 2 | |
| | P | | | 0.067 (0.067) | | | 0.000(0.000) | | 0.000 (0.000) | |
| **Fertilizer rate** | Nil | 47 | 23.5 | 26.0 | 17.0 | 32.1 | 32.0 | 9.3 | 33.0 | 14.0 |
| | <=100 kg DAP | 29 | 14.5 | 6.0 | 17.0 | 17.9 | 20.0 | 5.3 | 19.0 | 10.0 |
| | 50-100 kg each | 32 | 16.0 | 4.0 | 21.3 | 17.9 | 19.2 | 10.7 | 7.0 | 25.0 |
| | 100 kg each | 92 | 46.0 | 64.0 | 44.7 | 32.1 | 28.8 | 74.7 | 41.0 | 51.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.252 (19.08) 6 | | | .669(40.77)4 | | 0.310 (21.69) 4 | |
| | P | | | 0.010 (0.004) | | | 0.000 (0.000) | | 0.004 (0.000) | |
| **Measurement** | Nil +drill | 87 | 43.5 | 32.0 | 37.2 | 64.3 | 54.4 | 25.3 | 69.0 | 18.0 |
| | Estimation | 113 | 56.5 | 68.0 | 62.8 | 35.7 | 45.6 | 74.7 | 31.0 | 82.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma, | | | -0.396(14.04) 2 | | | .557(16.11)1 | | .820(52.91) 1 | |
| | P | | | 0.000 (0.001) | | | 0.000 (0.000) | | 0.000 (0.000) | |
| **Method** | Nil | 57 | 28.5 | 28.0 | 22.3 | 39.3 | 40.0 | 9.3 | 43.0 | 14.0 |
| | With fertilizer | 76 | 38.0 | 10.0 | 52.1 | 39.3 | 45.6 | 25.3 | 28.0 | 48.0 |
| | Besides | 67 | 33.5 | 62.0 | 25.5 | 21.4 | 14.4 | 65.3 | 29.0 | 38.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.296 (35.16) 4 | | | .533 (56.8) 2 | | 0.326 (22.23) 2 | |
| | P | | | 0.000 (0.000) | | | 0.000 (0.000) | | 0.000 (0.000) | |
| **Variety** | Local | 101 | 50.5 | 30.0 | 53.2 | 64.3 | 65.6 | 25.3 | 69.0 | 32.0 |
| | Others | 32 | 16.0 | 34.0 | 8.5 | 12.5 | 8.0 | 29.3 | 13.0 | 19.0 |
| | PHB-3253 | 67 | 33.5 | 36.0 | 38.3 | 23.2 | 26.4 | 45.3 | 18.0 | 49.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | 0.239 (22.76) 4 | | | .409 (33.4) 2 | | 0.381 (29.02) 2 | |
| | P | | | 0.000 (0.000) | | | 0.000 (0.000) | | 0.000 (0.000) | |
| **Area coverage** | Nil | 102 | 51.0 | 30.0 | 53.2 | 66.1 | 65.6 | 26.7 | 70.0 | 32.0 |
| | 50-75percent | 20 | 10.0 | 12.0 | 11.7 | 5.4 | 8.8 | 12.0 | 9.0 | 11.0 |
| | >75percent | 78 | 39.0 | 58.0 | 35.1 | 28.6 | 25.6 | 61.3 | 21.0 | 57.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.373 (15.14) 2 | | | .629(29.76) 2 | | 0.631 (30.97) 2 | |
| | P | | | 0.000 (0.004) | | | 0.000 (0.000) | | 0.000 (0.000) | |
| **Seed source** | Local | 118 | 59.0 | 40.0 | 63.8 | 67.9 | 74.4 | 33.3 | 75.0 | 43.0 |
| | Certified | 82 | 41.0 | 60.0 | 36.2 | 32.1 | 25.6 | 66.7 | 25.0 | 57.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V, Phi[a] | | | 0.226 (10.18) 2 | | | .404(32.68) 1 | | 0.325 (21.66) 1 | |
| | P | | | 0.006 (0.006) | | | 0.000 (0.000) | | 0.000 (0.000) | |

[*] Numbers in brackets represent Chi-square and p values

[D] Numbers next to Chi-square values represent degree of freedom

[a] Phi coefficient is the equivalent of Cramer's V used for all computations wit 1 degree of freedom

**Appendix 5.6 Continued...**

| Practice | Category | Total N | Total percent | Farm size Small | Farm size Medium | Farm size Better-off | Media Low | Media High | Agro ecology Low | Agro ecology Middle |
|---|---|---|---|---|---|---|---|---|---|---|
| **Plant spacing** | Broadcast | 106 | 53.0 | 44.0 | 42.6 | 78.6 | 60.8 | 40.0 | 83.0 | 23.0 |
| | 25-1seed/hill | 94 | 47.0 | 56.0 | 57.4 | 21.4 | 39.2 | 60.0 | 17.0 | 77.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.420 (20.44) 2 | | | .399 (8.14) 2 | | 0.885 (72.26) 2 | |
| | P | | | 0.000 (0.000) | | | 0.004 (0.004) | | 0.000 (0.000) | |
| **Raw spacing** | <50cm-1seed/hill | 161 | 80.5 | 54.0 | 89.4 | 89.3 | 94.4 | 57.3 | 87.0 | 74.0 |
| | 50-80 cm-2seed/hill | 39 | 19.5 | 46.0 | 10.6 | 10.7 | 5.6 | 42.7 | 13.0 | 26.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.586 (29.8) 2 | | | .852(41.03) 1 | | 0.403 (5.30) 1 | |
| | P | | | 0.000 (0.000) | | | 0.000 (0.000) | | 0.019 (0.020) | |

## Appendix 5.7 The percentage distribution of maize farmers according to their extension contact, attitudinal modernity, farming experience, and adoption behavior

| Practice | Category | Total | | Extension | | Modernity | | | Farming experience | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | percent | Low | High | Low | Medium | High | Short | Medium | Long |
| Fertilizer type | None | 47 | 23.5 | 26.4 | 10.8 | 20.3 | 27.8 | 22.2 | 13.8 | 20.7 | 33.8 |
| | DAP | 29 | 14.5 | 17.8 | | 18.9 | 15.3 | 7.4 | 12.3 | 15.5 | 15.6 |
| | DAP+UREA | 124 | 62.0 | 55.8 | 89.2 | 60.8 | 56.9 | 70.4 | 73.8 | 63.8 | 50.6 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | .275 (15.11)[*] 2[D] | | .109 (4.75) 4 | | | 0.155 (9.65) 4 | | |
| | P | | | 0.001 (0.001) | | 0.314 (0.314) | | | 0.047 (0.047) | | |
| Fertilizer rate | Nil | 47 | 23.5 | 26.4 | 10.8 | 20.3 | 27.8 | 22.2 | 13.8 | 20.7 | 33.8 |
| | <=100 kg DAP | 29 | 14.5 | 17.8 | | 18.9 | 15.3 | 7.4 | 12.3 | 15.5 | 15.6 |
| | 50-100 kg each | 32 | 16.0 | 19.0 | 2.7 | 24.3 | 16.7 | 3.7 | 23.1 | 15.5 | 10.4 |
| | 100 kg each | 92 | 46.0 | 36.8 | 86.5 | 36.5 | 40.3 | 66.7 | 50.8 | 48.3 | 40.3 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | .724 (30.89) 3 | | .173 (19.17) 6 | | | -0.213 (11.04) 6 | | |
| | P | | | 0.000 (0.000) | | 0.058 (0.004) | | | 0.017 (0.087) | | |
| Measurement | Nil +drill | 87 | 43.5 | 49.7 | 16.2 | 45.9 | 47.2 | 35.2 | 29.2 | 46.6 | 53.2 |
| | Estimation | 113 | 56.5 | 50.3 | 83.8 | 54.1 | 52.8 | 64.8 | 70.8 | 53.4 | 46.8 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | .692 (13.75) 1 | | .127 (2.1) 2 | | | -0.324 (8.58) 2 | | |
| | P | | | 0.000 (0.000) | | 0.270 (0.349) | | | 0.003 (0.014) | | |
| Method | Nil | 57 | 28.5 | 32.5 | 10.8 | 28.4 | 31.9 | 24.1 | 13.8 | 31.0 | 39.0 |
| | With fertilizer | 76 | 38.0 | 46.0 | 2.7 | 52.7 | 38.9 | 16.7 | 41.5 | 37.9 | 35.1 |
| | Besides | 67 | 33.5 | 21.5 | 86.5 | 18.9 | 29.2 | 59.3 | 44.6 | 31.0 | 26.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | .538 (57.92) 2 | | .261 (27.16) 4 | | | 0.174 (12.18) 4 | | |
| | P | | | 0.000 (0.000) | | 0.000 (0.000) | | | 0.016 (0.016) | | |
| Variety | Local | 101 | 50.5 | 58.3 | 16.2 | 55.4 | 58.3 | 33.3 | 38.5 | 51.7 | 59.7 |
| | Others | 32 | 16.0 | 9.8 | 43.2 | 9.5 | 18.1 | 22.2 | 15.4 | 24.1 | 10.4 |
| | PHB-3253 | 67 | 33.5 | 31.9 | 40.5 | 35.1 | 23.6 | 44.4 | 46.2 | 24.1 | 29.9 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V | | | .402 (32.3) 2 | | .173 (11.94) 4 | | | 0.174 (12.04) 4 | | |
| | P | | | 0.000 (0.000) | | 0.000 (0.018) | | | 0.017 (0.017) | | |
| Area coverage | Nil | 102 | 51.0 | 58.9 | 16.2 | 55.4 | 58.3 | 35.2 | 38.5 | 53.4 | 59.7 |
| | 50-75percent | 20 | 10.0 | 8.6 | 16.2 | 12.2 | 6.9 | 11.1 | 9.2 | 13.8 | 7.8 |
| | >75percent | 78 | 39.0 | 32.5 | 67.6 | 32.4 | 34.7 | 53.7 | 52.3 | 32.8 | 32.5 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | .644 (22.02) 2 | | .228 (8.9) 4 | | | -0.262 (8.85) 4 | | |
| | P | | | 0.000 (0.000) | | 0.024 (0.063) | | | 0.011 (0.065) | | |
| Seed source | Local | 118 | 59.0 | 66.9 | 24.3 | 68.9 | 61.1 | 42.6 | 44.6 | 63.8 | 67.5 |
| | Certified | 82 | 41.0 | 33.1 | 75.7 | 31.1 | 38.9 | 57.4 | 55.4 | 36.2 | 32.5 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Cramer's V, Phi[**] | | | .336 (22.57) 1 | | .214 (9.15) 2 | | | 0.205 (8.42) 2 | | |
| | P | | | 0.000 (0.000) | | 0.000 (0.010) | | | 0.015 (0.015) | | |

[*] Numbers in brackets designate Chi-square and p values
[D] Numbers nest to Chi-square values designate degree of freedom
[**] Phi coefficient is the equivalent of Cramer's V used for all computations with 1 degree of freedom

**Appendix 5.7** **Continued...**

| | | Total | | Extension | | Modernity | | | Farming experience | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Practice** | **Category** | N | Percent | Low | High | Low | Medium | High | Short | Medium | Long |
| **Plant spacing** | Broadcast | 106 | 53.0 | 57.1 | 35.1 | 47.3 | 58.3 | 53.7 | 44.6 | 51.7 | 61.0 |
| | 25-1seed/hill | 94 | 47.0 | 42.9 | 64.9 | 52.7 | 41.7 | 46.3 | 55.4 | 48.3 | 39.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.421 (5.82) 1 | | -0.100 (1.80) 2 | | | -0.226 (3.87) 2 | | |
| | P | | | 0.016 (0.016) | | 0.387 (0.407) | | | 0.047 (0.144) | | |
| **Raw spacing** | <50cm-1seed/hill | 161 | 80.5 | 89.6 | 40.5 | 91.9 | 86.1 | 57.4 | 78.5 | 77.6 | 84.4 |
| | 50-80 cm-2seed/hill | 39 | 19.5 | 10.4 | 59.5 | 8.1 | 13.9 | 42.6 | 21.5 | 22.4 | 15.6 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.853 (43.18) 1 | | 0.617 (25.91) 2 | | | -0.136 (1.24) 2 | | |
| | P | | | 0.000 (0.000) | | 0.000 (0.000) | | | 0.339 (0.539) | | |

**Appendix 5.8 The percentage distribution of dairy farmers according to age, education, gender, and farm size and adoption behavior**

| Practice | Category | Total | | Age | | | | Education* | | | | Gender | | Farm size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Percent | 12-38 | 39-45 | 46-57 | 58-80 | I | P | S | T | M | F | Small | Medium | Better-off |
| No. of cross breeds | <75percent | 37 | 18.5 | 24.5 | 23.4 | 16.7 | 9.6 | 33.3 | 20.7 | 16.8 | 5.4 | 17.5 | 23.5 | 25.4 | 18.2 | 11.9 |
| | >75percent | 163 | 81.5 | 75.5 | 76.6 | 83.3 | 90.4 | 66.7 | 79.3 | 83.2 | 94.6 | 82.5 | 76.5 | 74.6 | 81.8 | 88.1 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/Phi | | | 0.286 (4.86)** 3 | | | | 0.438 (10.17) 3 | | | | -.059 (0.69) 1 | | .295 (4.02) 2 | | |
| | P | | | 0.027 (0.183) | | | | 0.002 (0.017) | | | | 0.407 (0.407) | | .043 ((0.134) | | |
| Cross breeds>=50percent | <75percent | 40 | 20 | 28.3 | 25.5 | 10.4 | 15.4 | 25.6 | 20.7 | 20.0 | 13.5 | 19.3 | 23.5 | 28.4 | 22.7 | 9.0 |
| | >75percent | 160 | 80 | 71.7 | 74.5 | 89.6 | 84.6 | 74.4 | 79.3 | 80.0 | 86.5 | 80.7 | 76.5 | 71.6 | 77.3 | 91.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/Phi*** | | | 0.287 (6.63) 3 | | | | 0.175 (1.76) 3 | | | | -.040 (0.31) 1 | | .397 (8.34) 2 | | |
| | P | | | 0.036 (0.085) | | | | 0.207 (0.624) | | | | 0.572 (.572) | | .003 (0.015) | | |
| Cross breeds>=62.5percent | !/4 of herd | 45 | 22.5 | 26.4 | 21.3 | 20.8 | 21.2 | 33.3 | 20.7 | 25.3 | 5.4 | 22.3 | 23.5 | 28.4 | 21.2 | 17.9 |
| | Half | 39 | 19.5 | 17.0 | 17.0 | 22.9 | 21.2 | 17.9 | 17.2 | 24.2 | 10.8 | 21.1 | 11.8 | 22.4 | 15.2 | 20.9 |
| | 3/4 of herd | 19 | 9.5 | 5.7 | 12.8 | 8.3 | 11.5 | 10.3 | 20.7 | 7.4 | 5.4 | 10.8 | 2.9 | 10.4 | 7.6 | 10.4 |
| | About all | 97 | 48.5 | 50.9 | 48.9 | 47.9 | 46.2 | 38.5 | 41.4 | 43.2 | 78.4 | 45.8 | 61.8 | 38.8 | 56.1 | 50.7 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.007 (2.90) 9 | | | | -0.007 (23.28) 9 | | | | .152 (4.62) 3 | | .146 (5.20) 6 | | |
| | P | | | 0.938 (0.966) | | | | 0.286 (0.006) | | | | 0.202 (0.202) | | .107 (0.516) | | |
| Feed trough | No | 28 | 14.0 | 9.4 | 12.8 | 12.5 | 21.2 | 20.5 | 10.3 | 10.5 | 18.9 | 15.1 | 8.8 | 23.9 | 10.6 | 7.5 |
| | Poor | 82 | 41.0 | 52.8 | 34.0 | 41.7 | 34.6 | 41.0 | 51.7 | 40.0 | 35.1 | 40.4 | 44.1 | 47.8 | 48.5 | 26.9 |
| | Moderate | 57 | 28.5 | 26.4 | 31.9 | 27.1 | 28.8 | 28.2 | 24.1 | 32.6 | 21.6 | 27.7 | 32.4 | 19.4 | 27.3 | 38.8 |
| | Good | 33 | 16.5 | 11.3 | 21.3 | 18.8 | 15.4 | 10.3 | 13.8 | 16.8 | 24.3 | 16.9 | 14.7 | 9.0 | 13.6 | 26.9 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.011 (7.10) 9 | | | | 0.110 (7.78) 9 | | | | .077 (1.17) 3 | | 0.406 (23.65) 6 | | |
| | P | | | 0.887 (0.563) | | | | 0.230 (0.548) | | | | .759 (0.759) | | 0.000 (0.001) | | |

[*] I= Illiterate, P= Primary, S= Secondary, T= Tertiary
[**] Numbers in brackets designate Chi-square and p vales and numbers next to brackets denote degree of freedom
[***] Phi coefficient is the equivalent of Cramer's V used for all computations with 1 degree of freedom

## Appendix 5.8 Continued...

| Practice | Category | Total | | Age | | | | Education | | | | Gender | | Farm size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Percent | 12-38 | 39-45 | 46-57 | 58-80 | I | P | S | T | M | F | Small | Medium | Bigger |
| **Gutter** | No | 31 | 15.5 | 13.2 | 14.9 | 22.9 | 11.5 | 17.9 | 34.5 | 11.6 | 8.1 | 16.3 | 11.8 | 25.4 | 10.6 | 10.4 |
| | Poor | 99 | 49.5 | 54.7 | 40.4 | 43.8 | 57.7 | 61.5 | 34.5 | 50.5 | 45.9 | 48.8 | 52.9 | 53.7 | 53.0 | 41.8 |
| | Moderate | 70 | 35 | 32.1 | 44.7 | 33.3 | 30.8 | 20.5 | 31.0 | 37.9 | 45.9 | 34.9 | 35.3 | 20.9 | 36.4 | 47.8 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.035 (6.20) 6 | | | | 0.269 (15.68) 6 | | | | .048 (0.46) 2 | | .353 (14.51) 4 | | |
| | P | | | 0.681 (0.400) | | | | 0.003 (0.016) | | | | .791 (0.791) | | .000 (0.006) | | |
| **Floor** | Poor | 104 | 52.0 | 52.8 | 51.1 | 50.0 | 53.8 | 64.1 | 55.2 | 46.3 | 51.4 | 49.4 | 64.7 | 65.7 | 54.5 | 35.8 |
| | Moderate | 66 | 33.0 | 34.0 | 34.0 | 31.3 | 32.7 | 25.6 | 27.6 | 37.9 | 32.4 | 34.3 | 26.5 | 28.4 | 28.8 | 41.8 |
| | Good | 30 | 15.0 | 13.2 | 14.9 | 18.8 | 13.5 | 10.3 | 17.2 | 15.8 | 16.2 | 16.3 | 8.8 | 6.0 | 16.7 | 22.4 |
| | Total | 200 | 100.0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | 0.001 (0.81) 6 | | | | 0.129 (4.10) 6 | | | | .119 (2.84) 2 | | .362 (14.43) 4 | | |
| | P | | | 0.990 (0.992) | | | | 0.186 (0.664) | | | | .241 (0.241) | | .000 (0.006) | | |
| **Roof and side wall** | Poor | 102 | 51 | 54.7 | 44.7 | 52.1 | 51.9 | 64.1 | 48.3 | 47.4 | 48.6 | 48.2 | 64.7 | 61.2 | 53.0 | 38.8 |
| | Moderate | 70 | 35 | 34.0 | 34.0 | 37.5 | 34.6 | 25.6 | 41.4 | 37.9 | 32.4 | 38.0 | 20.6 | 29.9 | 31.8 | 43.3 |
| | Good | 28 | 14 | 11.3 | 21.3 | 10.4 | 13.5 | 10.3 | 10.3 | 14.7 | 18.9 | 13.9 | 14.7 | 9.0 | 15.2 | 17.9 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | 0.001 (3.15) 6 | | | | 0.146 (4.60) 6 | | | | .141 (3.95) 2 | | .260 (7.40) 4 | | |
| | P | | | 0.994 (0.790) | | | | 0.140 (0.600) | | | | .138 (0.138) | | .007 (0.116) | | |
| **Stall** | No | 132 | 66.0 | 62.3 | 57.4 | 72.9 | 71.2 | 61.5 | 82.8 | 63.2 | 64.9 | 69.3 | 50.0 | 71.6 | 65.2 | 61.2 |
| | Poor | 43 | 21.5 | 18.9 | 25.5 | 20.8 | 21.2 | 25.6 | 6.9 | 25.3 | 18.9 | 18.1 | 38.2 | 19.4 | 22.7 | 22.4 |
| | Moderate | 25 | 12.5 | 18.9 | 17.0 | 6.3 | 7.7 | 12.8 | 10.3 | 11.6 | 16.2 | 12.7 | 11.8 | 9.0 | 12.1 | 16.4 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.179 (6.68) 6 | | | | 0.054 (5.99) 6 | | | | .186 (6.94) 2 | | .155 (2.28) 4 | | |
| | P | | | 0.091 (0.352) | | | | 0.626 (0.425) | | | | .031 (0.031) | | .159 (0.685) | | |
| **Ecto parasite** | No | 102 | 51.0 | 41.5 | 48.9 | 58.3 | 55.8 | 53.8 | 51.7 | 56.8 | 32.4 | 53.6 | 38.2 | 46.3 | 60.6 | 46.3 |
| | 100percent | 98 | 49.0 | 58.5 | 51.1 | 41.7 | 44.2 | 46.2 | 48.3 | 43.2 | 67.6 | 46.4 | 61.8 | 53.7 | 39.4 | 53.7 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/Phi | | | -0.175 (3.50) 3 | | | | 0.166 (6.53) 3 | | | | .116 (2.67) 1 | | .000 (3.64) 2 | | |
| | P | | | 0.092 (0.321) | | | | 0.133 (0.088) | | | | .102 (0.012) | | 1.000 (0.162) | | |

**Appendix 5.8 Continued…**

| | | Total | | Age | | | | Education | | | | Gender | | Farm size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Practice** | **Category** | N | Percent | 12-38 | 39-45 | 46-57 | 58-80 | I | P | S | T | M | F | Small | Medium | Bigger |
| **Indo Parasite** | Not at all | 54 | 27.0 | 26.4 | 25.5 | 33.3 | 23.1 | 41.0 | 34.5 | 24.2 | 13.5 | 27.1 | 26.5 | 32.8 | 27.3 | 20.9 |
| | <100percent | 25 | 12.5 | 11.3 | 12.8 | 10.4 | 15.4 | 15.4 | 6.9 | 17.9 | | 12.0 | 14.7 | 10.4 | 16.7 | 10.4 |
| | 100percent | 121 | 60.5 | 62.3 | 61.7 | 56.3 | 61.5 | 43.6 | 58.6 | 57.9 | 86.5 | 60.8 | 58.8 | 56.7 | 56.1 | 68.7 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.012 (1.82) 6 | | | | 0.363 (20.0) 6 | | | | .030 (.18) 2 | | 0.165 (4.25) 4 | | |
| | P | | | 0.898 (0.936) | | | | 0.000 (0.003) | | | | .913 (.913) | | 0.119 (0.373) | | |
| **Byproduct** | Sometimes | 29 | 14.5 | 15.1 | 12.8 | 16.7 | 13.5 | 20.5 | 13.8 | 13.7 | 10.8 | 13.9 | 17.6 | 17.9 | 12.1 | 13.4 |
| | Regularly (Some) | 140 | 70.0 | 66.0 | 78.7 | 62.5 | 73.1 | 76.9 | 69.0 | 69.5 | 64.9 | 69.3 | 73.5 | 67.2 | 69.7 | 73.1 |
| | Regularly (All) | 31 | 15.5 | 18.9 | 8.5 | 20.8 | 13.5 | 2.6 | 17.2 | 16.8 | 24.3 | 16.9 | 8.8 | 14.9 | 18.2 | 13.4 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.013 (4.28) 6 | | | | 0.261 (8.02) 6 | | | | .087 (1.53) 2 | | 0.035 (1.52) 4 | | |
| | P | | | 0.903 (0.639) | | | | 0.015 (0.236) | | | | .465 (0.465) | | 0.759 (0.822) | | |
| **Processed feed** | Sometimes | 36 | 18.0 | 20.8 | 14.9 | 16.7 | 19.2 | 25.6 | 20.7 | 17.9 | 8.1 | 15.7 | 29.4 | 20.9 | 22.7 | 10.4 |
| | Regularly (Some) | 101 | 50.5 | 47.2 | 57.4 | 41.7 | 55.8 | 59.0 | 41.4 | 50.5 | 48.6 | 50.6 | 50.0 | 55.2 | 43.9 | 52.2 |
| | Regularly (Most) | 63 | 31.5 | 32.1 | 27.7 | 41.7 | 25.0 | 15.4 | 37.9 | 31.6 | 43.2 | 33.7 | 20.6 | 23.9 | 33.3 | 37.3 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.014 (4.66) 6 | | | | 0.244 (9.67) 6 | | | | .150 (4.51) 2 | | 0.194 (6.18) 4 | | |
| | P | | | 0.880 (0.588) | | | | 0.007 (0.139) | | | | .105 (0.105) | | 0.035 (0.186) | | |
| **Legumes** | Not at all | 122 | 61.0 | 50.9 | 63.8 | 68.8 | 61.5 | 59.0 | 65.5 | 63.2 | 54.1 | 65.1 | 41.2 | 68.7 | 59.1 | 55.2 |
| | Sometimes | 54 | 27.0 | 30.2 | 23.4 | 27.1 | 26.9 | 30.8 | 31.0 | 25.3 | 24.3 | 22.3 | 50.0 | 22.4 | 28.8 | 29.9 |
| | Regularly (Some) | 24 | 12.0 | 18.9 | 12.8 | 4.2 | 11.5 | 10.3 | 3.4 | 11.6 | 21.6 | 12.7 | 8.8 | 9.0 | 12.1 | 14.9 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | G/C'V | | | -0.138 (6.40) 6 | | | | 0.088 (5.80) 6 | | | | .235 (11.09) 2 | | 0.174 (2.85) 4 | | |
| | P | | | 0.171 (0.379) | | | | 0.410 (0.445) | | | | .004 (0.004) | | 0.098 (0.583) | | |

**Appendix 5.9 The percentage distribution of dairy farmers according to farming experience, media exposure, attitudinal modernity, organizational participation and adoption behavior**

| | | Total | | Farming experience | | | Media | | Modernity | | | Organization | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Practice** | **Category** | N | Percent | Short | Medium | Long | Low | High | Low | Medium | High | Low | High |
| **No. of cross breeds** | <75percent | 37 | 18.5 | 27.9 | 16.4 | 10.8 | 27.3 | 14.2 | 24.6 | 26.8 | 5.6 | 19.1 | 14.8 |
| | >75percent | 163 | 81.5 | 72.1 | 83.6 | 89.2 | 72.7 | 85.8 | 75.4 | 73.2 | 94.4 | 80.9 | 85.2 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.375 (6.79)* 2 | | | .388 (5.02) 1 | | 0.426 (12.60) 2 | | | NC** | |
| | P | | | 0.010 (0.034) | | | .037 (0.025) | | 0.001 (0.002) | | | | |
| **Cross breeds>=50percent** | <75percent | 40 | 20.0 | 30.9 | 13.4 | 15.4 | 25.8 | 17.2 | 24.6 | 23.9 | 12.5 | 20.8 | 14.8 |
| | >75percent | 160 | 80.0 | 69.1 | 86.6 | 84.6 | 74.2 | 82.8 | 75.4 | 76.1 | 87.5 | 79.2 | 85.2 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.321 (7.71) 2 | | | .252 (2.04) 2 | | 0.256 (3.96) 2 | | | 0.203 (0.52) 1 | |
| | P | | | 0.030 (0.021) | | | .173 (0.153) | | 0.062 (0.138) | | | 0.428 (0.469) | |
| **Cross breeds>=62.5percent** | !/4 of herd | 45 | 22.5 | 33.8 | 19.4 | 13.8 | 28.8 | 19.4 | 19.3 | 26.8 | 20.8 | 23.7 | 14.8 |
| | Half | 39 | 19.5 | 11.8 | 26.9 | 20.0 | 28.8 | 14.9 | 15.8 | 26.8 | 15.3 | 20.2 | 14.8 |
| | 3/4 of herd | 19 | 9.5 | 8.8 | 9.0 | 10.8 | 12.1 | 8.2 | 14.0 | 7.0 | 8.3 | 9.8 | 7.4 |
| | About all | 97 | 48.5 | 45.6 | 44.8 | 55.4 | 30.3 | 57.5 | 50.9 | 39.4 | 55.6 | 46.2 | 63.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.175 (11.39) 6 | | | .369 (13.52) 3 | | 0.034 (7.70) 6 | | | 0.276 (2.66) 3 | |
| | P | | | 0.061 (0.077) | | | .001 (0.004) | | 0.709 (0.261) | | | 0.104 (0.447) | |
| **Feed trough** | No | 28 | 14.0 | 16.2 | 11.9 | 13.8 | 21.2 | 10.4 | 5.3 | 18.3 | 16.7 | 12.7 | 22.2 |
| | Poor | 82 | 41.0 | 42.6 | 38.8 | 41.5 | 39.4 | 41.8 | 54.4 | 29.6 | 41.7 | 41.6 | 37.0 |
| | Moderate | 57 | 28.5 | 25.0 | 35.8 | 24.6 | 27.3 | 29.1 | 22.8 | 39.4 | 22.2 | 30.1 | 18.5 |
| | Good | 33 | 16.5 | 16.2 | 13.4 | 20.0 | 12.1 | 18.7 | 17.5 | 12.7 | 19.4 | 15.6 | 22.2 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.052 (3.33) 6 | | | 0.206 (4.91) 3 | | -0.040 (14.84) 3 | | | NC | |
| | P | | | 0.573 (0.767) | | | 0.076 (0.178) | | 0.646 (0.022) | | | | |

* Numbers in brackets designate Chi-square and p values, Numbers next to the Chi-square value represent degree of freedom
** Not computed

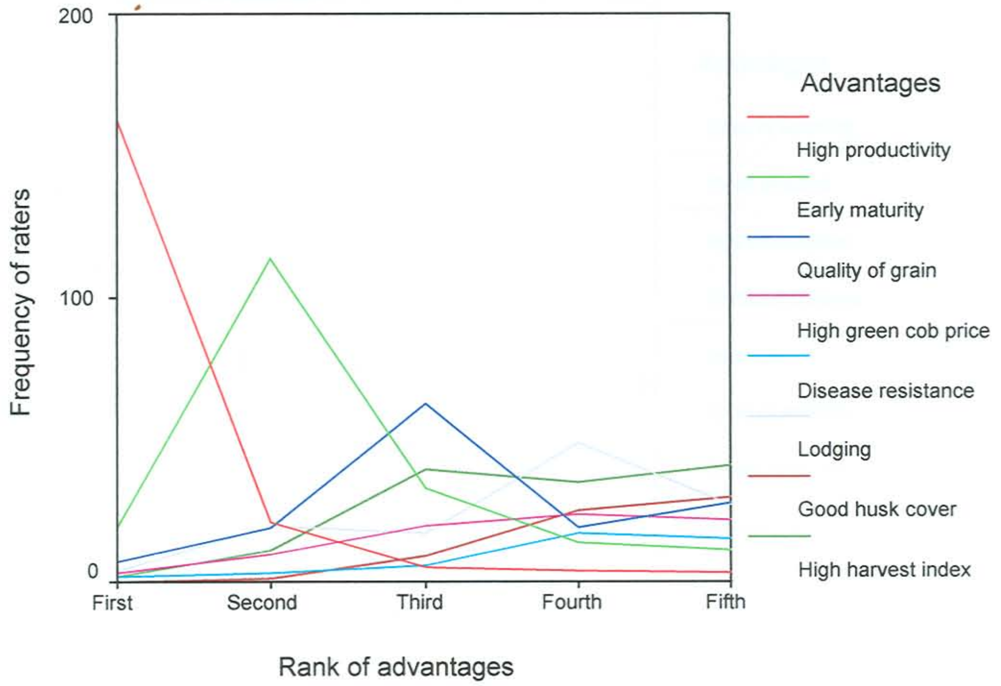
## Appendix 5.9 Continued…

| Practice | Category | Total | | Farming experience | | | Media | | Modernity | | | Organization | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Percent | Short | Medium | Long | Low | High | Low | Medium | High | Low | High |
| **Gutter** | No | 31 | 15.5 | 16.2 | 14.9 | 15.4 | 19.7 | 13.4 | 14.0 | 16.9 | 15.3 | 16.2 | 11.1 |
| | Poor | 99 | 49.5 | 48.5 | 46.3 | 53.8 | 53.0 | 47.8 | 59.6 | 40.8 | 50.0 | 49.1 | 51.9 |
| | Moderate | 70 | 35.0 | 35.3 | 38.8 | 30.8 | 27.3 | 38.8 | 26.3 | 42.3 | 34.7 | 34.7 | 37.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100.0 | 100 |
| | Gamma | | | -0.035 (1.04) 4 | | | 0.225 (3.05) 2 | | 0.056 (4.73) 4 | | | 0.088 (0.46) 2 | |
| | P | | | 0.723 (0.902) | | | 0.077 (0.218) | | 0.552 (0.316) | | | 0.615 (0.790) | |
| **Floor** | Poor | 104 | 52.0 | 52.9 | 58.2 | 44.6 | 62.1 | 47.0 | 50.9 | 49.3 | 55.6 | 50.9 | 59.3 |
| | Moderate | 66 | 33.0 | 30.9 | 29.9 | 38.5 | 25.8 | 36.6 | 35.1 | 36.6 | 27.8 | 34.1 | 25.9 |
| | Good | 30 | 15.0 | 16.2 | 11.9 | 16.9 | 12.1 | 16.4 | 14.0 | 14.1 | 16.7 | 15.0 | 14.8 |
| | Total | 200 | 100.0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.080 (2.71) 4 | | | 0.251 (4.05) 2 | | -0.033 (1.45) 4 | | | -0.123 (0.79) 2 | |
| | P | | | 0.429 (0.607) | | | 0.054 (0.132) | | 0.745 (0.836) | | | 0.507 (0.674) | |
| **Roof and side wall** | Poor | 102 | 51.0 | 51.5 | 55.2 | 46.2 | 62.1 | 45.5 | 52.6 | 45.1 | 55.6 | 50.9 | 51.9 |
| | Moderate | 70 | 35.0 | 29.4 | 32.8 | 43.1 | 31.8 | 36.6 | 38.6 | 40.8 | 26.4 | 35.3 | 33.3 |
| | Good | 28 | 14.0 | 19.1 | 11.9 | 10.8 | 6.1 | 17.9 | 8.8 | 14.1 | 18.1 | 13.9 | 14.8 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.005 (4.40) 4 | | | 0.340 (7.12) 2 | | 0.013 (5.20) 4 | | | -0.006 (0.04) 2 | |
| | P | | | 0.962 (0.354) | | | 0.007 (0.029) | | 0.899 (0.267) | | | 0.972 (0.798) | |
| **Stall** | No | 132 | 66.0 | 69.1 | 53.7 | 75.4 | 63.6 | 67.2 | 70.2 | 66.2 | 62.5 | 67.1 | 59.3 |
| | Poor | 43 | 21.5 | 17.6 | 31.3 | 15.4 | 24.2 | 20.1 | 21.1 | 21.1 | 22.2 | 20.2 | 29.6 |
| | Moderate | 25 | 12.5 | 13.2 | 14.9 | 9.2 | 12.1 | 12.7 | 8.8 | 12.7 | 15.3 | 12.7 | 11.1 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.085 (8.02) 4 | | | -0.057 (0.44) 2 | | 0.116 (1.39) 4 | | | 0.119 (1.20) 2 | |
| | P | | | 0.426 (0.091) | | | 0.691 (0.803) | | 0.294 (0.846) | | | 0.534 (0.543) | |
| **Ecto parasite** | No | 102 | 51.0 | 41.2 | 53.7 | 58.5 | 62.1 | 45.5 | 54.4 | 54.9 | 44.4 | 52.0 | 44.4 |
| | 100percent | 98 | 49.0 | 58.8 | 46.3 | 41.5 | 37.9 | 54.5 | 45.6 | 45.1 | 55.6 | 48.0 | 55.6 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100.0 | 100 |
| | Gamma | | | -0.229 (4.27) 2 | | | 0.325 (4.87) 1 | | 0.138 (1.94) 2 | | | 0.151 (0.53) 1 | |
| | P | | | 0.042 (0.118) | | | 0.025 (0.118) | | 0.228 (0.379) | | | 0.464 (0.464) | |

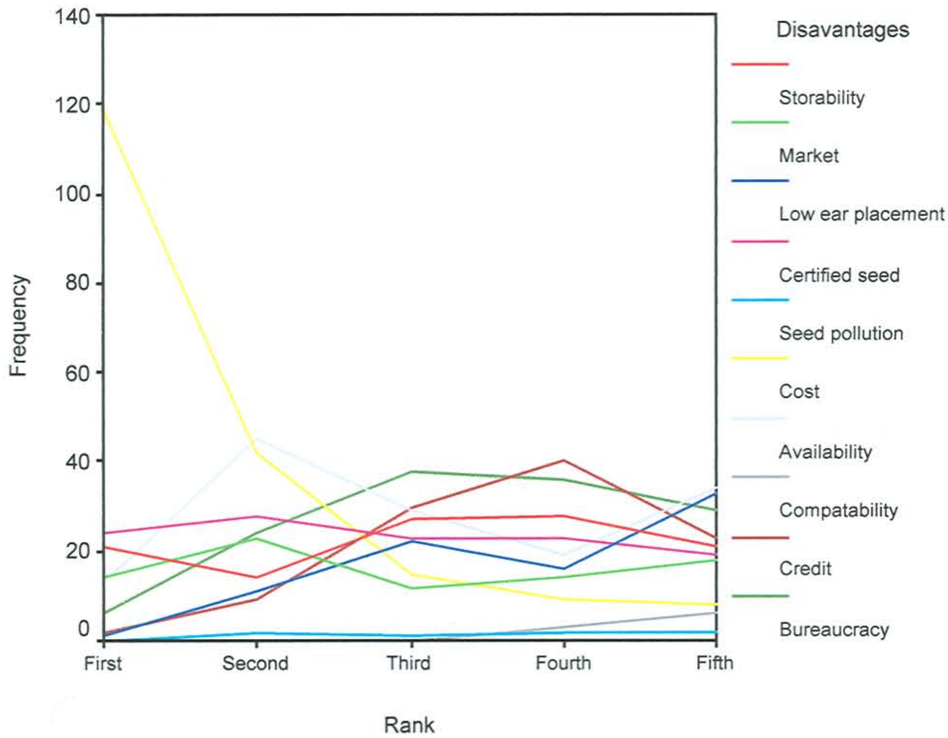
Appendix 5.9 Continued…

| Practice | Category | Total N | Total Percent | Farming experience Short | Farming experience Medium | Farming experience Long | Media Low | Media High | Modernity Low | Modernity Medium | Modernity High | Organization Low | Organization High |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indo Parasite** | Not at all | 54 | 27.0 | 26.5 | 32.8 | 21.5 | 40.9 | 20.1 | 24.6 | 32.4 | 23.6 | 28.9 | 14.8 |
| | <100percent | 25 | 12.5 | 13.2 | 9.0 | 15.4 | 22.7 | 7.5 | 10.5 | 18.3 | 8.3 | 13.3 | 7.4 |
| | 100percent | 121 | 60.5 | 60.3 | 58.2 | 63.1 | 36.4 | 72.4 | 64.9 | 49.3 | 68.1 | 57.8 | 77.8 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.047 (2.84) 4 | | | 0.541 (24.79) 2 | | 0.055 (6.63) 4 | | | 0.405 (3.90) 2 | |
| | P | | | 0.649 (0.589) | | | 0.000 (0.000) | | 0.604 (0.157) | | | 0.034 (0.142) | |
| **Byproduct** | Sometimes | 29 | 14.5 | 16.2 | 16.4 | 10.8 | 25.8 | 9.0 | 14.0 | 16.9 | 12.5 | 14.5 | 14.8 |
| | Regularly (Some) | 140 | 70.0 | 66.2 | 70.1 | 73.8 | 72.7 | 68.7 | 77.2 | 70.4 | 63.9 | 72.8 | 51.9 |
| | Regularly (All) | 31 | 15.5 | 17.6 | 13.4 | 15.4 | 1.5 | 22.4 | 8.8 | 12.7 | 23.6 | 12.7 | 33.3 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.037 (1.59) 4 | | | 0.676 (21.14) 2 | | 0.206 (6.38) 4 | | | NC | |
| | P | | | 0.752 (0.810) | | | 0.000 (0.000) | | 0.070 (0.172) | | | | |
| **Processed feed** | Sometimes | 36 | 18.0 | 19.1 | 16.4 | 18.5 | 39.4 | 7.5 | 19.3 | 22.5 | 12.5 | 20.2 | 3.7 |
| | Regularly (Some) | 101 | 50.5 | 52.9 | 62.7 | 35.4 | 48.5 | 51.5 | 43.9 | 52.1 | 54.2 | 53.2 | 33.3 |
| | Regularly (Most) | 63 | 31.5 | 27.9 | 20.9 | 46.2 | 12.1 | 41.0 | 36.8 | 25.4 | 33.3 | 26.6 | 63.0 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | 0.162 (12.24) 4 | | | 0.679 (36.87) 2 | | 0.037 (4.25) 2 | | | 0.635 (15.17) 2 | |
| | P | | | 0.119 (0.016) | | | 0.000 (0.000) | | 0.713 (0.374) | | | 0.000 (0.001) | |
| **Legumes** | Not at all | 122 | 61.0 | 57.4 | 56.7 | 69.2 | 62.1 | 60.4 | 68.4 | 50.7 | 65.3 | 59.0 | 74.1 |
| | Sometimes | 54 | 27.0 | 27.9 | 28.4 | 24.6 | 28.8 | 26.1 | 26.3 | 33.8 | 20.8 | 28.3 | 18.5 |
| | Regularly (Some) | 24 | 12.0 | 14.7 | 14.9 | 6.2 | 9.1 | 13.4 | 5.3 | 15.5 | 13.9 | 12.7 | 7.4 |
| | Total | 200 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Gamma | | | -0.167 (4.02) 4 | | | 0.059 (0.83) | | 0.052 (7.30) 4 | | | -0.307 (2.25) | |
| | P | | | 0.105 (0.403) | | | 0.669 (0.403) | | 0.617 (0.121) | | | 0.111 (0.324) | |

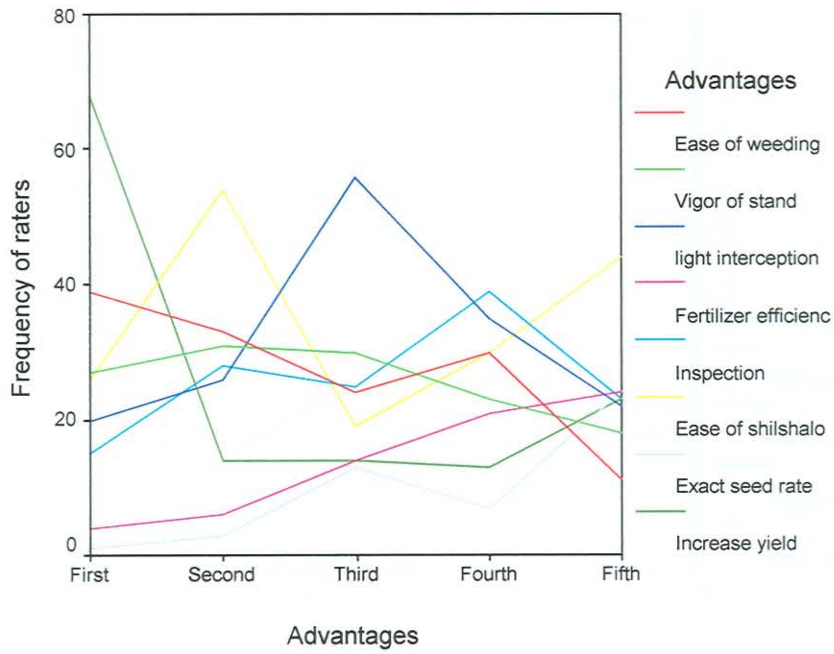
**Appendix 6.1 a** **Rank order position of perceived relative advantages of improved maize cultivars**



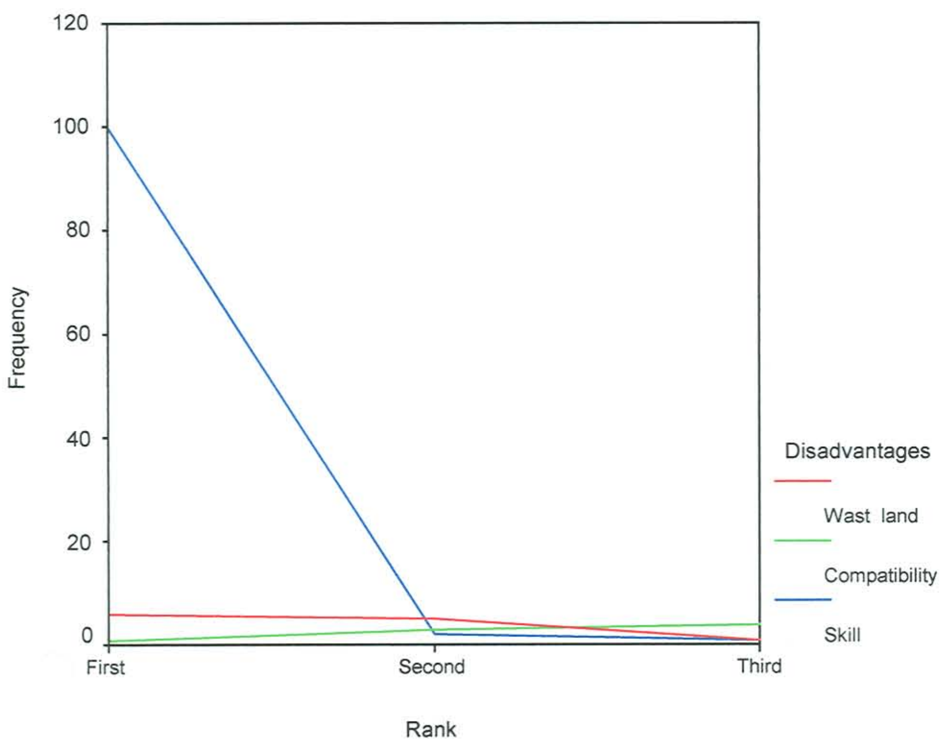

**b)** **Rank order position of perceived relative disadvantages of improved maize cultivars**



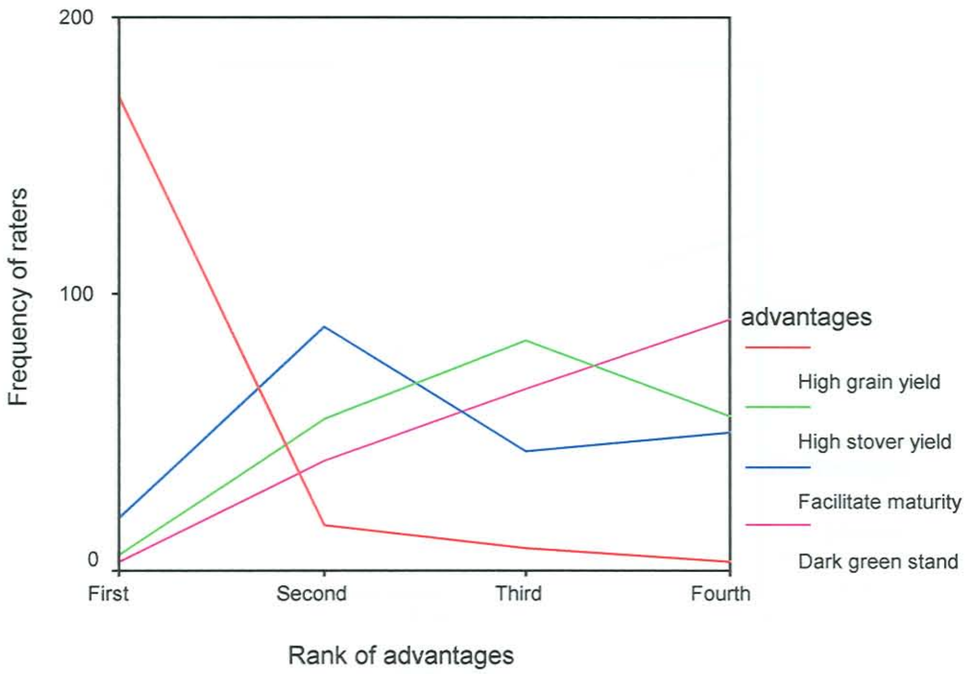
**Appendix 6.2a** **rank order position of perceived relative advantages of line planting**



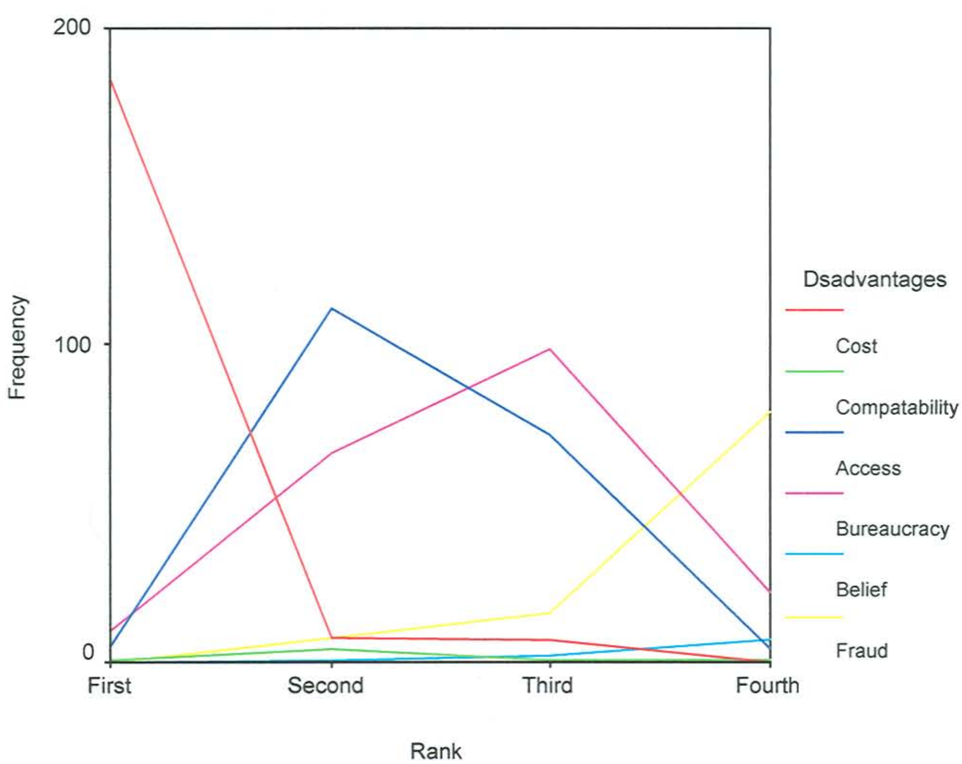

**b Rank order position of perceived relative disadvantages of line planting**



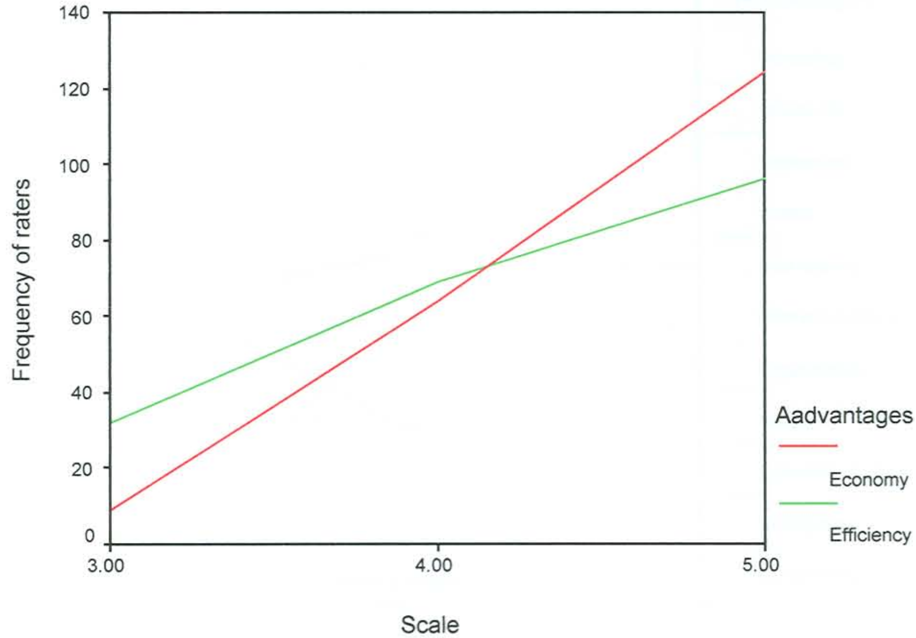
**Appendix 6.3a rank order position of perceived relative advantages of fertilization**



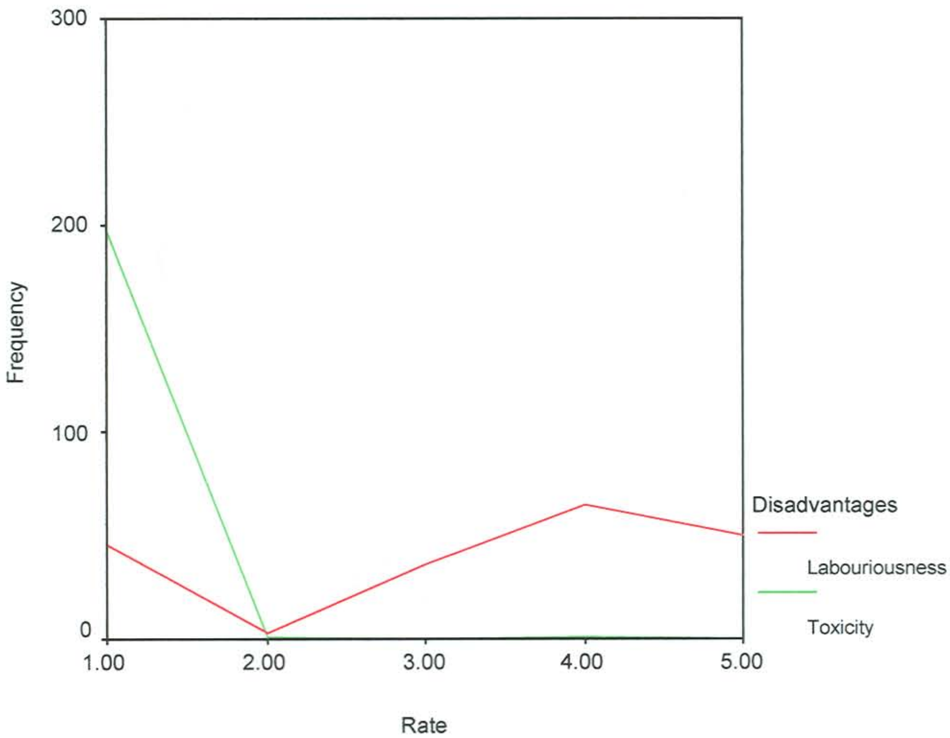

**b Rank order position of perceived relative disadvantages of fertilization**



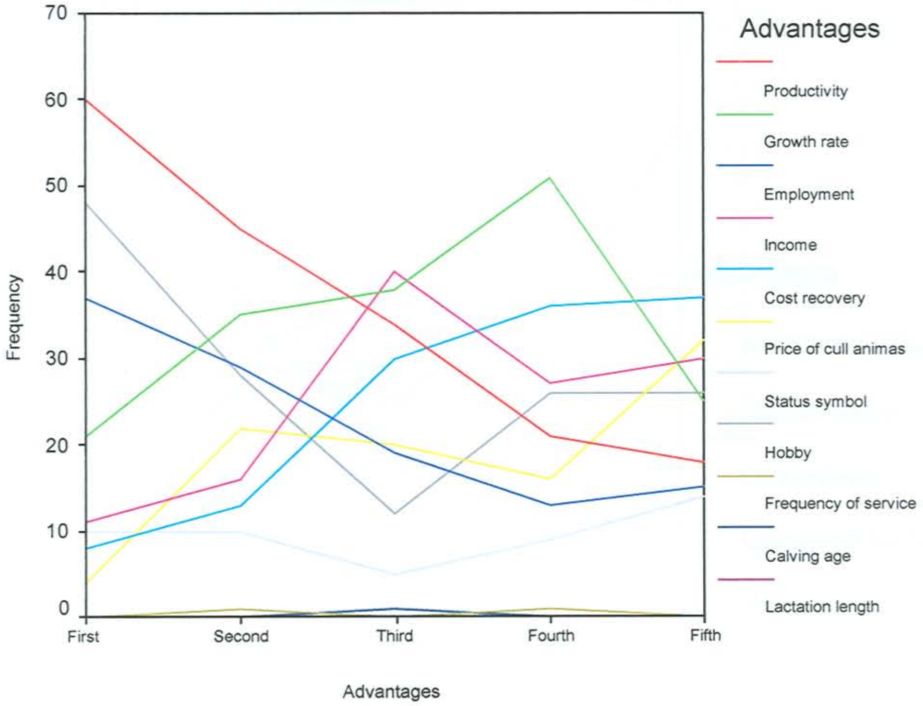
**Appendix 6.4a** **A five-point scale rank position of perceived relative advantages of spot application**



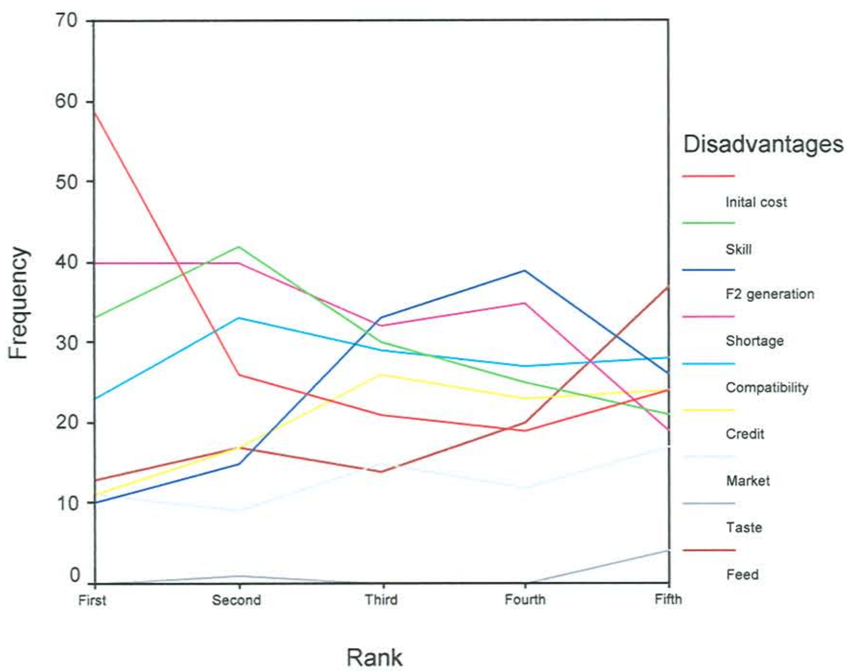

**b** **A five-point scale rank order position of perceived relative disadvantages of spot application**



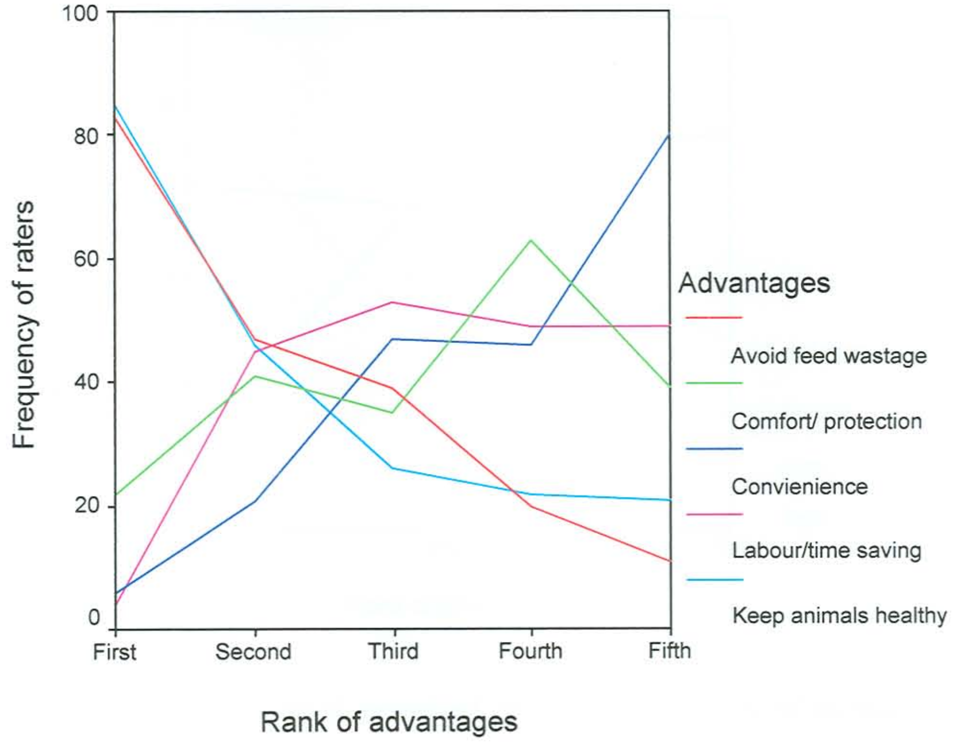
**Appendix 6.5a Rank order position of perceived relative advantages of improved dairy breeds**



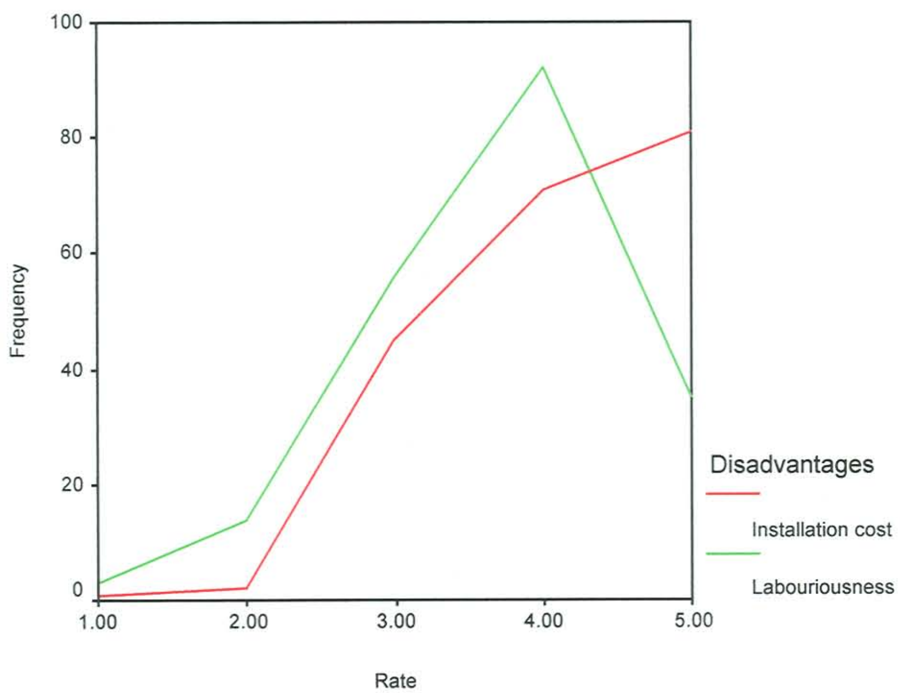

**b Rank order position of perceived relative disadvantages of improved breed**



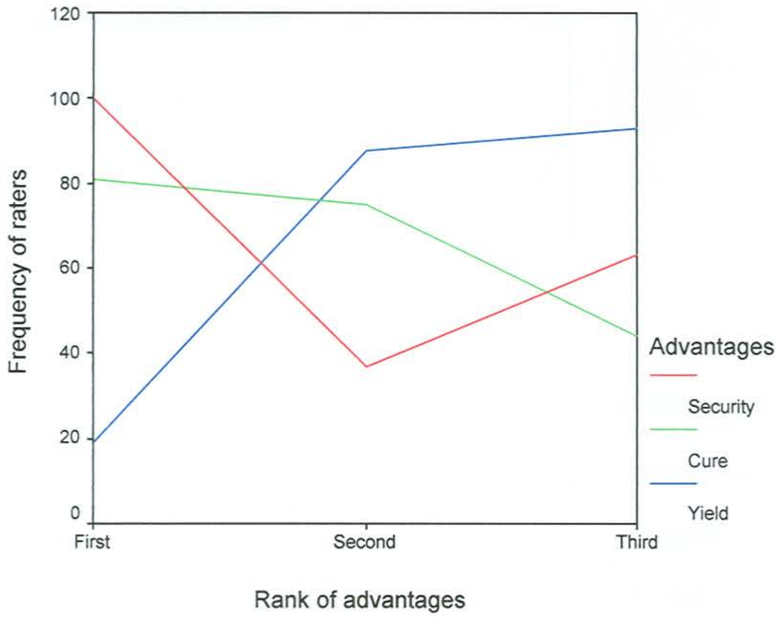
**Appendix 6.6a Rank of perceived relative advantages of improved housing**



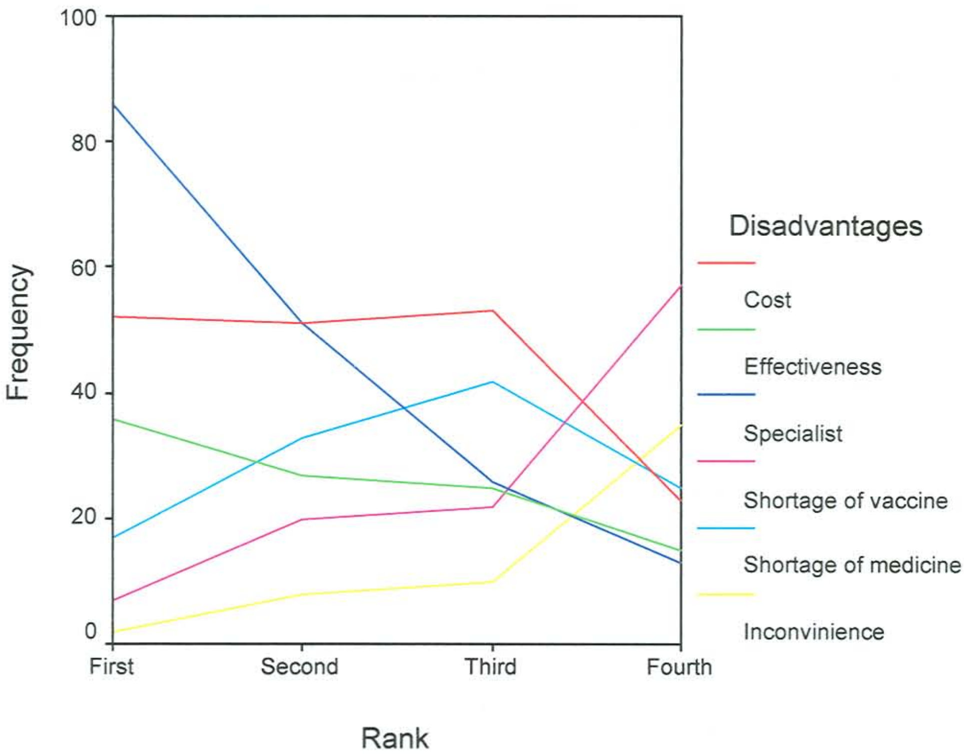

**b A five-point scale rank order position of perceived relative disadvantages of improved housing**



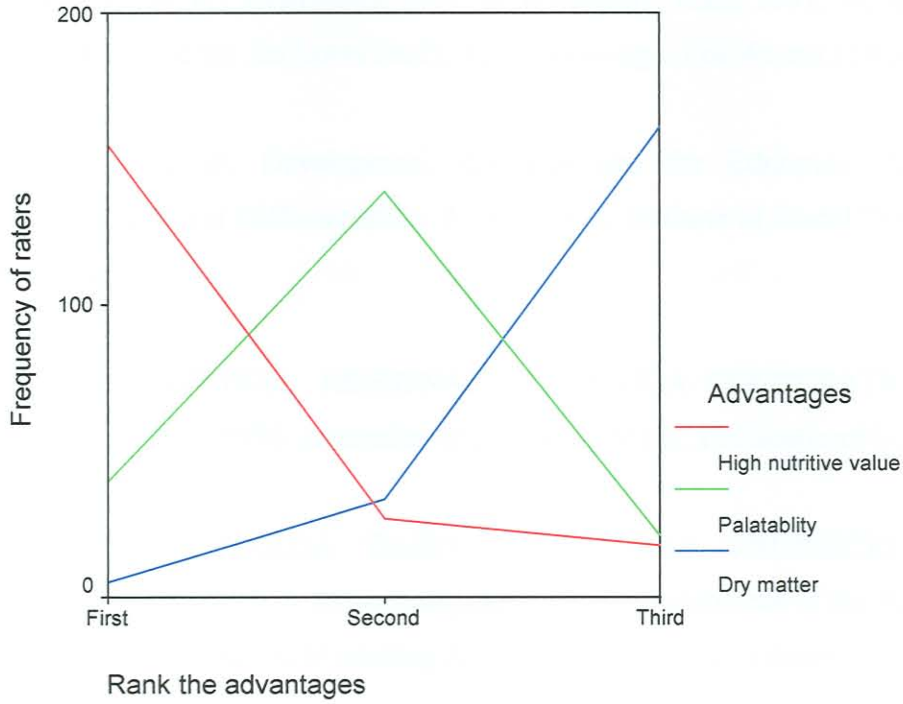
**Appendix 6.7a Rank order position of perceived relative advantages of recommended medical practices**



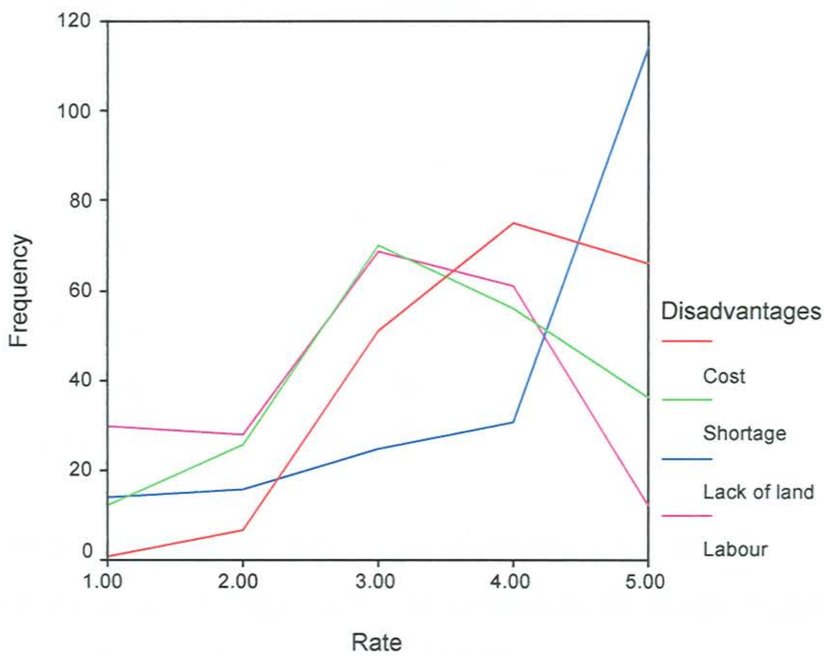

**b Rank order position of perceived relative disadvantages of medical practices**



**Appendix 6.8a Rank order position of perceived relative advantages of recommended feed practices**




**b Rank order position of perceived relative disadvantages of recommended feed practices**



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