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		Total
		Least efficient	Most efficient	
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.