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SOME FACTORS ASSOCIATED WITH THE EFFECTIVENESS OF THE AGRICULTURAL PRODUCTION COMPONENT IN AREAS OF INTEGRATED RURAL DEVELOPMENT IN COLOMBIA AS PERCEIVED BY FARMERS

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OF THE AGRICULTURAL PRODUCTION COMPONENT IN
AREAS OF INTEGRATED RURAL DEVELOPMENT IN COLOMBIA
AS PERCEIVED BY FARMERS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Education

in

The Department of Agricultural Extension
and International Education
(Extension Education)

by

Luis Eduardo Chaves E.
A.I., National University of Colombia, 1966
M.S., Cornell University, 1971
May 1986
ACKNOWLEDGMENTS

The author wishes to acknowledge and thank his Graduate Committee members, Dr. Lynn L. Pesson, Chairman, major professor, and Vice Chancellor for Student Affairs; Dr. Edward W. Cossie, Professor and Head of the Department of Extension and International Education; Dr. Satish Verma, Professor of Extension Education; Dr. Ralph D. Christy, Professor of Agricultural Economics; Dr. Quentin A. L. Jenkins, Professor of Rural Sociology, and Dr. Lisandro O. Pérez, Professor of Sociology for their direction, advice, and assistance in his study program, and for their valuable knowledge presented in the courses they taught.

Special recognition and gratitude is expressed to Dr. Lynn L. Pesson for his patient, helpful counsel, guidance, encouragement, and friendly understanding throughout the author's graduate study, and for his valuable assistance in the conduct and writing of this dissertation.

Grateful appreciation is expressed to Dr. Satish Verma for his opportune and helpful assistance in the statistical analysis of the data and interpretation of the results and for his useful suggestions given in developing this study.

Gratitude is extended to the Organization of American States (OAS) for the financial support during the first part of the author's graduate study.
The writer is deeply indebted to the W. K. Kellogg Foundation, for the fellowship granted at the time when it was most needed, which enabled him to continue and to properly complete his doctorate study program.

Special gratitude is expressed to ICA's Regional Direction at Ibague for its assistance and support during the author's stay in Colombia gathering information for this dissertation.

Appreciation is also extended to the Directors, extension personnel, and staff of the South Tolima and Fusagasugá Districts for their opportune cooperation and assistance, which facilitated the collection of the data for this study, and for the valuable information furnished.

The author wishes to express his gratitude to the Colombian Agricultural Institute (ICA) and the Colombian Institute for Technical Studies Abroad (ICETEX) for approving his travel to Louisiana State University to undertake his doctoral study program.

Special appreciation is extended to Mrs. Barbara Jackson, Mrs. Kathy Mayeax, Mrs. Mary Beth Burnett, Mrs. Estell W. Smilie and Mrs. Denise Arnold for their understanding and opportune assistance when it was needed.

Thanks also go to Ms. Trudy Van Buren for typing this manuscript.

Many other persons helped the author in one or another way during his studies at LSU; many thanks to all of them.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>11</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>xii</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>3</td>
</tr>
<tr>
<td>General Purposes</td>
<td>10</td>
</tr>
<tr>
<td>Specific Objectives</td>
<td>10</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>12</td>
</tr>
<tr>
<td>II. THEORETICAL FRAMEWORK</td>
<td>14</td>
</tr>
<tr>
<td>Review of Literature</td>
<td>14</td>
</tr>
<tr>
<td>The Concepts of Agricultural and Rural</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>14</td>
</tr>
<tr>
<td>The Concept of Integrated Rural Development</td>
<td>18</td>
</tr>
<tr>
<td>Factors Associated with Agricultural and Rural Development</td>
<td>22</td>
</tr>
<tr>
<td>Agricultural Technology</td>
<td>29</td>
</tr>
<tr>
<td>Appropriate Technology</td>
<td>36</td>
</tr>
<tr>
<td>Transfer of Technology</td>
<td>39</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Adoption of Technology</td>
<td>43</td>
</tr>
<tr>
<td>Credit</td>
<td>52</td>
</tr>
<tr>
<td>Marketing</td>
<td>58</td>
</tr>
<tr>
<td>Land</td>
<td>65</td>
</tr>
<tr>
<td>Characteristics of the Selected DRI Districts</td>
<td>70</td>
</tr>
<tr>
<td>South Tolima District (Sur Tolima)</td>
<td>70</td>
</tr>
<tr>
<td>Fusagasugá District</td>
<td>73</td>
</tr>
<tr>
<td>The Research Model</td>
<td>75</td>
</tr>
<tr>
<td>Statement of Hypotheses</td>
<td>77</td>
</tr>
<tr>
<td>III. RESEARCH METHODOLOGY</td>
<td>78</td>
</tr>
<tr>
<td>The Setting</td>
<td>78</td>
</tr>
<tr>
<td>Selection of the Sample</td>
<td>78</td>
</tr>
<tr>
<td>Interview Schedule</td>
<td>80</td>
</tr>
<tr>
<td>Operationalization of the Variables</td>
<td>83</td>
</tr>
<tr>
<td>Crop Productivity Limiting Factors</td>
<td>83</td>
</tr>
<tr>
<td>Technology</td>
<td>84</td>
</tr>
<tr>
<td>Adoption of Technology</td>
<td>86</td>
</tr>
<tr>
<td>Crop Production</td>
<td>87</td>
</tr>
<tr>
<td>Credit</td>
<td>88</td>
</tr>
<tr>
<td>Marketing</td>
<td>89</td>
</tr>
<tr>
<td>Farmers' Satisfaction</td>
<td>91</td>
</tr>
<tr>
<td>Collection of Data</td>
<td>92</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical Analysis of Data</td>
<td>92</td>
</tr>
<tr>
<td>IV. ANALYSIS OF DATA</td>
<td>96</td>
</tr>
<tr>
<td>General Aspects</td>
<td>98</td>
</tr>
<tr>
<td>Length of Time of DRI Services</td>
<td>98</td>
</tr>
<tr>
<td>Size of the Farms</td>
<td>100</td>
</tr>
<tr>
<td>Land Tenure Status</td>
<td>102</td>
</tr>
<tr>
<td>Crop Productivity Limiting Factors</td>
<td>103</td>
</tr>
<tr>
<td>Extent of Limitation</td>
<td>113</td>
</tr>
<tr>
<td>Crop Technology</td>
<td>117</td>
</tr>
<tr>
<td>Generation and Availability of Appropriate Technology</td>
<td>117</td>
</tr>
<tr>
<td>Transfer of Technology</td>
<td>122</td>
</tr>
<tr>
<td>Means of Transferring Technology</td>
<td>125</td>
</tr>
<tr>
<td>Satisfaction in Relation to DRI Technical Assistance</td>
<td>127</td>
</tr>
<tr>
<td>Adoption of Technology</td>
<td>129</td>
</tr>
<tr>
<td>Reasons for Non Adoption of Technology</td>
<td>133</td>
</tr>
<tr>
<td>Crop Production</td>
<td>137</td>
</tr>
<tr>
<td>Credit</td>
<td>139</td>
</tr>
<tr>
<td>Kinds of Financial Resources</td>
<td>139</td>
</tr>
<tr>
<td>Length of Time Utilizing DRI Credit</td>
<td>141</td>
</tr>
<tr>
<td>Difficulty in Obtaining DRI Credit</td>
<td>142</td>
</tr>
<tr>
<td>Timeliness of the DRI Credit</td>
<td>144</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequacy of the Amount of the DRI Credit</td>
<td>145</td>
</tr>
<tr>
<td>Interest Rates of the DRI Credit</td>
<td>147</td>
</tr>
<tr>
<td>Terms for Repaying Loans</td>
<td>148</td>
</tr>
<tr>
<td>Satisfaction in Relation to the DRI Credit Program</td>
<td>149</td>
</tr>
<tr>
<td>Marketing</td>
<td>151</td>
</tr>
<tr>
<td>Major Uses of Crop Production</td>
<td>151</td>
</tr>
<tr>
<td>Difficulty in the Marketing Process</td>
<td>153</td>
</tr>
<tr>
<td>Sale Price of Crop Production</td>
<td>155</td>
</tr>
<tr>
<td>Membership in Marketing Organizations</td>
<td>156</td>
</tr>
<tr>
<td>Marketing Channels</td>
<td>158</td>
</tr>
<tr>
<td>Marketing Difficulties</td>
<td>159</td>
</tr>
<tr>
<td>Satisfaction in Relation to the DRI Marketing Program</td>
<td>164</td>
</tr>
<tr>
<td>Relationships Between Variables</td>
<td>165</td>
</tr>
<tr>
<td>V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS</td>
<td>178</td>
</tr>
<tr>
<td>Summary</td>
<td>178</td>
</tr>
<tr>
<td>Conclusions</td>
<td>203</td>
</tr>
<tr>
<td>Recommendations</td>
<td>217</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>223</td>
</tr>
<tr>
<td>Appendix A: Interview Schedule</td>
<td>235</td>
</tr>
<tr>
<td>Appendix B: Relationship Between Variables</td>
<td>248</td>
</tr>
<tr>
<td>VITA</td>
<td>256</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A Comparison of the Length of Time Farmers Had Been Receiving DRI Services by Districts, 1985</td>
</tr>
<tr>
<td>2</td>
<td>A Comparison of the Size of Farms and the Amount of Farm-land Dedicated to Crops and Pasture by Districts, 1985</td>
</tr>
<tr>
<td>3</td>
<td>A Comparison of the Land Tenure Status of Farmers by Districts, 1985</td>
</tr>
<tr>
<td>4</td>
<td>A Comparison among the Crop Productivity Limiting Factors, District 1 and District 2, 1985</td>
</tr>
<tr>
<td>5</td>
<td>A Comparison for each Crop Productivity Limiting Factor by Districts, 1985</td>
</tr>
<tr>
<td>6</td>
<td>A Comparison of the Farmers' Perception in Relation to the Extent of Limitation of Crop Productivity Limiting Factors by Districts, 1985</td>
</tr>
<tr>
<td>7</td>
<td>Selected Recommended Cultural Practices by Crops and their Sources of Generation and Adaptation to Local Conditions, Districts 1 and 2, 1985</td>
</tr>
<tr>
<td>8</td>
<td>A Comparison of the Farmers' Perception in Relation to the Extent to which the DRI Program Was Effectively Transferring Technology by Districts, 1985</td>
</tr>
<tr>
<td>9</td>
<td>A Comparison of the Farmers' Perception in Relation to the Means through which they Learned about Cultural Practices by Districts, 1985</td>
</tr>
<tr>
<td>10</td>
<td>A Comparison of the Farmers' Levels of Satisfaction in Relation to the DRI Technical Assistance by Districts, 1985</td>
</tr>
<tr>
<td>11</td>
<td>A Comparison of the Use of Cultural Practices Recommended by the DRI Program According to the Information Provided by the Farmers by Districts, 1985</td>
</tr>
<tr>
<td>Table</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>A Comparison of the Levels of Adoption of Technology by Districts, 1985</td>
</tr>
<tr>
<td>13</td>
<td>A Comparison of the Farmers' Perception in Relation to the Reasons that Did not Allow them to Adopt the Recommended Cultural Practices by District, 1985</td>
</tr>
<tr>
<td>14</td>
<td>A Comparison of Levels of Crop Production by Districts, 1985</td>
</tr>
<tr>
<td>15</td>
<td>A Comparison of the Kinds of Financial Resources Utilized by DRI Farmers to Grow their Crops by Districts, 1985</td>
</tr>
<tr>
<td>16</td>
<td>A Comparison of the Length of Time Farmers Had Been Utilizing DRI Credit by Districts, 1985</td>
</tr>
<tr>
<td>17</td>
<td>A Comparison of the Farmers' Perception in Relation to the Difficulty in Obtaining DRI Credit by Districts, 1985</td>
</tr>
<tr>
<td>18</td>
<td>A Comparison of the Farmers' Perception in Relation to Timeliness of DRI Credit by Districts, 1985</td>
</tr>
<tr>
<td>19</td>
<td>A Comparison of the Farmers' Perception in Relation to the Adequacy in the Amount of Money of DRI Credit by Districts, 1985</td>
</tr>
<tr>
<td>20</td>
<td>A Comparison of the Farmers' Perception in Relation to the Interest Rates of DRI Credit by Districts, 1985</td>
</tr>
<tr>
<td>21</td>
<td>A Comparison of the Farmers' Perception in Relation to the Terms Established for Repaying Loans by Districts, 1985</td>
</tr>
<tr>
<td>22</td>
<td>A Comparison of the Farmers' Levels of Satisfaction in Relation to the DRI Credit Program by Districts, 1985</td>
</tr>
<tr>
<td>23</td>
<td>A Comparison of the Major Uses of Crop Production by Districts, 1985</td>
</tr>
<tr>
<td>24</td>
<td>A Comparison of the Farmers' Perception in Relation to the Difficulty in Marketing Crop Production by Districts, 1985</td>
</tr>
</tbody>
</table>
Table 25  A Comparison of the Farmers' Perception in Relation to the Conditions of the Sale Price for Crop Production by Districts, 1985 ........................................ 156

Table 26  A Comparison of Farmers' Membership in Marketing Organizations by Districts, 1985 ................................. 157

Table 27  A Comparison of the Channels Used by the Farmers for Marketing Crop Production by Districts, 1985 ......................... 159

Table 28  A Comparison of the Farmers' Perception in Relation to the most Salient Difficulties for Marketing Crop Production by Districts, 1985 .......................... 161

Table 29  A Comparison of the Farmers' Levels of Satisfaction in Relation to the DRI Marketing Program by Districts, 1985 .................................................. 164

Table 30  Relationships of the Selected Independent Variables with Adoption of Technology and Crop Production by Districts, 1985 .................................................. 167
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Republic of Colombia. Location of South Tolima,</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>(Sur Tolima) and Fusagasugá Districts</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Research Model of Factors Related to Adoption</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>of Agricultural Technology and Changes in Crop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Productivity, Integrated Rural Development</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program (DRI)</td>
<td></td>
</tr>
</tbody>
</table>
ABSTRACT

This study was conducted in two Integrated Rural Development Districts in Colombia; South Tolima and Fusagasugá. Its specific objectives were:

1. To determine the extent to which:
   a) the factors included in the agricultural production component of the DRI program (research, extension, credit, marketing), in addition to farmland and climate were limiting crop productivity;
   b) the DRI program was effectively transferring crop technology;
   c) farmers adopted recommended crop technology;

2. To determine:
   a) some of the reasons that limited adoption of agricultural technology;
   b) changes in crop production;
   c) some relevant characteristics of the DRI credit and marketing programs;
   d) farmers' satisfaction related to the DRI technical assistance, credit, and marketing programs;
   e) the extent of association between the dependent variables, adoption of technology and crop production, and the independent variables effectiveness in transferring technology, difficulty in obtaining credit, difficulty in marketing crop production, as well as between crop production and adoption of technology.
Sixty cooperating farmers were selected at random from each district for a total sample of 120 respondents. Data were collected through an interview schedule, and statistically analyzed.

The major conclusions were as follows:

1. Some progress in agricultural production was evident in both districts as supported by some improvements in crop production. Nevertheless, agricultural development has been taking place slowly and it is not yet at the desired level.

2. Appropriate conditions of research, extension, credit, marketing, farmland, and climate were not present in the most appropriate mix in order to maximize productivity and accelerate development. These factors affected productivity and development to a different extent in each district. Inappropriate marketing conditions were perceived by the farmers as the principal constraint to crop productivity, while credit was perceived as the least limiting factor.

3. In order to further accelerate agricultural development, greater emphasis is needed on generating appropriate crop technologies, adapted to local farming conditions, on proper and effective technology transfer to the farmers. Stable and effective local organizations are necessary for these conditions to exist, particularly to support marketing activities. Risk and uncertainty to the farmer must be reduced as much as possible so that change can be facilitated.
CHAPTER I
INTRODUCTION

Colombia is a typical agricultural country. Approximately thirty six percent of its population is made up of rural people who depend on agricultural production for their living. The total population is estimated at 28 million. There are about 1.9 million small rural families who live on about 1.6 million farms of less than 20 hectares (50 acres) (131, p. 7).

Agriculture and livestock are fundamental for the country's overall economy. They provide the principal products for export, the raw materials for industry, and most of the food for national consumption.

Agriculture and livestock are favored by the country's peculiar topographic and climatic conditions. Wide variation in topography, which heavily influences the climate, allows diversity and specialization in agricultural production. As a tropical country, and due to its position near the equator, Colombia has little variation in seasons, which enables the cultivation of crops and the raising of cattle the year around.

Colombia has two different types of agriculture. They are the modern or commercial sector and the traditional sector, both characterized by differences in development and structure in regard to
farmland, capital, labor, levels of technology, use of credit, and marketing facilities.

Modern agriculture involves both commercial and industrial crops and large livestock enterprises. It constitutes the most dynamic sector of the agricultural economy. Crops are grown and livestock is raised on the more fertile lands in a modernizing setting, with appropriate mechanization, specialized labor, availability of credit and marketing facilities, modern technology and agricultural inputs. The modern sector produces the majority of agricultural export products and industrial raw materials, representing approximately sixty five percent of the national income (39, p. 9).

The traditional sector is composed of rural communities with small holdings or parcels, many of them located on marginal lands and in isolated places, where small-scale farmers or peasants face socio-economic and technological problems. In addition, this sector is characterized by limited access to land and the use of land, capital, modern technology, lack of appropriate marketing and transportation facilities, slow technological progress, and low agricultural productivity. The traditional sector produces the majority of internal consumption foods (55 percent). Although Colombia exports some agricultural and livestock products, the country has to import other agricultural commodities to meet national food needs. The importation of foods and agricultural raw materials reached the amount of US $1,167.6 millions during 1982-83 (131, p. 13).
The development of the modern agricultural sector is adequate, but it is low in the traditional farming area. There are still many technological, economic, and social factors associated with the poor socio-economic conditions of traditional rural families.

The development process in the traditional rural sector in Colombia could be accelerated at the same time as the technological, economic, and social problems could be overcome. It is not an easy task, but it could be possible with a major effort and participation by the government, and with a better coordination and integration among the agencies involved in the rural sector. Furthermore, the active participation and interest of the farmers is also crucial. The development of the Colombian traditional rural sector is a pressing need for the welfare of the country's rural population.

Statement of the Problem

Like many other developing countries, Colombia is known for its poverty in the rural area. There is a great gap between the traditional and the modern agricultural sectors in relation to the technological, economic, and social conditions.

With very few exceptions, most of the traditional rural sector is characterized by low agricultural productivity. This level of productivity is due to low average crop and livestock yields, high costs per unit of production, and unfavorable prices offered for the farm products.
With few exceptions, most of traditional agriculture is found on lands with low or fair levels of fertility, lacking appropriate technology. Traditionally, little attention had been given to agricultural research under conditions of small farms. Only in the middle of the 1970s the government began to pay attention to this situation. Since then, a small part of the traditional sector has counted on some national and external financial resources that have been invested to generate appropriate technology for this sector. Many limitations of former extension programs were evident due, in part, to the inability to adapt and apply proper farm technology to the different conditions of traditional farming. Sometimes, it seems that there is not adequate understanding between extension personnel and agricultural researchers to overcome properly the technological problems of traditional agriculture.

In addition, the limited agricultural research findings available to the traditional agricultural sector had not had a proper impact on productivity because many of the findings had not been made known to most of the small farmers. It was due possibly to inadequate programs of technology transfer or inadequate dissemination of agricultural information.

An unequal distribution of the land exists and the majority of the farms are "minifundia". Seventy five percent of the farms are less than 10 hectares, representing 7.5 percent of the total farmland. Twenty five percent of the farms are less than one hectare, representing 0.5 percent of the total farmland (30, p. 177). Some
progress has been made by reallocating land resources through the agrarian reform programs and colonization projects, but they have not been successful enough. Nevertheless, ownership is the predominant land tenure status, followed by renters, share-tenants, and squatters.

With few exceptions, agricultural credit for small farmers has been difficult to obtain due to its many requirements and red tape. Credit has also been insufficient and time consuming. Loans have been granted predominantly at high interest rates and with short term due-dates on installment-pay plans. Nevertheless, agricultural credit has been improving, especially through specific government programs. Official resources for credit have been increasing and the interest rates and installments have been becoming more adequate for the small farmers.

Generally, agricultural production in the traditional sector is also characterized by disorderly and inefficient markets, which are very unstable. Relative prices for farm products vary widely and, in most cases, they are unfavorable for the farmer. There are many intermediaries in the marketing chain. Farm and institutional storage facilities are inadequate, limited, or nonexistent. There is a shortage of farm-to market roads, and in many places it is necessary to carry farm products on muleback.

Social conditions of the traditional rural sector are reflected on its general poverty, characterized by low levels of living, malnutrition, poor housing conditions, poor health conditions, low levels
of formal and informal education, and poor infrastructure. In addition, there are high rates of population growth, unemployment, and rural-urban migration. The social public services such as schools, health centers, communication facilities, protection for life and property, family health and life insurance, public utilities, and recreation facilities are poorly developed or nonexistent in many places. Farmers' participation in organized activities and local government decisions is also low.

Many efforts have been devoted by the government in order to improve the socio-economic conditions of the poor rural families, but not all of them have been successful. As a strategy for accelerating the development of the traditional sector, the government established the Integrated Rural Development Program – DRI – in 1975. The DRI program is based on the integration and coordination of the government's rural services. Its objective is oriented to improve the economic and social conditions of the rural population. The strategy of the DRI program consists of three groups of components and their factors. They are: 1) the agricultural production component, which includes agricultural research, agricultural extension, farm credit, marketing, and reforest; 2) the social component, which includes community organization, education, health, nutrition, housing, and drinking water; and 3) the infrastructure component, which includes roads and transportation facilities, rural electrification, and agroindustries.
Due to the interinstitutional character of the DRI program, each set of factors is under the responsibility of one or several government agencies. Their activities are oriented under the policy of coordination and integration of services at local, regional, and national levels. Farmers in DRI areas are supposed to benefit by all the DRI services and components.

The agricultural production component includes the activities related to technological development, and it is aimed to improve the economic situation of the rural families by increasing farm income through the improvement of agricultural production and productivity.

Some of the purposes of the DRI's production component are oriented to develop agricultural research for the traditional sector, to develop adequate means of transferring technology, to provide adequate farm credit, to improve marketing facilities, to increase basic food supplies, and to improve agricultural production and productivity.

The accomplishment of these objectives are under the responsibility of different agencies. The Colombian Agricultural Institute (ICA) is in charge of generating and transferring appropriate technology through agricultural research and extension. This agency is constantly in contact with the farmers through its extension program. The Agrarian Credit Bank (CAJA AGRARIA) is in charge of providing farm credit, and it is also a distributor of farm inputs and supplies. The Central Cooperative of Agrarian Reform (CECORA) and the Cooperative Financial Fund (FINANCIACOP) are in charge of developing
the marketing programs for the improvement of marketing systems and facilities.

The activities of the DRI program are carried out through DRI districts, which are composed of several municipalities and villages with similar socio-economic, technological, and environmental characteristics.

Many improvements have been obtained through the DRI program, but not all of its objectives have been reached successfully, as they had been stated by the government. Up to 1984, only five percent of the total rural families with farms less than 20 hectares had been benefited directly by the DRI's agricultural production component (131, p. 13). Some DRI districts are more developed than others, and some of them are older than others.

In some DRI areas agricultural productivity has increased while in some others it has remained the same or little improvement has been made. It is known that the development, influence, and impact of each one of the factors of the agricultural production component, especially technology, credit, and marketing, are not the same everywhere. They vary from one district to another, thus stimulating or limiting, to some extent, the agricultural production of a given district. It seems that those production factors are associated with adoption of technology and with crop yields.

Frequently, the failure in both the adoption of appropriate technology on the part of the farmers and the improvement of crop productivity has been associated with inadequate programs of diffusion
of technology or inadequate technical assistance, without taking into account the influence that some other factors, such as land tenure, availability of financial resources, agricultural inputs and supplies, and marketing facilities could have had.

It is sound to affirm that agricultural production and productivity can increase when the different factors of the agricultural production component are available to be used and applied efficiently by the farmers on their farms. Nevertheless, this condition is not always given in DRI areas. The availability of appropriate technology, the effectiveness in transferring this technology adequately, the availability of sufficient financial resources, the availability of adequate marketing systems and facilities, the farmers' interest and motivation to adopt technology, etc., are not always the same and they vary from one DRI district to another. In this case, agricultural productivity could be limited to the extent in which these factors are lacking.

This study was oriented to determine, according to the farmers' perception, those factors involved in the DRI's agricultural production component, that were associated with crop productivity and to identify some of their characteristics, as well as to determine and compare to what extent those factors were associated with the adoption of technology and increase of crop yields in DRI areas where the DRI services had been provided for different length of time. Furthermore, this study also intended to determine the levels of farmers' satisfaction in relation to those limiting factors.
General Purposes

The general purposes of this study were:

1. To determine the extent to which selected factors\(^1\) were limiting crop productivity in areas of integrated rural development as perceived by farmers, and to identify relevant characteristics of some of these factors.

2. To determine to what extent these selected factors were associated with adoption of agricultural technology and with increase of crop yields.

3. To determine the levels of farmers' satisfaction as related to some of the selected crop productivity limiting factors.

Specific Objectives

The specific objectives of this study were:

1. To determine the extent to which selected factors were limiting crop productivity at the farm level in areas of integrated rural development.

\(^1\)Most of the factors selected were those included in the DRI's agricultural production component (research, extension, credit, and marketing). In addition, farmland and "other factors" were also included in the list.
2. To determine the extent to which the DRI program was effectively transferring agricultural technology in areas of integrated rural development.

3. To determine the extent to which farmers had adopted recommended crop practices, and to determine some of the reasons why farmers had not adopted new technology in areas of integrated rural development.

4. To determine changes in crop production in areas of integrated rural development.

5. To determine some relevant characteristics of the DRI credit program and the DRI marketing program in areas of integrated rural development.

6. To determine the farmers' satisfaction levels in relation to the DRI technical assistance program, the DRI credit program, and the DRI marketing program.

7. To determine the extent of association between adoption of technology and a) effectiveness in transferring technology (technical assistance), b) difficulty in obtaining credit, and c) difficulty in marketing crop production.

8. To determine the extent of association between increase in crop yields and a) effectiveness in transferring technology, b) difficulty in obtaining credit, c) difficulty in marketing crop production, and d) adoption of technology.
Definition of Terms

Some terms used in this study may not be explicitly explained in the chapters where they appear. For the purposes of this study, the following terms and definitions were used:

Appropriate Technology: cultural practices that have been tested and adapted under local farming conditions, which have been proved as efficient in terms of crop productivity and profitability, and have met the farmers' needs and expectations.

Transfer of Technology: process whereby the DRI program communicates or disseminates and encourages the use of technological crop recommendations that have been proved as appropriate under local conditions in order to improve crop productivity. Transfer of technology, technical assistance, and extension are used as interchangeable terms.

Limiting Factor: technological, climatic, or related circumstance that affects or limits crop productivity. The crop productivity limiting factors involved in this study were research, extension, credit, marketing, farmland, and climate.

Crop Productivity: economic efficiency of a crop in terms of profitability - net profit. It is measured as the difference between the total income obtained from the sale of the crop production and the total expenses or total production costs.
**Crop Production:** amount of crop product obtained per area or per farm. It is also related to crop yields per hectare.

**Intermediaries:** merchants or traders who intervene between the farmers (producers) and the consumers in the marketing process. They, generally, offer unfavorable marketing conditions for the crop products obtained by the farmers.

**Satisfaction:** fulfillment of aspirations, needs, and wants or the accomplishment of goals and objectives of the farmers. In this study, reference is done to the farmers’ satisfaction in relation to technical assistance, credit, and marketing.
CHAPTER II
THEORETICAL FRAMEWORK

Review of Literature

The Concepts of Agricultural and Rural Development

Developing countries are known for their poverty in the rural sector. The majority of rural communities face many technological, economic, and social problems. It is well known that most of the developing regions in the world are predominantly agricultural.

The role of agriculture in the processes of economic and social development in these nations has received much attention by governments and international organizations during recent decades. It has been said that without progress in agriculture, development won't occur, and the "vicious circle of poverty and low productivity will be perpetuated" (6, p. xv).

In relation to the importance of agriculture, Gallis et al. (46, p. 476) point out:

Agriculture is the one sector that produces food. Man­kind can survive without steel or coal or even electric power, but not without food. For most manufactured products, in fact, there are substitutes, but there is no substitute for food. Either food must be produced within a country or it must be imported.
Sixteen years ago, Mosher (96, p. 7) said that agriculture was the only way to produce food on which human beings depend and that it was necessary to narrow the gap between the increasing population and the world's food supply. He also said: "This will require faster agricultural development in the next twenty years that almost any country has ever accomplished in the past." For this author, agricultural development is a social and economic accomplishment and a part of the general development of a country.

The concepts of "agricultural development" and "rural development" have been used interchangeably to denote different and sometimes conflicting approaches related to the rural sector. Before defining these concepts, it is necessary to analyze the concept of "development".

"Development" has been defined as a widely participatory process of social change in a society intended to bring about both social and material advancements for the majority of people through their gaining greater control over their environment (112, p. 121). Ellis (40, p. 11) states that "development" is the improvement of living conditions. Weitz (133, p. 58) defines "development" as "a continuous process of change which is manifested in all aspects of human life and social behavior". Todaro (129, p. 87, 580) contends that "development" is the process of improving the quality of all human lives, and that three equally important aspects of development are the following: "(a) raising people's living levels, i.e., their incomes and consumption levels of food, medical services, education,
etc., through 'relevant' economic growth processes; (b) creating conditions conducive to the growth of people's self-esteem through the establishment of social, political, and economic systems and institutions which promote human dignity and respect; and (c) increasing people's freedom to choose by enlarging the range of their choice variables, e.g., increasing varieties of consumer goods and services."

The above definitions involve, explicitly or implicitly, social and economic concepts. Thus, it can be said that "development" is concerned with the social and economic changes required to improve continuously the conditions of living of people.

Agriculture and rural are sometimes used as synonymous terms (126, p. 4). Nevertheless, some authors recognize that rural development contains agricultural development or, in other words, that agricultural development is required for rural development.

Aziz (7, p. 285) emphasizes the need to distinguish between the physical characteristics of agricultural development and the social dimensions of rural development. This author says that the task of increasing crop production through larger investment and improved technological packages could lead to agricultural development but not to rural development, because rural development has to start with people and not with physical elements such as land and water. Mao (85, p. 3) points out that agricultural development is viewed as a short-term transitional phase of economic growth rather than a way of life, and that nonquantitative properties such as social
stability, quality of life, well being, or even health are generally ignored.

According to Mosher (97, p. 12-36), the term "agricultural development" involves at least six related but individual concepts: agricultural expansion, increased production per acre, agricultural growth, rising value of agricultural products per farmer, rising income per person employed, and agricultural transformation. Barraclough (9, p. 51, 62) adds the concept of agricultural growth per capita to those given by Mosher.

It has been pointed out that the main objective of agricultural development is aimed usually at increasing agricultural output, while the principal purpose of rural development is aimed at improving the material and social welfare of the rural population (92, p. 31).

"Rural development" has been referred as a strategy designed to improve the economic and social life of the rural poor, including small-scale farmers, tenants, and the landless (134, p. 3; 19, p. 147). A more integrated concept of "rural development" has been defined by Lowdermilk and Laitos (83, p. 691) as "a continuous process of planned social, political, and economic change in rural and urban social structures and organizations which provides for adequate incentives, production possibilities, and services to help rural people achieve higher levels of living, knowledge, and skills. Rural development helps to modify their physical and social environments and maintain sustained progress toward desired goals which the rural poor helps establish and implement over time."
Summing up, rural development involves the improvement of both the economic and the social welfare of rural people. Agricultural development, in terms of economic growth by increasing farm production and productivity, is a prerequisite for rural development. Most of the time, rural people need to improve their economic situation to improve their social conditions.

The concepts of agricultural and rural development are useful to analyze the integrated rural development approach.

The Concept of Integrated Rural Development

The importance of the rural sector in developing countries began to be taken into account in the 1950s (127, p. 3). As a result, a community development movement expanded during that decade to Asia, Africa, and Latin America (53, p. 404). According to Hayami and Ruttan (53, p. 405), these community development programs were criticized for failing to improve the economic and social welfare of rural people. It seems that little importance was given to agriculture in the traditional rural sector.

Agricultural development became one of the major concerns to most developing countries during the 1960s and 1970s and each one of these nations attempted to devise strategies which could be useful in improving its social and economic rural conditions (104, p. 213). In 1961, the Latin American Presidents, meeting in Punta del Este, Uruguay, signed an agreement in which they agreed to take special
actions on various fronts to accelerate economic and social development in their countries. Agriculture was one of the fields that deserved special mention. It was stated:

We will modernize the living conditions of our rural population, raise agricultural productivity in general, and increase food production for the benefit of both Latin America and the rest of the world. The living conditions of the rural workers and farmers of Latin America will be transformed to guarantee their full participation in economic and social progress. For that purpose, integrated programs of modernization, land settlement, and agrarian reform will be carried out as the countries so require. Similarly, productivity will be improved and agricultural production diversified. Furthermore, recognizing that the Continent's capacity for food production entails a dual responsibility a special effort will be made to produce sufficient food for the growing needs of their own peoples and to contribute toward feeding the peoples of other regions (4, p. 9, 10).

During the decade of 1960 some production-oriented programs such as the "green revolution" were established in different countries around the world. Agriculture reached some degree of modernization in various developing countries, but in the majority of them it still remained traditional, characterized by low levels of productivity. It seemed that the objectives of these production programs were not accomplished as they were stated, and not every rural family equally benefited.

In 1971 a symposium on Agricultural Institutions for Integrated Rural Development was convoked in Rome by the FAO in order to analyze new strategies to improve the economic and social development of
rural regions. On that occasion, it was recognized that rural development depends on the interaction of several interrelated activities and that an integrated program could contribute to the improvement of agricultural production and rural welfare (118, p. 394). This approach rose, in part, as a reaction to some of the dissapointments of the green revolution and other production-oriented programs carried out during the 1960s (117, p. 9; 127, p. 20).

The rationale for "integrated rural development" as stated by FAO (41, p. 4) is that "this represents a coordinated - or even simultaneous - series of measures on several fronts to tackle the multiple constraints to improving farm livelihood."

According to Jedlicka (70, p. 108), an efficient integrated rural development strategy must involve both a vertical and a horizontal linkage relationship among all of the change agencies and other support groups involved in a given country to overcome rural problems. This approach is related to that of Howell (59, p. 5) who points out that the implementation of rural development programs must be the responsibility of different ministries and government agencies including agricultural production, agricultural trade and credit, rural infrastructure, rural public services, and rural industry and employment.

The Rehovot approach to integrated rural development as stated by Weitz (133, p. 11) is based on a defined strategy and a planning methodology of determining activities and the sequence of implementation in order to accomplish development goals; execution (implementa-
tion) varies from place to place according to the socio-economic characteristics and conditions of each region. This approach is also based on the assumptions that agricultural growth is the key to rural development, that the development of the secondary and tertiary sectors is required for agricultural development, and that social forces are indispensable in agricultural development.

Based on their experiences derived from Colombian cases, Londoño and Rochin (81, p. 273) consider "integrated rural development" as "the process by which the effort of various (multisectorial) government agencies are integrated with those of the rural people themselves so as to realize both agricultural development and improvement in such other areas as health, education, and social justice."

The Bangladesh Academy for Rural Development at Comilla was considered as the pioneer of the integrated rural development programs (118, p. 395). This program was successful in relation to diffusion of more productive agricultural technology, mobilization of local resources for village improvement, and the development of cooperative institutions. The cooperatives were in charge of providing credit, transferring technical information, developing infrastructure facilities such as roads, and irrigation and drainage projects (53, p. 408).

During the 1970s many integrated rural development programs were established in various developing countries such as the Philippines, Ethiopia, Afghanistan, Nigeria, Tanzania, Malawi, Kenya, Nicaragua, Mexico, Perú, Colombia, etc. (53, p. 407).
In 1975, the Integrated Rural Development Program - DRI - was established in Colombia as a strategy for accelerating the development of the traditional rural sector. This program was based on the integration and coordination of the government's rural services and attempts to overcome farmers' economic problems through agricultural production programs, and to improve social conditions in relation to health, education, nutrition, community organization, infrastructure, etc. Currently, there are 31 districts in different regions of the country where the DRI program is being carried out.

Evaluations conducted by the National Planning Department (DNP) (Departamento Nacional de Planeación) (33, p. 2-48; 34, p. 2, 3), the government agency in charge of coordinating the different activities of the DRI program, have shown that this program has been successful in some districts and has failed in others.

The degree of success or failure has depended on social, economic, technological, structural, institutional, and environmental factors, but the extent to which these factors affect the means and goals of the program are not well known, hence this research project.

Factors Associated with Agricultural and Rural Development

As it was stated, rural development depends, in part, on agricultural development, which in turn, depends, to a great extent, on agricultural change. Agriculture does not change by itself. It
requires a complex, interrelated set of factors (systems, elements, services, ingredients, components, activities, variables, etc.) which facilitate or limit change.

Social, economic, technological, environmental, and institutional factors can influence positively or negatively the processes of agricultural and rural development. It depends on the extent to which those factors are present or lacking in particular situations, as well as on their characteristics and performance. The extent of influence can also vary from place to place according to the conditions or characteristics of the environment, the community, the farm, the family, or the farmer.

There are many descriptive, analytical, and empirical studies carried out in different developing countries on factors associated with agricultural and rural development.

According to Mosher (96, p. 47, 91), the development of agriculture cannot be accomplished by farmers acting alone; it cannot develop beyond simple farming without suitable improvements in other parts of the life of a country within which agriculture exists. This author classifies the elements or factors of agricultural development as essentials and accelerators. The essential factors are: markets for farm products, a continually changing technology, local sources of supplies and equipment, production incentives for farmers, and transportation. The accelerators are: education for development, production credit, group action by farmers, improving and enlarging agricultural land, and national planning for agricultural development.
This author points out that the essential elements "must be provided for farmers if agriculture is to develop. Without any of them there can be no agricultural development", and that the accelerators are important, but "there can be agricultural development without one or more of them."

Moris (94, p. 35) classifies the components or essential ingredients for agricultural development in three different groups: 1) those ingredients that are the base for agricultural production in any farming system either traditional or modern such as resources (land, water, and climate), crops (suitable varieties, required technology, and control of pests and diseases), and labor (farm labor force); 2) those additional components which depend on an established communication network responding to market forces such as demand (marketing surplus on-farm and off-farm demand and exchange), transport (transportation facilities, intermediary storage and marketing systems); and 3) other additional ingredients which transform farming into a kind of rural industry involving changing technology and specialized production such as research (development of new varieties, technologies, and recommendations), extension (diffusion of innovations and training by transferring skills and management), inputs (production and supply of inputs and specialized supporting services), finance (crop purchasing organization, and credit), and incentives (reduction in levels of risk, profitability of crops, and social and administrative incentives).
The World Bank (135, p. 6, 72) points out that the constraints of agricultural growth in developing countries are found in the environment in which farmers operate, in the technology available to them, in the incentives for production and investment, in the availability and price of farm inputs, and in the provision of irrigation and other appropriate infrastructure. The World Bank says that land improvements, new farming methods, and more research are necessary requirements for agricultural development and that, however, these factors are not sufficient conditions for its attainment by themselves, the reasons being that it requires some other complementary but important services such as infrastructure, extension, marketing, credit, and rural public works.

Studies analyzed by Castillo (3, p. 19), related to the impact of high-yielding varieties of rice in changing the socio-economic conditions of certain rural areas in Philippines, showed that the principal factors required to increase agricultural production were technology (improved varieties, fertilizers, and irrigation), extension (transfer of technology), credit (provision of financial resources), and marketing and related services (milling, storage, and transportation).

Donald (37, p. 17), analyzing the characteristics of credit in the process of development of the rural sector in several developing countries, concluded that besides credit, other elements such as availability of new technology, inputs, and favorable product markets are indispensable for small farmer development. Long (82, p. 27) has
a similar perception, based on his studies in developing regions; he states that "for the success of a credit program more than money is needed. There must be a new technology, markets that can supply additional inputs and absorb additional outputs, institutions willing to lend to small farmers on terms the farmers consider attractive, and, perhaps, more important farmers willing to borrow, to invest and repay loans."

From a comparative evaluation of 17 rural development projects from East and West Africa, Lele (77, p. 287) concluded that lack of profitable technology, ineffective extension, and inadequate technology (i.e., fertilizers) are common constraints to improve productivity in all subsistence agriculture. This author suggests the following to insure an efficient agricultural development process in those countries: "... in the first phase provision of technology, extension, inputs, manpower training, and a feeder road network ... Credit may become the major thrust of the program. Marketing services may also fall in the category of facilitative development at an early stage. The initial emphasis may be on providing intermediate forms of intervention and on improving the bargaining position of the farmer ... through construction of public facilities for seasonal storage, improvement of roads, provision of farmer information, and standardization of weights and measures."

Based on experiences in East and West Africa, Asia, and Latin America, Abbot (1, p. 153) concludes that for a successful agricultural development program an efficient extension program is required
to disseminate appropriate technology, credit facilities must be available, and ready access to a marketing system is imperative.

In studies carried out in Kenya, Malaysia, Indonesia, Nigeria, and South Korea, it was found that increased agricultural productivity requires the provision of adequate services, principally research to generate technology appropriate for small farmers, extension, credit, and appropriate pricing and marketing policies, as well as the provision of incentives to motivate farmers to act (22, p. 349).

Other studies mentioned by Castillo (18, p. 312) and conducted by the Rice and Corn Study Committee indicate that the low production and productivity in rice and corn in some areas of Philippines was due to inefficient transfer of technical information to the farmers; inadequate financial resources and lack of credit supervision; lack of and high cost of agricultural inputs and equipment, as well as lack of irrigation water; inefficient organization of farmers, millers, and retailers; disincentives to farmers due to inappropriate pricing and monetary policies, inefficient marketing systems, warehousing, and milling; lack of coordination among the agencies involved in the production process; inappropriate implementation of land reform; lack of civic consciousness and national discipline; and disastrous effects of hurricanes.

Some experiences in Colombia have demonstrated that the participation of rural people when they are motivated to change is indispensable in rural development programs, and that an effective integration and coordination of the different government rural services
(research, technical assistance, credit, marketing, agrarian reform, natural resource conservation, health, nutrition, housing, education, infrastructure, etc.) are the primary requirements to improve the material and social welfare of the rural families (51, p. 230). Johnston (71, p. 297) asserts that research, extension, credit, marketing, land reform, farmers' education and organization, and other economic and social factors are substrategies which must be appropriately complemented and implemented under a general integrated strategy in designing effective development programs.

The above mentioned authors coincide in most of their appreciations about the factors, components, or ingredients that are associated with agricultural and rural development. Those factors could be grouped in two big groups, economic and technological factors and social factors. The most important economic and technological factors are: agricultural research to generate appropriate technology, extension to transfer that technology and to provide technical assistance, credit to encourage the use of recommended technology, marketing to facilitate the allocation of farm surplus, provision of agricultural inputs and transportation, and availability of appropriate farmland. The principal social factors are: health, education, nutrition, housing, farmers' organization, public infrastructure, and other public services. It also is necessary to take into account the environmental and institutional factors. This study deals only with those factors included in the DRI's agricultural production component; i.e. agricultural research, agricultural extension, farm
credit, and marketing. Land tenancy has been listed as not being an important limitation for agricultural development in the DRI areas in Colombia since the majority of the DRI users are owners of their farms. Nevertheless, some references will be made in relation to the role of the land in agricultural development.

Some of the most important aspects to take into account in any agricultural or rural development program are effective integration and coordination among the different intervening factors, and the motivation of farmers to insure their participation in pursuing common objectives; i.e. in obtaining improvements in their economic and social conditions.

**Agricultural Technology**

Experiences in developed countries have demonstrated that modernization in agricultural technology has been a prerequisite in accomplishing high levels of agricultural and rural development (108, p. 93).

It has also been recognized that agricultural technology is one of the most important variables in any strategy of development in developing countries (87, p. 29; 17, p. 226), and that the level of production technology is an outstanding factor influencing the economic outcomes of any agricultural or rural development program (133, p. 19). New technology is an absolutely vital component in any strategy aimed to improve agricultural production and productivity.
Research in developing countries has often failed by generating or promoting technologies not suitable for the traditional agricultural sector (70, p. 9). Tinnermeier (128, p. 38) states that too often research in these countries generates new technologies for medium and large-sized farms in experiment stations, many of which are located on the best land, with good availability of resources, under conditions different to those where most of the small farmers are living. Chambers and Ghildyal (20, p. 5), analyzing the characteristics of agricultural research for small farmers, state:

In most agricultural sciences, the centers in which research is conducted are experimental stations, glasshouses and laboratories, supported by back-up services, with provision for controlled conditions, with excellent access to inputs, without significant cost or labor constraints, and without the requirements that a crop must be marketed and make a profit. Scientists in experimental stations, glasshouses and laboratories generate or test, new technologies and then pass them over the extension services to transmit to farmers.

Experiences in Tanzania, the Cameroons, and Kenya have demonstrated that inadequate adaptative research has been a major constraint in improving agricultural productivity and incomes of small farmers (77, p. 287). In 1982, the World Bank (135, p. 91) contended that the lack of technological improvements suitable for African conditions was a "main reason for Africa's poor performance so far", and suggested the need to conduct research to generate agricultural technologies that can be adapted to local conditions of small farms.
It has been recognized that in most traditional agricultural areas in developing countries many new technologies have not been tested and adapted under conditions similar to those faced by the farmers, or if adapted, such technologies still may be unprofitable (128, p. 38).

Based on a study carried out in Colombia to define the relevant constraints for research resource allocation, Sanders and Lynan (119, p. 273) concluded that "less emphasis should be put on testing for wide adaptation of new varieties and more emphasis on better qualifications of potential research benefits through networking in the target area. Data collection efforts should be focused more towards the research problem of priority definition." In relation to the low use of improved seeds in the traditional rural sector in Colombia, Sin Clavijo (125, p. 10, 15) states that the new crop varieties generated by research have not benefited small farmers because those materials were, possibly, not adapted to the conditions, the production systems, and the resources of that type of farmer. He adds that it seems that there is not a defined research policy oriented toward the traditional subsector which meets the needs and expectations of small farmers. In another study conducted in the South of Tolima DRI district, Colombia, some farmers reported that they did not use improved varieties of corn because the yields were lower than those of traditional varieties, the production costs were higher since they required more fertilizers and weed control practices, the
seed was more expensive and more difficult to obtain, and because of increased risk (56, p. 62).

The importance of adaptative research cannot be overstated (77, p. 287). "There is no such thing as an universally best technology for agriculture." (46, p. 491). New technology must be tested and adapted from area to area, taking into account the soil and climatic conditions, and according to the economic and social characteristics of the farmers.

Research for the traditional rural sector in developing countries must be oriented to generate profitable technological packages directly on the farmers' holdings. Tinnermeier (128, p. 38) contends that research must be aimed toward the production of those output-increasing or cost-saving technologies appropriate for small farmers, and that any new agricultural recommendation must be finally tested to determine its economic performance for the farmer on his own. Based on a study conducted in Philippines in relation to on-farm research, Potts et al. (109, p. 40) state that "even in areas already achieving average yields, there may be groups of farmers for whom alternative technologies would be beneficial. These technologies may not necessarily involve an increase in agronomic yield, but can still result in improved monetary returns. Such technologies appear most likely to be accepted." It has been recommended that for a higher level of adoption, new technologies must be properly tested in terms of profitability according to the farmers' needs
Experiences in a rural development program in Caqueza, Colombia, point out that the formulation of agricultural technological packages meeting the farmer's needs is "a far more demanding task than scientifically trained agronomists at first assume." (139).

Dissatisfaction with the accomplishments of research for the traditional rural sector has been evident in developing countries. This situation has led to the development of more appropriate research methodologies and strategies which could be more likely to meet the needs of the small farmers. One of these strategies has been called farming systems research (FSR) (100, p. 813; 48).

Farming systems research has become a major issue in international circles. According to Garrett (47, p. 580), the Consultive Group of International Agricultural Research (CGIAR) stated the objective of this approach as "the improvement of human welfare through sustainable increased agricultural productivity." This author says that FSR helps orient agronomic research by improving problem identification, designing new and/or improved production systems, conducting and evaluating on-farm research, and assessing the impact of recommended technologies for the traditional rural sector.

Farming systems research is a term used to cover the activities of interdisciplinary programs carried out directly on the farmers' fields to generate appropriate technologies to overcome agricultural production problems (12, p. 133). FSR has evolved to strengthen
linkages between farmers and researchers and to emphasize agricultural research under the different physical, economic, and sociocultural conditions of the rural people (72, p. 82).

According to Byerlee et al. (16, p. 897), the objectives of research with a farming systems perspective range from increasing the knowledge about farming systems to solving specific problems in the farming system. These authors state that the aim of FSR is to increase farm productivity by generating new technologies appropriate for the farmers and that "this research is often further divided into location-specific research with a short-run objective of developing improved technologies for a target group of farmers and research conducted with a long time perspective to overcome major widespread constraints in farming systems." This situation is referred as "downstream" and "upstream" (48).

Hildebrand (58, p. 905) contends that FSR should be more than a part of a dynamic research system, that it must be a part of a complete technological system, and that research and extension must merge to ensure effectiveness in agricultural production and productivity. Some authors (58, p. 905; 72, p. 81) agree that FSR is not an appropriate name for this approach and that it must be called farming systems research and extension.

It has been stated that an efficient research and extension system is crucial to agricultural development, and that farming systems research without extension is an incomplete process (72, p. 81, 85). Biggs (11, p. 5) says that "FSR is an applied problem-
solving approach to technology generation and diffusion... FSR is frequently seen as the critical research component which facilitates the linkages and flows of information between farmers, researchers on experiment stations and extension staff."

The following are some of the common features that characterize a farming systems research and extension process, as perceived by Biggs (11, p. 2): 1) all activities of the farmer are analyzed in an holistic farming systems framework; 2) relatively homogeneous groups of farmers are identified as the clients of research and extension in specific agro-climatic zones; 3) it is an interdisciplinary approach, involving social scientists and natural scientists; 4) it is mainly concerned with 'downstream' (applied) research issues and with ways of ensuring effective linkages to influence 'upstream' (basic) research activities; 5) it involves farmer participation; 6) it involves on-farm trials, surveys (socioeconomic and technical), and different diffusion methods; and 7) it is a dynamic 'learning by doing' approach.

Many failures of former agricultural development programs have been evident in Colombia due, in part, to inadequate methodologies to generate and adapt technologies suitable for the traditional rural sector. Extension programs attempted to transfer research findings obtained in experiment stations to farmers without previous adaptation to their local environmental, social, and economic conditions. There was a lack of defined research policies oriented to solve the immediate agricultural problems faced by the traditional rural communities.
Only, in the last decade, some attempts have been made to overcome this situation, especially through the DRI program. Nevertheless, as it was already stated, this program covers only five percent of the small rural families. The farming systems research and extension approach has been applied to generate and transfer technology to these families. It has been recognized that the DRI program has been successful in some regions and has failed in others in its attempt to generate appropriate agricultural technologies for the traditional rural sector.

**Appropriate Technology**

It seems that there is no consensus in relation to the meaning attached to the concept of appropriate technology. It means many things to many people and everybody perceives this concept in a different way.

De Forest (28, p. 11) points out that appropriate technology has not in itself an intrinsic meaning as a concept and that it can only be understood in relation to specific social, economic, and cultural referents.

Jedlicka (70, p. 10), talking about the organization for rural development, states that an appropriate technology is one that effectively utilizes the manpower, resources, and environmental and institutional realities in a given country. According to the Ministry of Overseas Development, HMSO, London, as referred to by Milles
(87, p. 2), a technology is appropriate when it maximizes the use of those factors which are locally plentiful and minimizes the use of those which are locally scarce. For McDivitt and Ntim (86, p. 157), appropriate technology is that which fits best with the life style of the people who use it, taking into account their economic, physical, and cultural environments, and regardless of its traditional, adapted or imported origin.

Hildebrand (57, p. 375), analyzing the change process, contends that the reason for the resistance, on the part of many small farmers, to adopt or to change is not one of motivation but rather one of lacking available technology which is appropriate for their needs. This author considers that appropriate technology is that which is acceptable to target farmers and can be put into practice immediately under their agro-socioeconomic conditions.

For the purposes of this study, appropriate technology is referred to the cultural practices that have been tested and adapted under local farming conditions, which have been proved as efficient in terms of crop productivity and profitability, and have met the farmers' needs and expectations. An appropriate agricultural technology can be either a traditional technology (developed by farmers at the local level) or a new technology. Traditional technologies and new technologies or innovations can be considered as appropriate only if they satisfy the particular needs and expectations of farmers.
In relation to farming, it has been said that traditional technology is "the particular way the inputs of land, labor, seed, hand implements, oxen, organic fertilizer, and water have been combined and used in a particular area over a considerable period of time" (128, p. 36). The principal characteristic of traditional technology is that it changes very slowly (46, p. 489).

"New technology" has been defined as "a set of inputs or factors of production which are different from a traditional set - that is, at least one factor has been added, dropped, or changed in some way" (46, p. 36).

Rogers (112, p. 11) says that an innovation is "an idea, practice, or object that is perceived as new by an individual or other unit of adoption", and that "the perceived newness of the idea for the individual determines his or her reaction to it." Tinnermeier (128, p. 36) points out that adoption of a new technology or innovation does not imply that new practices are necessarily the result of recent scientific discoveries, and that the word "new" means only that the practices in question have not previously been used by the farmers in a given area.

Appropriate technology, therefore, is an inherent component of agricultural and rural development. For a new technology to be effective it must be transferred to farmers to be applied to improve agricultural productivity, and it must work properly under the farmer's conditions. That is appropriate technology.
Transfer of Technology

The success of any agricultural development program depends to a large extent on effectiveness in disseminating and introducing appropriate technology among the farmers so that their farm productivity and incomes are improved. It seems that some agricultural projects in developing countries have not had a significant impact on crop production and productivity because technology has not been properly transferred. In Colombia, for instance, former extension programs and other agricultural development projects were not successful enough in attaining their objectives due, in part, to inadequate methodologies of technology transfer or inadequate dissemination of agricultural information.

Different meanings have been given to the concept of transfer of technology. There are many definitions about this term involving controversial points of view or approaches.

Rogers (111) considers that technology transfer is the process in which an innovation generated in one system is adopted for use in another system. According to Reichart (110) the transfer of agricultural technology as a system is a group of elements which applied in an orderly manner contribute to improved production in an agricultural production system. Jedlicka (70, p. 12) points out that transfer of technology is a component within the innovation diffusion
process and that transfer occurs when the innovation or technology is adopted.

Diffusion has been defined by Rogers (112, p. 5) as "the process by which an innovation is communicated through certain channels over time among the members of a social system." He adds that it is a type of communication of new ideas or innovations. This author defines communication as "a process in which participants create and share information with one another in order to reach a mutual understanding." According to Brown (14, p. 1) diffusion is the process by which innovations (a new product, technology, idea, or practice) spread from one locale or one social group to another.

For the Colombian Agricultural Institute (ICA) (65, p. 3), one of the government agencies in charge of transferring agricultural technology to DRI farmers, the transfer of technology is a process involving not only the diffusion but also the adoption of technical recommendations. In this case, the adoption of technology would depend on the feasibility of increasing farm productivity and on other factors as considered by farmers.

For the purposes of this study, the transfer of technology is considered as the process whereby the DRI program communicates or disseminates and encourages farmers to use technological crop recommendations that have been proved as appropriate under local conditions in order to improve crop productivity. Transfer of technology, technical assistance, and extension are used as interchangeable terms, therefore.
It has been said that "if one key to rapid progress in rural areas depends on the introduction of new inputs and new techniques, it follows that some of the most important rural institutions are those responsible for speeding the transfer of these new techniques to the farmers" (46, p. 502). In fact, technology does not move from research sources to farmers unless there is a means or vehicle to do that (72, p. 85). Extension has been considered as one of the most effective means to link research and farmers.

According to Tinnermeier (128, p. 42), extension is an educational program in charge of disseminating new technologies among farmers. This author says that an effective extension program would be one which significantly increases the adoption of new technology as compared with the level of adoption which would take place if it does not exist.

From his studies on agricultural development in developing countries, Mollett (92, p. 328) concludes that agricultural extension has a key role in transferring new technologies among farmers and that the essential ingredients for the success of extension services are not always given, and sometimes the ability to transfer attractive technological packages fails. It has been pointed out that the effectiveness of transferring technology in developing countries does not depend entirely on the abilities and capabilities of the extension agents but also in the role of an extensive number of intervening variables such as political commitment, development of institutional
resources, development of effective research, and availability of required financial support (70, p. 31).

From the extensive review of literature conducted by Rogers (112), it can be concluded that there are many factors influencing the diffusion or transfer of innovations or agricultural technologies, and that they vary among regions, communities, and individuals. The effectiveness in transferring technology can depend, among others, on the following factors: the characteristic of the technology or message itself; the capabilities of the extension agent or communicator; the means and channels used to transfer the information; the social, economic, technical, and cultural characteristics of the farmers; the environmental conditions of the setting where the transfer of technology occurs; the organization and other characteristics of the social system in charge of transferring technology, etc.

The means and channels of communication through which farmers receive agricultural information are varied and their effectiveness depends on many factors. The applicability of communication methods differs from people to people and from region to region. An analysis conducted by Arévalo and Alba (5, p. 80) in relation to the research on agricultural communication in Colombia shows that the most effective method to transfer technology among farmers in the rural setting was interpersonal communication between change agents and farmers, especially through farm visits, followed by different types of group meetings, and demonstrations conducted by opinion leaders. Secondary importance was assigned to the radio and newspapers.
Studies undertaken to evaluate the effectiveness of the DRI program indicate that the most effective means to transfer technology in DRI areas, Phase I, were result and method demonstrations, farmers' tours, research demonstration plots, group meetings, and field days (33, p. 45). As a consequence, it has been demonstrated that effectiveness in transferring agricultural technology plays an important role in the adoption process.

Adoption of Technology

Most of the traditional rural regions in developing countries face low agricultural productivity. Agricultural technology has been considered as a prerequisite to promote agricultural development in these nations. It may not be the sole requisite, but it is at least one of the most critical. In fact, the impact of agricultural technology depends on a network of relationships with other technological, economic, social, environmental, and structural factors.

Leagans (76) contends that the pay-off in agricultural development comes only when farmers act on new knowledge, not when they merely have been exposed to it, and that transferring technology is a relatively easy task, but getting people to understand, accept, and adopt it is a difficult one.

Adoption of new agricultural technology has been considered as an important field of study not only in developed but also in developing countries. A large amount of descriptive, analytical, and empirical literature has evolved. Most of the studies have
demonstrated that the adoption patterns are not always the same everywhere and that they can change due to many factors. Just and Zilberman (74, p. 435) state that the interaction among the various factors (social, economic, technological, cultural, institutional, and environmental) vary from place to place, presenting different adoption behavioral patterns. It could explain why, sometimes, studies about adoption of agricultural technology, conducted in different regions or countries, generate conflicting conclusions in relation to the same variables under study.

Based on theoretical and empirical studies analyzed by Rogers (111) and by Lionberger and Gwin (79) it can be concluded that the following factors are associated with diffusion and adoption of agricultural innovations:

- Personal characteristics of the farmers: social status, social participation, values, attitude toward change, degree of innovativeness, literacy and levels of formal and informal education, levels of homophily and heterophily, fatalism, cosmopolitiness, age, health, occupation;
- Economic factors: availability of economic resources, attitude toward credit, attitude toward economic rewards, uncertainty and risk, land tenure status, etc.;
- Situational factors: size of farm, soil quality, water supply, climatic conditions, labor supply, government policies, farm inputs, storage and transportation facilities, availability of extension education programs, marketing facilities, price policies;
- Communication behavior: exposure to mass media and interpersonal channels of communication, appropriate use of communication methods, characteristics of the change agent contact;
- Relationships between the characteristics of the agricultural innovation and the needs and problems of farmers; and
- Needs and desires of the farmers.

Díaz Bordenave (36, p. 151), in his study on communication of agricultural innovations in Latin American countries, points out that the adoption of a new technology is a decision of the farmer based on four ingredients: willingness to do things, knowledge of what to do, knowledge of how to do, and availability of the means to do.

Studies conducted in developing countries have demonstrated that the introduction and acceptance of many new agricultural technologies have been partially successful as measured by observed rates or adoption (44, p. 255). In fact, new technology by itself is not a sufficient motivation and cause of success.

Experiences in some agricultural development programs carried out in Nicaragua and Indonesia show that new agricultural technology was not completely adopted by farmers because of constraints in land tenure, marketing policies, lack of credit, and due to its low profitability (37, p. 40). Based on some Colombian study cases, Isaza (69, p. 37) concludes that agricultural technologies are adopted if they are economically attractive, and if financial resources are available for the farmers. Hernández (55, p. 82) found in the Northwest of Quindío, Colombia, that the adoption of crop technology
was related to the incomes of the farmers, the size of their farms, and the availability of marketing facilities. Information from several developing countries shows that farm ownership, size of farm, education, income, and social participation of the farmers are positively associated with readiness to adopt new agricultural technology (102, p. 43).

Perrin and Winkelman (106, p. 893), analyzing the adoption behavior of small and large farmers based on studies undertaken by CIMMIT, concluded that the extent of differences in adoption is due to differences in information, in the availability of farm inputs, in marketing opportunities, and in differences in farm size and farmer risk aversion. The differential adoption rates in some agricultural development programs in Bangladesh, India, and Pakistan were due to farm size and credit constraints; in regions with high concentrations of small farms and where credit was limited, small farmers were not able to adopt all the cultural practices required to grow high-yielding crop varieties (43, p. 59).

An evaluation of some DRI districts in Colombia showed that the low level of adoption of recommended cultural practices was due to lack of adequate technical assistance, high levels of rural-urban migration, lack of enough training of some extension agents, inappropriate technology in some instances, high economic risk, and farmers uncertainty (33, p. 29).

Labor availability is often mentioned as a factor affecting adoption of agricultural technology. Feder, et al. (44, p. 277), in
a survey about the patterns of adoption of agricultural innovations based on information from Taiwan, Gambia, Philippines, and Sierra Leone, found that frequently, shortage of labor supply is related to adoption of crop technology, and that adoption is less attractive for farmers with limited family labor or for those operating in areas of difficult access to labor markets. The authors point out that uncertainty in relation to availability of labor in peak seasons can explain adoption of new labor-saving technologies.

Level of education is one of the variables often analyzed in studies about the adoption of innovations. Results from several empirical studies in developing countries show that farmers with better education are earlier adopters of new technologies (44, p. 276). In a survey based on information from 18 developing countries it was found that the effect of education was much more likely to be positive in modern agriculture than in the traditional setting (80, p. 37).

In a study conducted in Thailand, Pontius (108, p. 93) determined that the major barrier to rapid adoption was the farmers' inadequate access to information about the crop technologies being recommended.

The adoption of an agricultural innovation depends, in part, on the characteristics of the innovation itself; these characteristics are: relative advantage, compatibility, complexity, triability, and observability (112, p. 15).
Other factors that have been widely analyzed in adoption studies are related to resistance of farmers to change. Resistance has been defined as "any conduct that serves to maintain the status quo in the face of pressure to alter the status quo" (137, p. 63).

Rohrer (113, p. 300), in a study on conflict between modern and traditional technologies concluded that the resistance of farmers can be associated with the social gap between them and the change agent, and that this resistance could indicate that development projects or technologies are sometimes irrelevant or of little interest for farmers. This author states:

Traditional farm families do not summarily resist new ideas. They have adopted radios, consumer goods, wage work, and health practices because clear benefits existed or because the new methods were necessary, inexpensive, subsidized, or convenient. But in farming they strongly prefer using low-risk, low cost methods validated by generations of local use.

Zaltman and Duncan (137, p. 67) classify resistance to change in four different types: cultural, social, psychological, and organizational barriers to change. These authors also mentioned certain facilitative strategies to overcome resistance and to make easier the implementation of change, assuming that a target group recognizes a problem, agrees with the need for change and can be open to external assistance (137, p. 90).

Resistance to change depends on the attitudes, values, and behavioral patterns of the farmers. It has been stated that obtaining adoption of new ideas in audiences which are resistant to change is
slow and requires a great deal of effort and additional cost (23, p. 22).

In a study conducted in Colombia, Isaza (68, p. 116) found that, based on characteristics of the farmers in East of Antioquia, adoption of agricultural technology was associated with the availability of financial resources, farmland, and technical assistance, and that traditionalism of the farmers was not a major constraint in agricultural production. Castillo (18, p. 118), analyzing the characteristics of some groups of farmers in Philippines in relation to the adoption of crop practices, points out: "resistance to change per se is not likely to be the bottleneck in increasing productivity. The constraints seem to be lack of infrastructure, facilities and services."

There are evidences showing that the apparent resistance of farmers to adopt can be overcome when the reasons for their behavior are understood (121, p. 384; 133, p. 32). Weitz (133, p. 32) states: "Occasionally, the reason for the peasant's indifference is less tangible and more difficult to comprehend, and only careful studies will disclose its nature. The task is to uncover the reasons for the peasant's attitude and to show how his aspirations can be directed towards the achievement of desired development goals."

According to Galjart (45, p. 31), certain characteristics of the farmers can explain why they do not always have a positive attitude to change. These are the following: 1) ignorance – the farmers do not know what they can do other than what they are currently doing;
2) inability - the farmers know what they could do but are unable to
do that for financial or other reasons; and 3) unwillingness - the
farmers know what they should do and can do, but they do not want to.

Risk and uncertainty have been other factors considered as
important in limiting adoption of agricultural technologies. Bohlen
and Beal (13, p. 9) say: "As a farmer faces decision making and
carrying out decisions, he is confronted with risk and uncertainty."

Agriculture has been considered as an uncertain and continuously
risky enterprise; its efficiency, structure, and performance may be
influenced by agricultural decision makers' responses to risk (73, p.
1107). Evidences show that new modern technology is an important,
risky and uncertain factor in farming (13, p. 11). Thus, it is argued
that smaller farmers are less motivated to adopt new agricultural
technologies provided that they are more risk averse (43, p. 59).

Uncertainty is a pervasive phenomenon in agricultural production
(52, 1071). According to Roumasset (115, p. 48), uncertainty refers
to the state of mind of a decision maker who perceives more than one
possible consequence of a particular act. This author says that risk
is likewise a property of uncertainty. Risk refers to a situation in
which the probability of obtaining some outcome of an event is not
precisely known (129, p. 605).

Risk and uncertainty have been considered as critical limita-
tions in the process of agricultural production (37, p. 40; 42,
p. 100; 78, p. 680). In relation to this approach Donal (37, p. 40)
states:
Researchers are recognizing more and more that risk is a significant factor in small farmers' decision making. Even the most illiterate farmers place probabilities on the outcomes of their farming decisions. Since they cannot accept conditions which might jeopardize their family's survival, their economic decisions attempt to reduce risk and to increase security. The added risk associated with new technologies can significantly affect the extent to which they are adopted ... In sum, it should be obvious that the adoption of new technology and its profitability are significantly affected by the associated risk. Small farmers are frequently regarded as ignorant, stupid, or too 'traditional' when they reject the innovations proposed to them, but from their own standpoint they may be quite rational in their responses. The dominant failure in much developmental work related to technological innovations has been the lack of understanding of the relationship between the expected variances of the old and new techniques with the level of living of the intended clientele.

According to Moscardi (95, p. 39), socio-economic and structural characteristics are important variables explaining the risk-bearing capacity of farmers. Small farmers are risk aversive due to their proximity to subsistence levels of living; modern techniques are more profitable on the average than traditional ones, but they are riskier as well; this situation frequently induces small farmers to use less than the amount of crop inputs recommended for the new technology (115, p. 55). This kind of practice is often counterproductive; if the technology is adopted only partially productivity can be affected negatively.

In a study conducted in Cáqueza, a rural development project in Colombia, it was found that risk was one of the most critical limitations to the adoption of new corn technology. Three kinds of risks were determined: 1) production risk, which included the
variations in yield, depending on causes not controlled by the farmers, such as differences in quality of soils and climatic variations during the growing period; 2) marketing risk, which involved the presence or lack of a market, changes in price, and changes in demand; and 3) institutional risk, related to the presence or absence of seed, fertilizer, and other material inputs at the proper time, and the timely availability of credit, transportation, and technical assistance (140, p. 154).

Experience has shown that farmers adopt new agricultural technology only when they prove to themselves that the techniques are not very risky (130, p. 70).

Since risk and adoption are related, and taking into account that agricultural production depends to a large extent on adoption of new technologies, attempts must be made to reduce risk and increase security. Adequate results will be obtained when those in charge of generating and transferring technology understand and pay attention to the behavioral patterns of the farmers.

Credit

Credit has been considered as one of the most universal and flexible transferable forms of economic resource (37, p. 17), and it has become a most significant input into agricultural production (50, p. 568). It has been recognized as a key component of agricultural and rural development in developing countries. It has also been said
that the provision of agricultural credit not only removes financial constraints but may also promote the adoption of new technologies and the commercialization of the rural economy (90, p. 203).

There has been controversy regarding the role of the credit in agricultural and rural development in developing countries and different and conflicting approaches have been stated.

Long (82, p. 28), analyzing the conditions for success of small farmer credit in developing countries, indicates that formerly it was believed that the shortage of credit was an obstacle in agricultural production for small farmers; he refers to Shult's approach (122) stated in the 1960s in the sense that capital was not a significant constraint on the output of farmers in traditional agriculture. This author also refers to studies conducted by Nisbet (98, p. 37) in Chile in 1967, by Miller (88, p. 13) in Perú in 1970, and by Gotsch (49, p. 326) in Pakistan in 1972, which concluded that credit was not an important constraint on agricultural production for small farmers in certain crops.

Tinnermeier (128, p. 38, 40) points out that there is evidence from studies related to the role of agricultural credit in developing countries to suggest that profitable technology is not always available when credit is granted to the farmers, and that further expansion or support of credit programs is not recommended until new, output-increasing and profitable technology is available and understood by farmers. He also says that "extending credit in the absence of this technology will lead to meager or even negative results from the
standpoint of both the borrower and the lender." In Cáqueza, Colombia, it was found that most of the farmers who obtained credit did not apply all of the recommended cultural practices in corn production or used smaller amounts of the inputs (i.e., fertilizer) recommended due to increase of risk (140, p. 149). It shows that the effect of credit on adoption of technology could depend on the presence or absence of other factors. In relation to this aspect, Donald (37, p. 40) says that "even if profitable new technology is provided with credit, this may still not be sufficient for its rapid adoption. If considerably more risk is associated with the new as compared with the old (technologies), the small farmers may be unwilling to assume such a risk."

Based on previous experiences in Africa, Moris (94, p. 83) points out that production credit only becomes beneficial once farming is predominantly monetized, the transfer of technology is efficient, loans are secured against farmers' credit records, farmers have adequate managerial skills, and there is a grass-roots organization to handle the crops and deduct loan payments.

It has been recognized that small farmers in developing countries who are not involved in particular development programs have been limited in access to credit; thus they have to use loans from informal lenders (37, p. 17). In studies carried out in some regions of Bangladesh, Brazil, and Colombia, it was determined that farmers preferred to obtain credit from moneylenders and not from formal sources because institutional loans involved too much red tape, were
delayed in transaction, and were too rigid in repayments (3, p. 172; 99, p. 72). In another study conducted in Colombia to determine the use and real cost of agricultural credit, it was found that many small farmers preferred to use non-institutional sources due in part to lack of formal credit, but also due to the substantial borrowing costs associated with using institutional sources; this study showed that a great amount of money and time was spent by farmers in the loan transaction including costs for paperwork, travel expenses incurred to negotiate the loan, costs and difficulties in obtaining a co-signer or collateral, red tape and credit administrative costs, and costs of the farmers' time used to negotiate the loan (132).

At the present time, DRI credit is considered as one of the most advantageous for small farmers in Colombia. According to the National Planning Department (DNP) (34, p. 21), DRI credit finances, at least the majority of production costs, does not require a co-signer or collateral, is timely, its interests are not deducted from the loan and are lower in comparison to other types of formal credit, and the terms for repayment are adequate; this type of credit requires regular technical assistance, however. The main objective of DRI credit is to encourage the adoption of recommended agricultural technologies, hence the requirement of technical assistance.

The requirements for a farmer to become a DRI credit user are the following: to possess and operate a farm less than 20 hectares, regardless of the tenure status, to have a gross family income of no more than 3,000,000 Colombian pesos (approximately 15,000 dollars),
and at least 70 percent of the family's income must be derived from agricultural activities (31, p. 5; 64, p. 1).

In developing countries, generally, the credit resources are not always appropriately distributed. Studies analyzed by Ross (114, p. 31) indicated that in Kenya about 15 percent of small farmers had access to government credit, but none was applied to subsistence crops; in Bangladesh, farmers with the largest holdings received 80 percent of the agricultural bank loans, while in Philippines owners of the largest farms obtained 98 percent of the institutional credit.

Castillo (18, p. 353), studying the role of agricultural credit in adoption of high-yielding varieties of rice in a region of the Philippines, points out that credit for agricultural production plays an important role because it is required for purchasing the inputs associated with new technologies. However, she says that "credit, despite all the hue and cry about it, is not as salient a constraint as perceived by farmers as water, diseases, insects and pests."

Studies conducted in developing countries have demonstrated that credit is required for adopting new agricultural technologies if they represent higher production costs, like in the case of additional inputs (44, p. 277; 66, p. 119; 82, p. 31; 123, p. 1). The availability of financial resources encourages farmers to accept and adopt quicker new and appropriate technology. It has been said that "without credit, some farmers will not adopt the more costly procedures; others will adopt the new techniques but only more slowly" (82, p. 70).
Colyer and Jiménez (24, p. 639), analyzing the use of supervised credit by farmers involved in an institutional program in Colombia, found that those farmers benefited by the program adopted more technologies related to the use of fertilizers, pesticides, and other agricultural inputs than those other farmers outside the program. Studies carried out in Mexico, Ethiopia, and Colombia, have shown that new and more profitable technologies have been successfully introduced with the use of credit among farmers in some regions of those countries (128, p. 40).

Studies conducted in several regions of Colombia have shown a significant association between use of credit and adoption of agricultural technology and improvements in crop productivity (56, p. 65; 68, p. 119; 91, p. 57). Other studies undertaken in that country showed, in spite of the fact that the relationship between the two variables was statistically not significant, a strong tendency to adopt more cultural practices among farmers who used credit (105, p. 703; 138, p. 44).

The World Bank (135, p. 76) contends that credit provided to farmers is essential for modernization, growth, and equity. Whether the use of credit is justified or not depends both on whether the benefits will exceed the production costs and whether the costs of other alternatives of production could be lower to obtain similar outcomes (82, p. 27).

According to Donald (37, p. 18), other indirect benefits for farmers and their families, derived from credit, could be the
following: independence from extortionate lenders, stronger position and advantage in the markets, improved nutrition, increased self-respect, improved social status and political influence, access to wider educational and occupational opportunities, etc.

The economic and social function of agricultural credit cannot be underestimated. The purposes of credit programs for small farmers in developing countries must be oriented not only to increase farm production and productivity but also to improve social conditions.

**Marketing**

Agricultural marketing comprises all the operations involved in the movement and trade of food stuffs and raw materials from the farm to the final consumer, as well as the distribution and trade of farm inputs, price policies, credit, storage, transportation, management, farmers organization, related services, etc. (38, p. 125).

Marketing has been considered as a powerful tool in promoting agricultural development. There is no doubt that this is an essential factor required to increase agricultural productivity. This is the reason why developing countries have tried to pay more attention to this factor within the process of rural development.

The current literature is replete with studies about the effect of marketing on farm productivity. According to Durand (38, p. 128), the study of particularities of marketing has received increased attention during the last 15 years, especially in Latin
American countries. This author contends that the findings of recent studies show, above all, a steady similarity among different countries in relation to agricultural marketing structures, problems, difficulties, and possibilities. Unfortunately, it seems that very little has been done to overcome agricultural marketing problems in developing countries since this situation is actually considered as one of the most critical limitations in agricultural development.

It has been stated that the specific conditions under which small farmers operate at the village level in developing countries are characterized by small marketable surpluses, low degrees of organization, lack of information about product demand, quality standards, and prices, being far from national marketing structures, and having insecure and instable marketing channels; all of these factors naturally impede their integration into existing marketing systems (26, p. 167).

Marketing can be one of the reasons for failure of agricultural development programs. The adverse impact of markets on adoption of technological recommendations has been stated in several studies carried out in Ecuador, India, Malaysia, and other developing countries (82, p. 28). This situation is not new. In 1965-1966 small farmers in a region of India were encouraged to grow high-yielding varieties of grain; adoption was evident and production increased; nevertheless, the lack of adequate marketing channels and storage facilities, as well as a decrease in price following harvesting time, resulted in a failure of the program up to the point
that farmers became reluctant to work with change agents (114, p. 2). Many marketing experts contend that the green revolution could have been a greater success if the marketing systems had been more efficient (66, p. 21).

In most developing countries, marketing is carried out informally by large numbers of traders "having a series of very particularistic, intricate, and sometimes shifting relationships with one another (37, p. 81)." They are referred to as middlemen or intermediaries. Middlemen are seen as "exploiters who get between the producer and consumer, driving the price paid to the farmer down and that changed to the latter up, with the middlemen reaping huge monopoly profits." (49, p. 504). It is true that the middlemen provide services (picking, cleaning, processing, packing, transporting, etc.) that need to be rewarded, but it also is true that very often they perceive larger benefits in comparison with those perceived by small producers (37, p. 186).

In relation to the role of middlemen, Durand (38, p. 136, 137) states: "A traditional point of view tend to consider middlemen, in general, as necessary evils that manipulate prices and market mechanisms and retain a large part of final value." This author adds that in some cases, middlemen are necessary, and that places or regions with problems of transportation, lack of credit facilities, and inadequate accessibility to urban areas, contribute to recognizing the role of the middlemen. In his study, Durand (38, p. 138) concludes that the smaller the farms and the larger the number of
small farmers, specially in case of food crops, the larger the number of intermediary stages, and suggests that in order to overcome this situation land reform programs or rural development projects should consider the need to establish or keep enough market power to deal with highly commercialized distributive systems.

Appropriate markets and adequate price incentives must exist for a new agricultural technology to be adoptable and profitable. It is sound to predict a positive relationship between efficiency in marketing agricultural products and adoption of technology when it is profitable.

Farmers in developing countries have generally responded eagerly to appropriate marketing opportunities (135, p. 74). According to the World Bank (33, p. 74), rubber growers in Malaysia, and cocoa, groundnuts, and cotton growers in West Africa rapidly adopted the recommended crop practices once marketing channels were established in the late nineteenth century; more recently in the Ivory Coast cocoa production was encouraged and it increased from 80,000 to over 400,000 tons in two decades since 1960, largely due to incentives of fair prices and availability of appropriate marketing facilities.

It seems that infrastructure, marketing, and agricultural productivity are also related. In fact, the World Bank (135, p. 82) points out that the lack of roads in some regions in developing countries may limit or prevent timely and cheap delivery of commercial supplies, profitable penetration of markets, specialized agricultural production, and efficient services of extension and research. A
similar approach is outlined by Gillis, et al. (46, p. 503) who say that in large parts of developing countries, improvements in transportation systems and hence in marketing facilities can exert a major impact on agricultural productivity. These authors indicate that "construction of an all-weather road system in Korea in the 1970s, for example, made it possible for millions of Korean farmers to increase dramatically their emphasis on vegetables and cash crops destined for urban and export markets. Even the simple device of building paved bicycle paths connecting the main road made it possible for Hong Kong farmers to expand their vegetables acreage."

Basic infrastructure is essential for agricultural development. Infrastructure and efficiency in marketing are closely related. The World Bank (135, p. 45) states: "The existence and expansion of basic infrastructure has contributed significantly to increased agricultural output in Asia and Latin America... Marketed farm produce is increasing sharply... Heavy investment in roads, railways, ports, and other links in the marketing chain are required, together with policies and institutional arrangements to ensure efficient transport, processing, and storage."

One of the reasons of poor marketing systems in developing countries is related to lack of organization of the majority of the farmers. The importance of improving farmers' organization is widely recognized (2, p. 285). One strategy proposed to overcome, in part, this critical situation is related to farmers' cooperatives. The role and the impact of this type of organization has been largely
discussed (2, p. 285-299; 116, p. 579-596). Abbott (2, p. 290), analyzing the studies conducted by FAO in relation to marketing cooperatives in Africa, Asia, and Latin America concludes:

The desire to set up a marketing cooperative is generally provoked by a feeling that existing marketing channels are not providing an adequate service or are charging too much for it. By joining together to assemble, pack, store and sell produce, farmers may either obtain better prices directly or induce existing traders to give better prices under the pressure of new competition. Among small farmers more often, perhaps, than originating from their own initiative, cooperatives are established by governments. Administrative convenience is often a main consideration. Here it must be remembered that economic, cultural, or social homogeneity in the potential membership of a co-operative is important.

Farmers' marketing cooperatives have been successful in some regions and have failed in others. Many of the disappointments or failures in organizing and implementing cooperative systems result from attempts to do this before farmers have recognized their common interest and tangible benefits (2, p. 298), or from inappropriate management or lack of capital (67, p. 169), or because farmers are not adequately informed even on basic aspects of cooperatives (103, p. 189), or due to inappropriate basic infrastructure (116, p. 58).

Ross (114, p. 18) states that cooperatives could be a mechanism to solve marketing problems in the development process, and that a multifunctional cooperative dealing with production, consumption, credit, and marketing could be the first step in moving a small farmer from a noncash into a cash economy.
Dams and Heyne (26, P. 170) suggest the following four-phase strategy for improving marketing systems in agricultural production in developing countries: 1) physical infrastructure at village level (investment phase); 2) farmers' organizations and service agencies (institutional phase); 3) production - processing - marketing - schemes (management phase); and 4) rural markets as service centers (market phase).

Based on analyses of empirical studies on agricultural marketing carried out in developing countries, Donald (37, p. 88) concludes the following: 1) Marketing infrastructure can have a very important influence on farm production and incomes, particularly feeder roads, storage facilities, and retail channels for agricultural inputs (and sometimes consumer goods); investment in these aspects may overcome bottlenecks that could impede the viability of output-oriented credit programs; 2) Credit to marketing organizations can contribute to farm production and profitability; it may be considered as a supplementary source or as a possible substitute for production credit. Innovative methods of stimulation to input suppliers should also be considered in conjunction with other means of promoting agricultural innovations; 3) Marketing organizations designed to improve bargaining positions of small farmers, such as cooperatives, should be administered so as to maximize their services to farmers rather than given unconditional protection.

The DRI strategy for agricultural marketing is oriented to promote adequate commercialization channels at the urban level, to
promote farmers' organizations, especially rural cooperatives, to provide technical assistance and training in marketing, to formulate specific marketing projects through CECORA and FINANCIACOP, to provide information about prices and terminal markets, and to provide associative supervised credit (34, p. 24-27). It seems that the efforts devoted by the DRI program to overcome marketing problems have not been successful enough since marketing is considered as one of the most critical limitations for agricultural development in some of the DRI districts.

It has been stated that "affording access to large numbers of rural people, the rural market can be an economical natural integrator of a range of development activities" (89).

Adequate market incentives would encourage farmers to apply more productive technologies in order to improve farm productivity and family income. The agricultural market structure in developing countries must change. The important role of agricultural marketing in the total process of agricultural and rural development must be fully recognized, and additional efforts must be made by governments and farmers to overcome this critical situation.

Land

Land is one of the most appreciated natural and economic resources in the world; it is considered as the main production factor
in agriculture. Land is used to produce food, raw materials, and many goods. It involves the soil and its environment.

Land plays an important role in agriculture development in developing countries. There are two different not mutually exclusive ways to develop agriculture; one of them is related to incorporation of additional land to cultivation, and the other is related to improvements in productivity per unit of land; the first alternative is possible without changing traditional farming methods, whereas the second is entirely dependent on technological improvement (6, p. 24; 107, p. 35).

The shortage of and the poor quality of farmland have been two of the principal restrictions to improve agricultural productivity. The quality of land in many regions of developing countries is not sufficient for substantial improvements in farm productivity; however, experiences around the world have shown that some lands in arid, saline, or severely waterlogged locations have been made adequate for farming by means of irrigation, acidification, and drainage (15, p. 287). Of course, this has been and is a costly process.

An important factor in agricultural production is the motivation, and willingness of farmers to apply certain techniques to improve the quality of their farmlands such as leveling, irrigating, and draining; farmers with a more secure tenure status are more likely to be motivated to make such investments than those who have less secure tenure on their land (135, p. 84). In his study about
modernization of agriculture in developing countries, Arnon (6, p. 448) contends:

It has become increasingly clear that the adoption of improved techniques is not possible unless the farmer operates land which he owns or holds securely, and from which he obtains an equitable share of the produce. If he is a tenant, who retains only a small proportion of his yield and all investments conducive to higher yields have to be made at his own expense, he has no incentive to adopt improved practices. An equitable redistribution of the land is therefore an essential precondition to agricultural progress.

Some experiences in developing countries indicate that a distribution of land from large estates into small peasant holdings increases productivity due to a more intensive use of the land (46, p. 487). Some other experiences show that agricultural output declines because the redistribution of land is not accompanied by complementary measures such as agricultural extension, support services, training, and facilities (114, p. 31).

It seems that quality of land and land tenure are related to access to credit. According to Gillis, et al. (46, p. 500), in many areas of developing countries local moneylenders know the reliability of the people to whom they are lending and the quality of the land they are putting up as collateral; farmers without land have more difficulties in obtaining loans even from local moneylenders.

It has been recognized that in most developing countries the highly unequal concentration of land is probably the single most important reason for inequitable distribution of income and wealth, and that small farmers have little hope of economic and social improvement when land is unevenly distributed (129, p. 313).
In many developing countries, most of the land is concentrated in the hands of a small group of landowners, such as in Latin America; this situation has become an obstacle for the development of the rural sector (133, p. 67; 93, p. 138). Arnon (6, p. 46) points out that the traditional and dominant forces of settlement in Latin America have been the large estates - latifundia - on one hand and extremely small holdings - minifundia - on the other, and that the minifundia generally occupy the poorest and least accessible land.

According to Gillis, et al. (46, p. 480), conditions of land tenure set the context within which all efforts to raise agricultural output must operate; tenants, small holders, share croppers, etc., are less motivated to increase production than landlords. These authors contend:

The kind of land tenure system that exists in any given country or region has an important bearing on economic development for several reasons. Prevailing land tenure arrangements have a major influence on the welfare of the farm family. Families that own the land they cultivate tend to feel they have a stake in the existing political order, even if they themselves are quite poor. Because they possess land they have something to lose from turmoil... Land tenure systems also have a major impact on agricultural productivity. An individual proprietor who owns land knows that increased effort or skill that leads to a rise in output will also improve his income. This result does not necessarily follow if the land is owned by someone else. Under sharecropping, for example, the landlord gets a percentage share, typically a half of any increase in output... Tenants otherwise would have no incentive to invest in improvements or even to maintain irrigation and drainage systems.

The Word Bank (135, p. 5) states that agrarian or land reform increases security of tenure and increases productivity. "Land reform
has substantially improved rural income distribution and is the base for subsequent agricultural progress in several countries; examples include China, Japan, and the Republic of Korea" (135, p. 84). Nevertheless, Arnon (6, p. 448) contends that land reform in itself does not necessarily ensure economic development, and that it must be supported by appropriate planning and a series of services and policies related to credit, marketing, agricultural research, and extension to be successful.

The DRI program was designed to operate in those regions where the land tenure structure was not considered as an obstacle for rural development (33, p. 6). Nevertheless, it seems that the selection of some DRI districts was not the most appropriate since they present some limitations in relation to availability and distribution of land, situations that affect agricultural production and productivity. Land by itself is not a factor included in the agricultural production component of the DRI program.

There is strong consensus among development specialists on the need for adequate land reform in developing countries. In 1979, the World Conference on Agrarian Reform and Rural Development met in Rome. They concluded that equitable distribution and efficient use of land is indispensable for rural development, for the mobilization of human resources, and for increased production for the alleviation of poverty in developing countries (29, p. 384). The Economic Commission for Latin America has determined that land reform is a prerequisite for agricultural development (129, p. 313).
Characteristics of the Selected DRI Districts

South Tolima District (Sur Tolima)

The South Tolima district lies between 3° 48' - 4° 15' North latitude and 74° 53' - 75° 15' West longitude. This district is located in Tolima State in the center of Colombia (Figure 1). The DRI area is about 2,310 square kilometers (905 square miles). There are 4,764 farms of less than 20 hectares (50 acres). Its population is estimated at 28,670 (64, p.l).

The district is comprised of five municipalities (El Guamo, San Luis, Valle de San Juan, Saldaña, and Espinal), and covers 43 villages (62, p. 3). At the time of collecting the data for this study only 26 villages were receiving DRI services.

The climate is influenced by both the rainfall and the altitude. There are two marked seasons, the wet and the dry. The average annual rainfall is 1,530 millimeters (60 inches). The distribution of the rainfall is not the most adequate for cropping because the rains are concentrated during two periods, April - May and October - November (32, p. 17).

The altitude ranges between 150 and 2,000 meters (492 - 6,560 feet) above sea level, averaging 300 meters (984 feet). Only 1.3 percent of the area is located above 2,000 meters. Temperatures range between 24° C (75° F) and 35° C (95° F), averaging 28° C (82° F). Eighty nine percent of the total area is hot, 9.7 percent
FIGURE 1
Republic of Colombia. Location of South Tolima (Sur Tolima) and Fusagasugá DRI Districts
temperate, and 1.3 percent cool. The bioclimatic regions vary between tropical arid woods and tropical very arid woods (32, p. 17).

The topography is characterized by lowland plains. A small area is slightly hilly (64, p. 3).

The fertility of the majority of the soils varies between poor and moderate. The main problem is the lack of water for agricultural purposes. Drought is one of the principal characteristics of farm-lands in this district, which obviously influences heavily soil fertility. The soil pH varies between 5.5 and 7.5, prevailing slightly acid and neutral soils. The content of organic material in the soils is low. The chemical status of the soils is poor in most of the area. There is great variation in soil texture. There are soils with differing content of clay, sand, and loam. Soil erosion varies between moderate and severe (32, p. 20).

This district is also characterized by a high concentration of "minifundia". Seventy eight percent of the farms are less than 10 hectares. Ownership is the prevalent land tenure status (32, p. 20).

The principal crops growing in this district are: sesame, sorghum, and corn. Other crops used mostly for family consumption are: cassava, plantains, and fruits. The principal livestock enterprises are: beef cattle, swine, poultry, goats, and sheep.

The principal problems affecting the rural sector of this district are: low levels of agricultural production and productivity, inadequate marketing systems, poor quality of farmlands, lack of water for irrigation, unequal distribution of land and other resources,
poor housing conditions, poor infrastructure, low levels of formal education, poor nutrition and health conditions, and high levels of rural-urban migration (32; 63; 64).

Extension programs have been carried out since 1968 in this district. The DRI program was established in 1982.

**Fusagasugá District**

Fusagasugá district is located in Cundinamarca state in the center of Colombia (Figure 1), laying between 3° 45' - 4° 25' North latitude and 75° 07' - 74° 30' West longitude. It has a total area of 1,875 square kilometers (733 square miles), 13,383 farms and a population of 119,000 (60, p. 2).

This district is comprised of nine municipalities, but its activities are more concentrated in five of them (Fusagasugá, Arbeláez, Pasca, Silvania, and San Bernardo), covering 40 villages (61, p. 2).

The climate is characterized by two seasons, the wet and the dry. The average annual temperature is 20° C (68° F). The climate is also heavily influenced by the altitude which ranges between 600 and 4,300 (1,968 - 14,100 feet) above sea level, averaging 1,800 meters (5,900 feet). Temperatures vary significantly according to the altitude. Seventeen percent of the total area is very cold, 40 percent cool, 35.6 percent temperate, and 6.4 percent hot (60, p. 3).
The average annual rainfall is 1,500 millimeters (59 inches). The rainfall has a seasonal character and varies year to year. There are two pronounced rainfall periods, March through May and September through November. The relative humidity averages 75 percent. The bioclimatic regions vary between tropical arid woods and sub-tropical very humid woods (60).

The topography is mostly hilly and mountainous. The fertility of the majority of the soils is moderate; however, there are some soils with low and some with high levels of fertility. The average pH is 5.4, ranging between 5.2 and 5.8. The soil organic material level is moderate. The texture of the soils ranges between loamy-clayey and loamy-sandy. There is low soil erosion.

There is a high concentration of "minifundia". Seventy five percent of the farms are less than 10 hectares (25 acres). Ownership is the main land tenure status (60, p. 5).

The principal crops growing in this district are: green peas, green beans, tomatoes, sugar cane, plantains, potatoes, fruits, coffee, and other vegetables. The most important are green peas and green beans. The main livestock enterprises are: dairy cattle, rabbits, poultry, swine, and bees (60, p. 12).

The National Planning Department (DNP) (31, p. 22) has identified the following as the most important problems affecting the rural sector of this district: low agricultural production and productivity, low levels of income, inadequate use of natural resources, deficient physical infrastructure, low levels of education and health, low
community participation, high concentration of minifundia, unequal resource distribution, and increasing rural-urban migration.

The DRI program was established in 1978; however, the extension service had been operating in some municipalities of this district since 1968.

**The Research Model**

Figure 2 shows the research model used in this study. This model presents the DRI's agricultural production component and its different factors (independent variables) as related to adoption of technology and crop production yields (dependent variables).

The framework shows the process by means of which technology generated by research is transferred to farmers through the extension service. Agricultural credit and marketing act as important supporting factors to facilitate adoption. Farmers adopting technology are supposed to increase crop production yields which could represent changes in crop productivity and farm income.
FIGURE 2

Research Model of Factors Related to Adoption of Agricultural Technology and Changes in Crop Productivity, Integrated Rural Development Program (DRI).
Statement of Hypotheses

The following null hypotheses were tested in this study:

1. There is not an association between adoption of agricultural technology and effectiveness in transferring technology.

2. There is not an association between adoption of agricultural technology and difficulty in obtaining credit.

3. There is not an association between adoption of agricultural technology and difficulty in marketing crop production.

4. There is not an association between increase in crop yields and effectiveness in transferring technology.

5. There is not an association between increase in crop yields and difficulty in obtaining credit.

6. There is not an association between increase in crop yields and difficulty in marketing crop production.

7. There is not an association between increase in crop yields and adoption of agricultural technology.
CHAPTER III
RESEARCH METHODOLOGY

The Setting

This study was conducted in two districts where the integrated Rural Development Program - DRI - was being carried out, South Tolima District, located in Tolima State, and Fusagasugá District, located in Cundinamarca State.

In this study South Tolima District is referred as District 1 and Fusagasugá District as District 2.

District 1 is considered as one of the newest DRI districts since it was inaugurated in 1982, under what was called, "DRI Phase II". District 2 is considered as one of the oldest DRI districts since its activities began in 1975 when the DRI program was established in Colombia. It is considered as a district in the "DRI Phase I". The principal characteristics of these two districts are presented in Chapter II.

Selection of the Sample

Since the proportions of the farmers growing the various crops selected in this study were different, a proportionate stratified random sample was drawn to assure that they would be equally
represented in the sample of each district (10, p. 49; 21, p. 27; 136, p. 27). Sixty DRI farmers were selected from the total number of clients in each district for a total sample of 120 respondents to be interviewed.

The principal crops grown in District 1 were sesame, sorghum, and corn, while in District 2 they were green peas and green beans. In District 1, fifty percent of the farmers were growing sesame, 30 percent sorghum, and 20 percent corn, while in District 2, sixty seven percent were growing green peas and 33 percent green beans.

The names of the respondents were selected at random from the updated lists of growers for each crop provided by the district directors in the district offices. Thirty sesame growers, 18 sorghum growers, and 12 corn growers were selected in District 1. Forty green peas growers and 20 green beans growers were selected in District 2. Only active DRI clients were selected as respondents in order to insure more homogeneous samples.

Although the crops were used as strata in drawing the samples, they were not considered as variables because it was not pertinent to the purpose of this study. Nevertheless, the statistical analysis performed indicated that there were no significant differences among and between the crops in District 1 and District 2, respectively, in relation to each dependent and independent variable used.

Farmers from four municipalities and 11 villages in District 1, and from three municipalities and 12 villages in District 2 were involved in the samples.
Interview Schedule

An interview schedule was used to collect the data for this study (Appendix A). The interview schedule was first prepared in English and then translated into Spanish. Most of the questions of the interview schedule were closed questions for more unbiased information.

The interview schedule was divided in the following five parts:

The first part included some general questions related to the length of time farmers were receiving services from the DRI program, the farmers' land tenure status, the area of the farms, the area of farmland designated for crop and livestock production, the farmers' satisfaction in relation to the overall DRI program, and the changes in farm income.

The second part was designed to find out the factors limiting crop productivity in the selected DRI areas as perceived by the respondents, and the extent to which those factors were presumed to affect crop productivity.

The third part was used to determine the availability of appropriate crop technology and its sources of generation and adaptation under local conditions, the extent of effectiveness in transferring appropriate agricultural technology, the means through which farmers obtained information about crop cultural practices, the extent of adoption of technology, the reasons impeding farmers in
adopting new technology, the crop yields obtained before and after adopting new practices, and the farmers' satisfaction in relation to DRI technical assistance. The information pertaining to availability of appropriate crop technology was provided by the extension personnel in charge of agricultural research in each district.

The fourth part was related to the DRI credit program and included questions pertaining to sources of credit, requirements and procedures for obtaining credit, levels of difficulty to get a loan, timeliness and adequacy of amount of credit, interest rates, terms for paying off loans, and farmers' satisfaction in relation to the DRI credit program.

Questions included in the fifth part were designed to obtain information about the characteristics of agricultural marketing in DRI areas. They were related to use of crop production, levels of difficulty in the marketing process, level of prices, farmers' membership in marketing organizations, marketing channels, difficulties in marketing crop products, and farmers' satisfaction in relation to the DRI marketing program.

The interview schedule was pre-tested by the author with six farmers in District 1. It was necessary to adjust some questions in order to avoid misunderstandings and to improve the validity of the questionnaire.

Some questions included in the interview schedule were related to the components of the research model and to the objectives previously stated. Specific questions were used to determine the
characteristics of the independent and dependent variables as perceived by farmers. These variables as used in this study were the following:

**Independent Variables:**
- Transfer of technology (extension), in terms of effectiveness in transferring technology, (Question No. 5);
- Credit, in terms of difficulty in obtaining credit, (Question No. 17); and
- Marketing, in terms of difficulty in marketing crop production, (Question No. 24).

**Dependent Variables:**
- Adoption of technology, in terms of levels of adoption of recommended cultural practices, (Question No. 9); and
- Crop production, in terms of changes in crop yields (Question No. 12).

The data obtained through these questions were also used to determine the extent of association between independent and dependent variables.

The other questions were used to measure other variables related to the extent of limitation of crop productivity limiting factors, the characteristics of the DRI transfer of technology, some of the reasons why farmers did not adopt crop recommendations, the characteristics of the DRI credit program, the characteristics of
the DRI marketing program, the most salient difficulties in marketing crop products, and the levels of farmers' satisfaction in relation to some selected limiting factors.

**Operationalization of the Variables**

The following description indicates the operationalization of the principal variables used in this study:

**Crop Productivity Limiting Factors**

Question No. 2 was used to determine the factors that were limiting crop productivity. The selected factors were related to agricultural research, agricultural extension, credit, marketing, farmland, and other possible limiting factors. Farmers had the opportunity to choose all the factors that they considered were affecting the productivity of their crops.

Question No. 3 was used to determine the extent to which the selected factors were limiting crop productivity. Respondents had the opportunity to indicate if the extent of limitation of the factors they chose through question No. 2 was "low", "fair", or "high". Score values of 1, 2, and 3 were assigned to each category, respectively.
Technology

Information in relation to the generation, adaptation, and availability of appropriate technology for each one of the selected crops was provided by the extension personnel in charge of research in each district.

Generation of Technology (Research). Question No. 4 was used to define the principal crops grown in each district and the three most important cultural practices (appropriate technology) recommended by the DRI program for each one of the selected crops, as well as to determine the sources that generated and adapted that technology to the local farming conditions.

The crops and the recommended cultural practices were defined according to the economic importance of each crop in the region, and according to the impact of each recommendation on the yield of a particular crop.

Transfer of Technology (Extension). Question No. 5 was used to determine the extent to which the DRI program was perceived as effectively transferring technology to the farmers. It was based on the knowledge of the farmers in relation to each recommendation.

The same crops and the same recommended cultural practices selected through question No. 4 were used in question No. 5. Responses of the farmers were compared with the information provided
by the extension personnel in question No. 4. If the response coincided, a "correct answer" (C) was computed. If the response did not coincide, an "incorrect answer" (I) was assigned. There was a maximum of three possible correct answers, one for each recommended cultural practice.

The extent of effectiveness in transferring technology was determined based on the responses of the farmers and according to the following categories, number of correct answers, and score values:

- "No effective" transfer of technology, (NE); zero correct answers; (0);
- "Slightly effective" transfer of technology, (SE); one correct answer; (1);
- "Fairly effective" transfer of technology, (FE); two correct answers; (2); and
- "Effective" transfer of technology, (E); three correct answers; (3).

Score values were assigned to each category ranking from zero to three according to the extent of effectiveness. Zero indicated "no effective" transfer of technology and three "effective" transfer of technology. This variable was used as the first independent variable in this study.
Means of Transferring Technology. Question No. 6 was used to determine the means through which farmers obtained information about crop cultural practices. The respondents had the opportunity to indicate the sources through which they learned about the recommendations, from a list of six means previously selected.

Adoption of Technology

Question No. 9 was used to determine the extent to which farmers had adopted recommended crop practices. Adoption of technology was related to the information provided through question No. 4, so the same crops and the same technological recommendations were used.

Farmers were asked to indicate the cultural practices they were using on their crops. The responses were compared with the information given by the extension personnel through question No. 4. If the response coincided, a "correct answer" (C) was computed. If the response did not coincide, an "incorrect answer" (I) was assigned. There was a maximum of three possible correct answers, one for each recommended cultural practice.

The extent to which farmers had adopted technology was given in terms of levels of adoption according to the following categories, number of correct answers, and scale values:

- "Non adoption" of technology, (NA); zero correct answers; (0);
- "Low level of adoption" of technology, (LA); one correct answer; (1);
- "Fair level of adoption" of technology, (FA); two correct answers; (2); and
- "High level of adoption" of technology, (HA); three correct answers; (3).

Score values were assigned to each category ranking from zero to three according to the extent or level of adoption. Zero indicated "non adoption" and three "high level of adoption" of technology. Adoption of technology was the first dependent variable used in this study.

Reasons for Non-Adoption of Technology. Question No. 13 was used to determine what reasons, if any, had deterred farmers from using or adopting the cultural practices recommended by the DRI program. The respondents were given the opportunity to indicate up to five reasons that impeded them from adopting new technology, from a list of 26 reasons previously selected.

Crop Production

Question No. 12 was used to determine the levels of crop production. Farmers were asked about their crop yields per hectare "before" and "after" using or adopting recommended cultural practices.
Their responses were compared to determine the changes in crop production which were classified in the following categories: "lower" crop production, (LY); "similar" crop production, (SY); or "higher" crop production, (HY). Score values of 0, 1, or 2 were assigned to each category, respectively. Level of crop production was used as the second dependent variable in this study.

Credit

Information to characterize credit as the second independent variable was sought in terms of difficulty in obtaining a loan (Question No. 17). Questions Nos. 16 through 22 were used to determine some characteristics of the DRI credit program, such as:

**Difficulty in Obtaining a Loan.** Question No. 17 was used to determine the levels of difficulty in obtaining DRI credit. Farmers had the opportunity to select one out of the following four alternatives: "very difficult", "difficult", "simple", or "very simple". Score values of 1, 2, 3, or 4 were assigned to each category, respectively.

**Timeliness of the Credit.** Question No. 18 was used to determine the opportuneness for the receipt of the loan by the farmers. The respondents had two alternatives to choose, "delayed" or "timely". Score values of 1 or 2 were assigned to each category, respectively.
Adequacy of the Amount of Credit. Question 19 was used to determine the adequacy of the amount of credit the farmers had received, using a scale of "not adequate", "fairly adequate", or "adequate" to put in practice all the recommended cultural practices to grow their crops. Score values were assigned to each category as follows: 0 for "not adequate"; 1 for "fairly adequate", or 2 for "adequate".

Interest Rates. Question No. 20 was used to determine if the interest rates charged to the farmers for a loan were considered as "low", "moderate", or "high". Score values assigned to each category were 1, 2, or 3, respectively.

Terms for Repaying Loans. Question No. 21 was used to determine if the terms for repaying loans were considered by the farmers as "short", "moderate" or "long". Score values of 1, 2, or 3 were assigned to each category, respectively.

Marketing

Information to characterize marketing as the third independent variable was given in terms of difficulty in marketing crop production (Question No. 24). Questions Nos. 23 through 29 were used to determine some characteristics of the marketing process in DRI areas, such as:
Major Uses of Crop Production. Question No. 23 was used to determine the major uses of crop production obtained by the farmers. The respondents had the opportunity to choose only one alternative from a list of eight.

Difficulty in Marketing Crop Production. Question No. 24 was used to determine the level of difficulty in the process of marketing crop production. Respondents had the opportunity to select one out of the following four alternatives: "very difficult", "difficult", "easy", or "very easy". Score values of 1, 2, 3, or 4 were assigned to each category, respectively.

Sale Price of Crop Products. Question No. 25 was used to determine if the prices paid for crop products were favorable or unfavorable to the farmer. The respondents had the opportunity to choose one out of the following five alternatives: "very unfavorable", "unfavorable", "just", "favorable", or "very favorable" prices. Score values of 1, 2, 3, 4, or 5 were assigned to each category, respectively.

Farmer Membership in Marketing Organizations. Question No. 26 was used to determine if the farmer was or was not a member of any marketing organization. Two categories, "no" and "yes", were the alternatives, with score values of zero and one, respectively.
Marketing Channels. Question No. 27 was used to determine the channels through which farmers marketed their crop products. The respondents had the opportunity to indicate the channels they had used in marketing their crop products in priority order, according to the amount of product sold. A list of five marketing channels previously selected was used to make the selections.

Marketing Difficulties. Question No. 28 was used to determine some of the most salient difficulties farmers faced in marketing their crop production. The respondents had the opportunity to indicate up to five from a list of 11 marketing difficulties previously selected.

Farmers' Satisfaction

Questions Nos. 7, 22, and 29 were used to determine the levels of satisfaction of the farmers in relation to the DRI technical assistance (transfer of technology), the DRI credit program, and the DRI marketing program.

Farmers had the opportunity to choose one of the following three levels of satisfaction, according to their perceptions: "not satisfied", "fairly satisfied", or "satisfied". Score values of 0, 1, or 2 were assigned to the three categories or alternatives, respectively.
Collection of Data

The data for this study were collected through a personal interview schedule. In conducting the interviews, the author was assisted by three extension agents from the Regional No. 6 of the Colombian Agricultural Institute, ICA.

Previous to the interviews, the author met with the other interviewers to analyze each one of the questions on the interview schedule to ascertain that the information collected was consistent. The assistants were trained to use the research instrument proficiently in conducting the interviews. Special care was taken to protect the integrity of the data.

The author interviewed the extension personnel in each district to obtain the information related to generation, adaptation, and availability of appropriate crop technology, as well as to define the crops and the recommended cultural practices to be used in this study.

All farmers were interviewed on their farms. The interviews were conducted during July, 1985.

Statistical Analysis of Data

After the respondents were interviewed, data were coded using a predetermined coding system. Data were processed through the facilities of the System Network Computer Center (SNCC) at Louisiana State University.
The statistical methods applied to analyze the data were the Chi-Square ($X^2$) goodness-of-fit test, the Chi-Square ($X^2$) test of independence when the data were measured at a nominal level, the Kolmogorov-Smirnov (K-S) one-sample and two-sample tests, and the Goodman and Kruskal "gamma" (G) procedure when the data were measured at an ordinal level.

The Chi-Square ($X^2$) goodness-of-fit test is a statistical method appropriate for defining the significance of differences between the observed and the expected frequencies of variables or categories in a sample representing a population (124, p. 42; 27, p. 255; 25, p. 189; 54, p. 188). This test was used to determine differences in frequency distribution in relation to crop productivity limiting factors in each district.

The Chi-Square ($X^2$) test of independence is a statistical method suitable for defining the significance of differences between two independent samples with respect to some characteristic and, therefore, with respect to the relative frequency with which group members fall in several categories (124, p. 104; 27, p. 174; 25, p. 189; 54, p. 192). This test was used to determine differences in frequency distributions between District 1 and District 2 in relation to the following variables: crop productivity limiting factors, means of transfer technology, timeliness of DRI credit, farmers' membership in marketing organizations, and marketing channels used.
The Kolmogorov-Smirnov (K-S) one-sample test is a type of goodness-of-fit test. This statistical method is appropriate for determining the significance of difference between an observed and an expected frequency distribution (21, p. 259; 84, p. 328; 124, p. 47). This test was used to determine differences in frequency distribution in each district in relation to the following variables: effectiveness in transferring technology, adoption of technology, levels of crop production, difficulty in obtaining DRI credit, and difficulty in marketing crop products.

The Kolmogorov-Smirnov (K-S) two-sample test is a statistical method appropriate for determining the significance of difference between two independent samples when each sample has been arranged into a cumulative frequency distribution through several categories (21, p. 266; 84, p. 374; 124, p. 127). This test was used to determine differences in frequency distribution between District 1 and District 2 in relation to the following variables: extent of limitation of crop productivity factors, effectiveness in transferring technology, adoption of technology, levels of crop production, difficulty in obtaining DRI credit, adequacy of the amount of DRI credit, interest rates of DRI credit, installments for reimbursing a loan, difficulty in marketing crop products, sale price of crop products, and farmers' satisfaction in relation to DRI technical assistance, the DRI credit program, and the DRI marketing program.
It was considered not necessary to apply a particular test to some variables. In this event, percentages, frequencies, and averages were used to present and describe the data. This was applied to the following variables: length of time of DRI services, size of the farms and amount of farmland in crops and pasture, land tenure status, use of recommended cultural practices, reasons for nonadoption of technology, kinds of financial resources, length of time utilizing DRI credit, major uses of crop production, and marketing difficulties.

The Goodman and Kruskal Coefficient "gamma" (G) is a measure of relationship or association appropriate for determining the extent of association between variables measured at the ordinal level. This measure is based on the difference of probabilities between frequencies in agreement or concordance and frequencies in disagreement or discordance among variables or categories (75, p. 121; 84, p. 170, 438; 120, p. 309; 10, p. 303). This measure was used to test the hypothesized associations between the independent and the dependent variables.

The 0.05 level of probability was used to indicate statistically significant differences among categories, variables, or between districts. The actual significance level (P) is presented in the respective Tables for each one of the tests performed. In the events where no significant differences were found, they are shown in the Tables by means of a (N.S.) indication.
CHAPTER IV
ANALYSIS OF DATA

This study was conducted in two integrated rural development (DRI) areas in Colombia. Its general purposes were oriented to determine, according to the farmers' perception, relevant characteristics of some of the factors included in the agricultural production component of the DRI program; the extent to which these factors were limiting crop productivity; the extent of adoption of recommended crop technology; the changes in crop yields; the levels of farmers' satisfaction in relation to some of those limiting factors; and the association between some selected limiting factors and adoption of technology and changes in crop yield, as well as between adoption of technology and crop production.

The data required to accomplish the objectives were collected by means of an interview schedule which was administered to a sample of 60 farmers in each one of the two DRI districts selected, for a total sample of 120 farmers.

The data were analyzed through the statistical methods described in Chapter III, that is,

- the Chi-Square ($X^2$) goodness-of-fit test and the Chi-Square ($X^2$) test of independence, used when the data were measured at a nominal level;
- the Kolmogorov-Smirnov (K-S) one-sample and two-sample tests, used when the data were measured at an ordinal level;
- the Goodman and Kruskal Coefficient "gamma" (G), used to determine the degree of association among selected variables, since they were measured at an ordinal level; and
- frequencies, percentages, and averages to present and describe the data when it was considered not necessary to apply any particular statistical test.

The 0.05 level of probability (P) was used to determine statistically significant differences in distribution of frequencies among the various categories of the variables in each district and between districts, as well as for determining significant differences in the degree of association among variables.

The independent and dependent variables selected for the purposes of determining the associations previously indicated were the following:

Independent variables;
- Transfer of technology (extension) - in terms of effectiveness in transferring technology;
- Credit - in terms of difficulty in obtaining credit; and
- Marketing, in terms of difficulty in marketing crop production.

Dependent variables;
- Adoption of technology - in terms of levels of adoption of recommended cultural practices; and
- Crop production - in terms of changes in crop yields.

In some cases, when the independent and dependent variables were studied, the data were analyzed independently for each one of the districts, and then compared between the two districts (Tables 8, 12, 14, 17, and 24). In most of the other cases, the comparisons of the variables were made between the two districts, only.

This chapter presents the findings of the study, based on the perceptions of the farmers interviewed. The analysis of the data is presented under the following major headings: general aspects, crop productivity limiting factors, crop technology, (generation, transfer, adoption), crop production, credit, marketing, and relationships between variables.

**General Aspects**

**Length of Time of DRI Services**

As it was already mentioned, the Integrated Rural Development Program - DRI - was established in 1982 in District 1, and in 1975 in District 2. Since its origin, the DRI program has been providing services to the farmers primarily by means of community organization activities, technical assistance, and financial resources.

Data in Table 1 indicate percentage distributions, according to the length of time farmers had been receiving DRI services. The majority of the farmers (95 percent) in District 1, the newer one, had been receiving the services from one to five years. More than
half of the farmers (60 percent) in District 2, the older one, had been receiving DRI services for more than five years, and 26.7 percent from two to five years. Only five percent of the farmers in District 1 and 3.3 percent in District 2 were considered as new users since they were incorporated to the DRI program during 1985.

TABLE 1
A Comparison of the Length of Time Farmers Had Been Receiving DRI Services by Districts, 1985

<table>
<thead>
<tr>
<th>Length of Time</th>
<th>Percent by District</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District 1 (n=60)</td>
<td>District 2 (n=60)</td>
</tr>
<tr>
<td>Less than one year</td>
<td>5.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Between one and two years</td>
<td>56.7</td>
<td>10.0</td>
</tr>
<tr>
<td>Between two and five years</td>
<td>38.3</td>
<td>26.7</td>
</tr>
<tr>
<td>More than five years</td>
<td>0</td>
<td>60.0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

According to this information, the farmers in District 2 were exposed for longer periods of time, as expected, to the different activities of the DRI extension program compared with the farmers in District 1.
Size of the Farms

As it was indicated previously, one of the requirements for affiliation with the DRI program is to operate a farm of no more than 20 hectares (has.) regardless of tenure status. Farmers in District 1 possessed farms with sizes, ranging between 1.5 and 20 has., while farmers in District 2 were operating farms ranging in size from 0.9 to 20 has. The average size of farm was nine has. in District 1 and 4.4 has. in District 2.

Most of the DRI farmers possessed farms of no more than 10 has. Data in Table 2 show that 68.3 percent of the farmers in District 1 and 95 percent in District 2 had farms of less than 10 has. It can also be noted that 71.7 percent of the farmers in District 2 operated farms of less than five hectares. It confirms that one of the characteristics of this District is its high concentration of "minifundia".

Table 2 also provides information in relation to the amount of farmland dedicated by farmers to crops and pasture. Frequently, and especially in District 1, farmland is not utilized completely in cropping and pasturing. The average amount of farmland utilized in these activities was 8.3 has. per farm in District 1 and 4.3 has. in District 2 in comparison with the average size of the farms of nine and 4.4 has., respectively.

According to the ratio between the average amount of farmland utilized in crops and pasture and the average size of farms, farmers in District 1 utilized an average of 92.2 percent of their farmland
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Hectares</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Five or less than five</td>
<td>33.3</td>
<td>71.7</td>
<td>52.5</td>
<td>41.7</td>
<td>71.7</td>
<td>56.7</td>
</tr>
<tr>
<td>Between five and ten</td>
<td>35.0</td>
<td>23.3</td>
<td>29.1</td>
<td>30.0</td>
<td>25.0</td>
<td>27.5</td>
</tr>
<tr>
<td>Between ten and fifteen</td>
<td>15.0</td>
<td>1.7</td>
<td>8.4</td>
<td>16.7</td>
<td>0</td>
<td>8.4</td>
</tr>
<tr>
<td>Between fifteen and twenty</td>
<td>16.7</td>
<td>3.3</td>
<td>10.0</td>
<td>11.6</td>
<td>3.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Range in farm size (has.)</td>
<td>1.5-20</td>
<td>0.9-20</td>
<td>0.9-20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average size of farms (has.)</td>
<td>9</td>
<td>4.4</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Amount of farmland in crops and pasture (has.)</td>
<td></td>
<td></td>
<td></td>
<td>8.3</td>
<td>4.3</td>
<td>6.3</td>
</tr>
</tbody>
</table>
In agricultural production, while farmers in District 2 utilized 97.7 percent.

The average size of farms in District 2 is smaller, but its soils present better physical and chemical characteristics than those of District 1 where the soils are characterized by their poor fertility and drought. It could explain, at least in part, why farmers in District 2 try to utilize the maximum land resource in growing crops and pasture. Farmers in District 1 have left small areas of their farms unutilized, primarily because those areas are not appropriate for farming due to poor quality soils.

**Land Tenure Status**

The DRI program does not have special entry requirements as far as the land tenure status of the farmers is concerned. It was found that ownership was the predominant land tenure status in the two districts, followed by lessees and share-tenants. No other category of land tenure was reported (Table 3).

In District 1, seventy one point seven percent of the farmers were owners of their farms, 26.7 percent lessees, and only 1.6 percent share-tenants, while in District 2, seventy six point seven percent of the farmers were owners, 16.7 percent lessees, and 6.6 share-tenants. It seems to indicate that there were, relatively speaking, less problems of land tenure in District 2 than in District 1.
TABLE 3
A Comparison of the Land Tenure Status of Farmers
by Districts, 1985

<table>
<thead>
<tr>
<th>Land Tenure Status</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>71.7</td>
<td>76.7</td>
<td>74.2</td>
</tr>
<tr>
<td>Lessee</td>
<td>26.7</td>
<td>16.7</td>
<td>21.7</td>
</tr>
<tr>
<td>Share-tenant</td>
<td>1.6</td>
<td>6.6</td>
<td>4.1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

The DRI program does not involve activities to reallocate land resources or to solve land tenure problems. The findings support one of the policies of the DRI program, in the sense that it should be carried out in those regions where land tenure is not a major constraint in the process of rural development.

**Crop Productivity Limiting Factors**

Information to determine the farmers' perception in relation to crop productivity limiting factors was obtained by means of a dialogue between the farmer and the interviewer. The respondents were encouraged to talk about the principal problems they faced as farmers and which they considered as obstacles for better crop
productivity on their farms. Information provided by the respondents was related to the following factors previously selected in question No. 2:

1. Research - in terms of lack of or inappropriate technology (cultural practices) for growing crops.

2. Extension - in terms of lack of or inadequate transfer of crop technology or technical assistance.

3. Credit - in terms of lack of or insufficient financial resources for growing crops.

4. Marketing - in terms of lack of or inappropriate facilities for marketing crop production.

5. Farmland - in terms of lack of or inadequate farmland for growing crops.

6. Other limiting factor (e.g., climate) - in terms of dampness or drought of soils caused by excessive or by lack of rain water. Climate was included in this category as a limiting factor taking into account that adverse climatic conditions were frequently mentioned by a high number of farmers.

The farmers had the opportunity to select all the factors they considered as limiting crop productivity. Since the majority of the respondents mentioned more than one factor, the total number of responses obtained was larger than the total number of farmers in each District. The total number of responses was 128 in District 1 and 127 in District 2.
Table 4 presents a comparison among the crop productivity limiting factors according to the total number of responses obtained in District 1 and in District 2.

**TABLE 4**

A Comparison among the Crop Productivity Limiting Factors, District 1 and District 2, 1985

<table>
<thead>
<tr>
<th>Limiting Factors</th>
<th>District 1</th>
<th></th>
<th>District 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>Research</td>
<td>5</td>
<td>3.9</td>
<td>20</td>
<td>15.7</td>
</tr>
<tr>
<td>Extension</td>
<td>2</td>
<td>1.6</td>
<td>32</td>
<td>25.2</td>
</tr>
<tr>
<td>Credit</td>
<td>7</td>
<td>5.5</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Marketing</td>
<td>51</td>
<td>39.8</td>
<td>52</td>
<td>40.9</td>
</tr>
<tr>
<td>Farmland</td>
<td>30</td>
<td>23.4</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Climate</td>
<td>33</td>
<td>25.8</td>
<td>19</td>
<td>15.0</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>100</td>
<td>127</td>
<td>100</td>
</tr>
</tbody>
</table>

$x^2_{5df.}$ 90.956 85.323

$P < 0.001 < 0.001$

The statistical analysis applied to the data of each district showed that there was a significant difference in frequency distribution among the different limiting factors in District 1 and in District 2, as perceived by the farmers.

In District 1, the most frequent limiting factor mentioned by farmers was marketing (39.8 percent), followed by climatic conditions
(25.8 percent), farmland (23.4 percent), credit (5.5 percent), research (3.9 percent), and extension (1.6 percent).

In District 2, the predominant limiting factor mentioned was also marketing (40.9 percent), but followed by extension (25.2 percent), research (15.7 percent), climatic conditions (15 percent), farmland (1.6 percent), and credit (1.6 percent).

The results indicated that the pattern of the limiting factors was not the same; it varied from one district to the other. It can be also observed that marketing was most frequently mentioned as a limiting factor of crop productivity in both districts, while the less frequently mentioned limiting factors were extension in District 1 and farmland and credit in District 2.

Table 5 presents a comparison between District 1 and District 2 for each crop productivity limiting factor according to the number of farmers considering each factor as a limitation. Therefore, only yes responses were recorded.

The statistical analysis applied to the data showed that there were significant differences for research, extension, farmland, and climate, as crop productivity limiting factors, between the two Districts, as perceived by the farmers. The differences for credit and marketing were not significant at the 0.05 level of confidence.

The following is an analysis of the situation, according to the data presented in Table 5:
TABLE 5
A Comparison for each Crop Productivity Limiting Factor by Districts, 1985

<table>
<thead>
<tr>
<th>Limiting Factor</th>
<th>District 1 Frequency</th>
<th>District 2 Frequency</th>
<th>Total Frequency</th>
<th>$X^2$ ldf.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>5</td>
<td>20</td>
<td>25</td>
<td>9.903</td>
<td>0.002</td>
</tr>
<tr>
<td>Extension</td>
<td>2</td>
<td>32</td>
<td>34</td>
<td>34.514</td>
<td>0.001</td>
</tr>
<tr>
<td>Credit</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>1.922</td>
<td>N.S.</td>
</tr>
<tr>
<td>Marketing</td>
<td>51</td>
<td>52</td>
<td>103</td>
<td>0.000</td>
<td>N.S.</td>
</tr>
<tr>
<td>Farmland</td>
<td>30</td>
<td>2</td>
<td>32</td>
<td>31.065</td>
<td>0.001</td>
</tr>
<tr>
<td>Climate</td>
<td>33</td>
<td>19</td>
<td>52</td>
<td>5.735</td>
<td>0.017</td>
</tr>
</tbody>
</table>

Research. Twenty point eight percent of the total sample reported research as a limiting factor. However, this situation was less critical in District 1 where only 8.3 percent of the farmers mentioned this as a limitation as compared with District 2 where 33.3 percent of the farmers did.

Respondents in District 2 wanted less expensive means to prevent and control pests and diseases on their crops as well as more appropriate crop varieties resistant to pests and diseases. Research problems in District 1 dealt principally with the quality of the soils, so farmers hoped for better systems to improve soil
conditions at lower costs in order to increase fertility levels. Also, pest and disease problems were mentioned by some farmers.

The generation of appropriate technology is a responsibility of the DRI program. Research is carried out at local levels on farms and in experiment stations. The two districts were undertaking adaptative research projects in order to solve the most pressing technological problems of the principal crops growing in their areas of influence. District 1 has a Regional Center of agricultural research "Nataima" which is located very close to its area of influence. Although District 1 is the newer of the two, it seems that it has been more successful than District 2 in generating appropriate technology to overcome farm problems. Of course, the situation and the problems are different.

Extension. Technical assistance or transfer of technology was reported as a limiting factor by 28.3 percent of the total sample. There was a marked difference in perception between the respondents of the two district in relation to this factor. In District 1, very few farmers (3.3 percent) considered the lack of technical assistance or its inadequacy as a limitation for better crop productivity, while more than half of the farmers (53.3 percent) in District 2 did. Data also showed that extension was the less frequent factor mentioned by the respondents in District 1, while in District 2 it was, after marketing, the second most limiting factor as perceived by farmers.
Some of the respondents in this situation in District 2 indicated that they were not visited by the extension agent during the last six months, while most of them said that they were visited rarely. Some of the farmers stated that they were visited by the extension agent only when they required the planning for credit. Information obtained from this district indicated that there had been many obstacles in replacing those technical assistants who, for one or other reason, had to leave their areas of work. At the time of collecting the data for this study, it was observed that some areas of work in District 2 lacked an extension agent, and some others were being assisted by temporary extension workers.

Due to the lack of enough field extension personnel this District was emphasizing the work with groups of farmers to transfer technology, but it was not possible to know to what extent this extension method was efficient.

In contrast with District 2, it seems that extension was not perceived as a major limitation in District 1.

Credit. Only 7.5 percent of the total sample perceived credit as a limiting factor of crop productivity. It was the less frequent factor mentioned by the respondents considering the two districts

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1The planning of the credit is a detailed plan of investments stating the necessary amount of money for financing each activity or cultural practice required to grow a crop, a group of crops, or to operate a farm. The DRI program requires that all credit projects be planned and supervised during their execution by an extension agent.
together. Just 3.3 percent of the farmers in District 2 and 11.6 percent in District 1 perceived credit as a problem to grow their crops. The problems were not related to the lack of financial resources but to the amount of red tape and requirements demanded to obtain a loan, the timeliness to receive the money, the interest rates, the terms for repaying the loan, and in very few instances, to the insufficiency in the amount of money lent. In fact, only one farmer in District 1 was not provided with DRI credit because he did not meet all the requirements demanded by the DRI program. It can be considered that credit was not a major constraint among the DRI farmers in these two districts.

Since credit has been considered as a very important factor in the process of agricultural development in Colombia, many efforts have been devoted by the DRI program in order to provide the farmers with the financial resources needed to apply the recommended cultural practices in the growing of their crops.

Marketing. This factor, in terms of inappropriate facilities for marketing the crop production, was perceived by the majority of the respondents as the outstanding problem in agricultural productivity in the two districts. No major differences in frequency distributions between the two districts were observed. Eighty five percent of the farmers in District 1 and 86.7 percent in District 2 considered marketing as the principal factor limiting better crop productivity
on their farms. In fact, this factor was the most frequently mentioned by the respondents in the two districts.

Many difficulties for marketing farm production were pointed out by the farmers, especially those related to unfavorable prices paid for their farm products, market intermediaries, lack of farmer cooperatives or similar marketing organizations, and lack of sufficient marketing channels.

The DRI program is responsible for carrying out actions oriented to help farmers market their farm production. When the DRI program was established 11 years ago, it was believed that marketing could be one of the crucial limitations to improve farm productivity (34, p. 23). It seems that the efforts devoted by the DRI program to overcome this situation have not been highly successful because the marketing problem persists, at least in these two districts.

**Farmland.** This factor was perceived as a problem by 26.7 percent of the total sample. As it was indicated previously, there was a significant difference in the distribution of frequencies in relation to this factor between the two districts. Fifty percent of the farmers in District 1 and only 3.3 percent in District 2 considered farmland as a limiting factor of crop productivity.

Most of the respondents in District 1 under this situation pointed out that a great amount of the land on their farms was inadequate for growing crops. This claim seemed to be related, at least in part, to the poor fertility of the soils in many areas of
this district. The few farmers in District 2 who mentioned farmland as a limiting factor indicated that their small-sized farms did not allow them to improve crop productivity.

Unfortunately, these situations are out of the hands of the DRI program, since it does not involve projects oriented to reallocate land resources.

Climate. As it was stated previously, this factor was included as a limitation under the category of "other limiting factors", taking into account that a high number of farmers considered climatic conditions as a problem associated with low farm productivity. In fact, climate was the second most frequent limiting factor perceived by the respondents (43.3 percent of the total sample). There was a significant difference between the frequencies observed in each District. The situation seemed to be more critical in District 1, where it was reported by 55 percent of the farmers, than in District 2, where 31.7 percent of the farmers did.

Respondents, under this situation, referred to inadequate conditions of dampness or drought in the soils due to excessive or to lack of rain water respectively. District 1 had an inadequate distribution of rain fall during the year, and a great part of its soils were characterized by excessive drought. This condition seemed to be associated with the poor quality of the lands. Problems in District 2 were related to dampness, sometimes causing a partial
or a total damage or loss in the crops. Its lands are more fertile than in District 1, nevertheless.

Extent of Limitation

Data to determine the extent of perceived limitation of the selected limiting factors were obtained through question No. 3 of the interview schedule. Farmers were asked to indicate to what extent each one of the factors they had considered previously was limiting better crop productivity on their farms. Farmers had the opportunity to select among "low", "fair", or "high" alternatives.

According to the results of the statistical analysis no significant differences in perception were found for any of the limiting factors between the two Districts (Table 6) at the 0.05 level of confidence. Nevertheless, the following tendencies can be observed:

Research. The extent of limitation of this factor seemed to be slightly higher in District 2 than in District 1. In fact, the farmers affected by research in District 1 assigned only a low extent of limitation to this factor, while in District 2, fifty-five percent of the respondents perceived the extent of limitation as low, 40 percent as fair, and five percent as high. The tendency of the extent of limitation for this factor was low in District 1 and between low and fair in District 2.
TABLE 6
A Comparison of the Farmers' Perception in Relation to the Extent of Limitation of Crop Productivity Limiting Factors by Districts, 1985

<table>
<thead>
<tr>
<th>Limiting Factors</th>
<th>District 1</th>
<th></th>
<th></th>
<th>Total (n=128)</th>
<th></th>
<th></th>
<th></th>
<th>Total (n=127)</th>
<th>Dm.*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (n=66)</td>
<td>Fair (n=39)</td>
<td>High (n=23)</td>
<td></td>
<td>Low (n=49)</td>
<td>Fair (n=47)</td>
<td>High (n=31)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td>100.0</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
<td>55.0</td>
<td>40.0</td>
<td>5.0</td>
<td>100.0</td>
<td>0.450</td>
<td>N.S.</td>
</tr>
<tr>
<td>Extension</td>
<td>50.0</td>
<td>50.0</td>
<td>0</td>
<td>100.0</td>
<td>50.0</td>
<td>21.9</td>
<td>28.1</td>
<td>100.0</td>
<td>0.281</td>
<td>N.S.</td>
</tr>
<tr>
<td>Credit</td>
<td>57.1</td>
<td>28.6</td>
<td>14.3</td>
<td>100.0</td>
<td>100.0</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
<td>0.429</td>
<td>N.S.</td>
</tr>
<tr>
<td>Marketing</td>
<td>49.0</td>
<td>29.4</td>
<td>21.6</td>
<td>100.0</td>
<td>25.0</td>
<td>46.2</td>
<td>28.8</td>
<td>100.0</td>
<td>0.268</td>
<td>N.S.</td>
</tr>
<tr>
<td>Farmland</td>
<td>50.0</td>
<td>33.3</td>
<td>16.7</td>
<td>100.0</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.833</td>
<td>N.S.</td>
</tr>
<tr>
<td>Climate</td>
<td>48.5</td>
<td>33.3</td>
<td>18.2</td>
<td>100.0</td>
<td>36.8</td>
<td>42.1</td>
<td>21.1</td>
<td>100.0</td>
<td>0.116</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

*Dm.*: Value (maximum difference) obtained through the Kolmogorov-Smirnov (K-S) two-sample test
Extension. As in the case of research, the perceived extent of limitation of extension in crop productivity seemed to be higher in District 2 than in District 1. In District 1 no one assigned a high extent of limitation to this factor, while in District 2, about 28 percent of the farmers did. However, the tendency of the extent of limitation of extension was between low and fair in the two districts.

Credit. The majority of the respondents (100 percent in District 2 and 57.1 in District 1) assigned a low extent of limitation to this factor. This perception seemed to be related to the low percentage of farmers who considered credit as a crop productivity limiting factor. The tendency of the extent of limitation for this factor was low in District 2 and between low and fair in District 1.

According to the farmers' perception, and taking into account the number of respondents affected by this factor in both districts, it can be said that credit was considered the least important factor among the selected crop productivity limiting factors.

Marketing. According to the data, the perceived extent of limitation of marketing seemed to be slightly higher in District 2 than in District 1. The tendency of the extent of limitation varied between low and fair for both districts. However, in comparison with the other limiting factors, and taking into account the number of
farmers affected particularly by this factor (85 percent in District 1 and 86.7 percent in District 2), marketing presented the highest perceived extent of limitation in the two districts. Twenty one point six percent of the respondents in District 1 and 28.8 percent in District 2 perceived the extent of limitation as high.

In accordance with the above information, it would be fair to say that, among the selected factors, marketing was perceived as the most critical limiting factor of crop productivity.

**Farmland.** According to the proportion of the farmers who reported being affected, this factor was considered more critical in District 1 than in District 2. However, the only two farmers in District 2 who perceived this factor as a limitation assigned it a high extent of limitation. In District 1, sixteen point seven percent of the respondents considered the extent of limitation of farmland as high, 33.3 percent as fair, and 50 percent as low.

The tendency of the extent of limitation for this factor was high for District 2 and between low and fair for District 1, highlighting the aforementioned differences in soil conditions.

**Climate.** Although a high number of farmers (55 percent in District 1 and 31.7 in District 2) perceived climatic conditions as a limitation for better crop productivity, only 18.2 percent of them in District 1 and 21.1 percent in District 2 considered the extent of limitation of this factor as high. The tendency of the extent of limitation for climate varied between low and fair for both districts.
Crop Technology

Generation and Availability of Appropriate Crop Technology

Data related to the generation of appropriate crop technology were obtained through question No. 4 of the interview schedule.

As it was mentioned previously, information in relation to the generation, adaptation, and availability of appropriate technology for each one of the selected crops was provided by the extension personnel in charge of research in each one of the two districts.

Table 7 presents the data gathered from the two districts in relation to the three most important cultural practices recommended by the DRI program for each one of the selected crops, and the sources that generated and adapted that technology to local conditions. These cultural practices were used then to determine the effectiveness in transferring technology and the levels of adoption of technology.

The relative importance of the selected crops was related to the number of farmers growing the crops, the area grown, and the...
extent of participation in the total farm income, derived from the sale of the crop production.

TABLE 7

Selected Recommended Cultural Practices by Crops and their Sources of Generation and Adaptation to Local Conditions, Districts 1 and 2, 1985

<table>
<thead>
<tr>
<th>Crops and their Selected Cultural Practices</th>
<th>Origin of the Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Generation</td>
</tr>
<tr>
<td></td>
<td>Research</td>
</tr>
</tbody>
</table>

**District 1**

**Sorghum (Sorghum bicolor (L.) Moench)**

1. **Kind of seed**: use seed of the hybrid "ICA Nataima", certified. Research Extension

2. **Weed Control**: apply a) 1.5 to 2 kilograms per hectare (kgs./ha.) of "Atrazina"; or b) 2 to 4 liters per hectare (lts./ha.) of "Gesaprin 500". Research Extension

3. **Fertilization**: apply 44 kg./ha. of N plus 35 kgs./ha. of P. There are two alternatives; apply a) 75 kgs./ha. of fertilizer "18-46-0" plus 75 kgs./ha. of urea; or b) 100 kgs./ha. of fertilizer "10-30-30" plus 75 kgs./ha. of urea. Research Extension

**Sesame (Sesamum indicum L.)**

1. **Kind of seed**: use seed of the varieties "ICA Ambala" or "ICA Pacandé", certified. Research Extension

2. **Distances of planting**: use a distance of a) 0.25 meters between places, and 0.65 meters between lines of "ICA Ambala"; or b) 0.25 meters between places and 0.75 meters between lines of "ICA Pacandé". Research Extension
Table 7 (continued)

3. **Fertilization:** apply between 25 and 50 kgs./ha. of N in the form of urea, nitron, or sulfate of ammonia.

**Corn (Zea mays L.)**

1. **Kind of seed:** use seed of a) hybrid "H-211"; or b) variety "Clavo Regional", certified.

2. **Weed control:** apply a) 1.5 to 2 kgs./ha. of "Atrazina"; or b) 2 to 4 lts./ha. of "Gesaprin 500".

3. **Fertilization:** according to the conditions of the soil, apply a) between 70 and 90 kgs./ha. of N in the form of urea, nitron, or sulfate of ammonia; b) 70 kgs./ha. of N plus 20 kgs./ha. of P plus 20 kgs./ha. of K; there are two alternatives; b1) 100 kgs./ha. of urea plus 150 kgs./ha. of fertilizer "15-15-15"; or b2) 125 kgs./ha. of urea plus 100 kgs./ha. of fertilizer "10-20-20".

**District 2**

**Green Peas (Pisum sativum)**

1. **Fertilization:** apply 250 kgs./ha. of fertilizer "10-30-10", or "10-20-20" at planting time.

2. **Prevention and control of** *(Melanogramisa linni)*: apply between 25 and 30 kgs./ha. of "Furadan" or "Curater" at planting time.

3. **Way and place of application:** apply the insecticide alone (without mixing with other pesticides) on the rootneck of the plant.
Table 7 (continued)

Green Beans  (Phaseolus vulgaris)

1. **Fertilization:** apply between 4 and 6 tons per hectare (ton./ha.) of organic matter, 15 days before planting, and then, apply 400 kgs./ha. of fertilizer "10-30-10" at planting time.

2. **Prevention and control of (Tialeurodis vaporariae):** apply any one of "Tomaron", "Monitor", "Folimat", "Azodrin", "Nuvacron 60", "Curacron", "Decis", or "Baytroide", according to the dose recommended by the manufacturer, 20 days after germination, and then, each 15 days.

3. **Prevention and control of (Uromices phaseoli):** apply "Baycor", or "Plant-vax 75" according to the dose recommended by the manufacturer, between 20 and 35 days after germination.

The crops selected were sesame, sorghum, and corn in District 1, and green peas and green beans in District 2. The farmer, generally grows only one crop which provides the principal source of his farm income. Those crops were the most important in each district. They were involved in this study in order to have a more representative and homogeneous sample from the population of each district.

The two districts had a technological package for each crop composed by the most appropriate cultural practices proved as most efficient for higher crop yields. The cultural practices were avail-
able to the farmers and they were recommended and transferred by means of different extension methods.

The selection of the recommended cultural practices by extension personnel, for the purposes of this study, was based on the relative importance of these recommendations facing the most pressing technological problems of each one of the crops.

According to Table 7, the cultural practices selected in District 1 were related to the kind of seed, weed control, and fertilization for sorghum and corn, and to the kind of seed, distance of planting, and fertilization for sesame. It can be observed that special emphasis was being given to the kind of seed and fertilization rates, taking into account the low crop yields per hectare due to soil fertility problems.

Most of the technology recommended by the DRI program in District 1 was generated by the research programs of the Colombian Agricultural Institute, ICA, through its Regional Center of agricultural research "Nataima". In some instances, like in fertilization, the generation of the recommendations was the result of joint work, at the district level, between the research programs of the experiment station and the extension service. Only in the case of corn, extension was responsible for determining the kinds and levels of fertilizers to be recommended. Another situation that deserves to be mentioned is related to the variety of corn identified as "Clavo Regional" which was considered as a local generated technology of production because it was generated by the farmers. The extension
service recommended this variety, but emphasized the use of certified seed. The adaptation of these technologies to farm conditions in the different areas of District 1 was carried out by the extension program.

In District 2, the cultural practices selected for green peas and green beans were related to fertilization and prevention and control of pests and diseases. In this instance, both the generation and adaptation of the technologies were carried out by the extension program.

Transfer of Technology

Transfer of technology has been considered as the basis of the DRI extension program. In this study, transfer of technology or extension is considered as one of the independent variables.

As it was previously indicated, the extent to which the DRI program was effectively transferring appropriate technology was determined according to the number of correct responses given by the farmers in relation to the recommended cultural practices they knew. Question No. 5 of the interview schedule provided the data to determine this extent of effectiveness.

The statistical analyses applied showed the following (Table 8):

a) There was a significant difference in relation to the extent of effectiveness of the DRI program in transferring technology in District 1.

b) There was not a significant difference, at the 0.05 level of
TABLE 8

A Comparison of the Farmers' Perception in Relation to the Extent to which the DRI Program Was Effectively Transferring Technology by Districts, 1985

<table>
<thead>
<tr>
<th>Extent of Effectiveness</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not effective</td>
<td>6.7</td>
<td>20.0</td>
<td>13.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slightly effective</td>
<td>13.3</td>
<td>31.7</td>
<td>22.5</td>
<td>0.434</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fairly effective</td>
<td>28.3</td>
<td>40.0</td>
<td>34.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective</td>
<td>51.7</td>
<td>8.3</td>
<td>30.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dm.**</td>
<td>0.300</td>
<td>0.167</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt; 0.001</td>
<td>N.S.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Dm.: Value (maximum difference) obtained through the Kolmogorov-Smirnov two-sample test.

**Dm.: Value (maximum difference) obtained through the Kolmogorov-Smirnov one-sample test.
confidence, in relation to the extent of effectiveness of the DRI program in transferring technology in District 2.

c) There was a significant difference in relation to the extent of effectiveness of the DRI program in transferring technology between District 1 and District 2.

In fact, 51.7 percent of the respondents in District 1 considered the transfer of technology as effective and only 6.7 percent as not effective. In District 2, forty percent of the farmers perceived the extent of effectiveness as fairly effective, 31.7 percent as slightly effective, 20 percent as not effective, and only 8.3 percent as effective. This indicated that the tendency of the extent of effectiveness in transferring appropriate technology varied between fairly effective and effective in District 1 (80 percent), while in District 2 it varied between slightly and fairly effective (71.7 percent).

According to the data, it can be determined that the transfer of technology was perceived to be more effective in District 1 than in District 2. These results seem to be related to those found when the perceived extent of limitation of extension as a limiting factor of crop productivity was analyzed. In that instance it was observed that a lower extent of limitation of extension was perceived by the farmers in District 1 than in District 2.
Means of Transferring Technology

Question No. 6 of the interview schedule provided the data to determine through what means of information farmers learned about cultural practices.

Data provided by the respondents is presented in Table 9. The Chi-Square ($X^2$) test was not calculated because of inadequacies in some cell frequencies. Nevertheless, the following can be observed:

By far, the most frequent means of information as perceived by the respondents was the DRI extension agent in both, District 1 (63.3 percent) and District 2 (66.6 percent), followed by the combination of the DRI extension agent and a friend or neighbor (28.3 percent in District 1 and 10 percent in District 2). Following in frequency was the combination of the DRI extension agent and written material (6.7 percent in each one of the two districts). A friend or neighbor as a means of information accounted 1.7 percent in District 1 and 3.3 percent in District 2. In District 2, farmers mentioned other means or combination of means with very low frequencies such as the radio and "others" (agricultural supply and input dealers).

The DRI extension agent alone, or in combination with other means, was perceived as the principal means of information of cultural practices by 98.3 percent of the farmers in District 1 and 91.7 percent in District 2. Thirty percent of the respondents in District 1 and 21.6 percent in District 2 perceived a friend or
neighbor alone or in combination with other means as the second most important means of information. Written material in combination with other means was mentioned by 6.7 percent of the respondents in District 1 and by 10.1 percent in District 2. Agricultural supply

<table>
<thead>
<tr>
<th>Means of Information</th>
<th>Percent by District</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District 1 (n=60)</td>
</tr>
<tr>
<td>DRI extension agent</td>
<td>63.3</td>
</tr>
<tr>
<td>Friend or neighbor</td>
<td>1.7</td>
</tr>
<tr>
<td>Extension agent plus friend or neighbor</td>
<td>28.3</td>
</tr>
<tr>
<td>Extension agent plus written material</td>
<td>6.7</td>
</tr>
<tr>
<td>Extension agent plus radio</td>
<td>0</td>
</tr>
<tr>
<td>Extension agent plus friend plus written material</td>
<td>0</td>
</tr>
<tr>
<td>Extension agent plus friend plus other*</td>
<td>0</td>
</tr>
<tr>
<td>Other plus friend</td>
<td>0</td>
</tr>
<tr>
<td>Other plus written material</td>
<td>0</td>
</tr>
<tr>
<td>Extension agent plus other</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

*Other refers to agricultural supply and input dealers. The Chi-Square ($X^2$) test was not calculated because of inadequacies in some cell frequencies.
and input dealers alone or in combination with other means were mentioned by 10 percent of the farmers in District 2, while they were not mentioned in District 1 as a means of information.

It can be determined that the most important means through which farmers learned about cultural practices for their crops was the DRI extension agent, followed by a friend or neighbor and by written material, both in District 1 and in District 2. Dealers had relatively minor importance as a means of information, and only in District 2.

Satisfaction in Relation to DRI Technical Assistance

Question No. 7 of the interview schedule provided the data to determine the levels of satisfaction of the respondents in relation to the technical assistance they were receiving from the DRI program.

The statistical analysis indicated a significant difference in levels of farmers' satisfaction between the two districts (Table 10).

In fact, 78.4 percent of the farmers in District 1 were satisfied with the DRI technical assistance, while in District 2, only 31.7 of the farmers felt the same way. More than half of the respondents (53.3 percent) in District 2 were fairly satisfied with technical assistance.

These results are consistent with the findings obtained through the analysis of the perceived extent of limitation of extension as a crop productivity limiting factor, and through the analysis of the
TABLE 10
A Comparison of the Farmers' Levels of Satisfaction in Relation to the DRI Technical Assistance by Districts, 1985

<table>
<thead>
<tr>
<th>Levels of Satisfaction</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not satisfied</td>
<td>3.3</td>
<td>15.0</td>
<td>9.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairly satisfied</td>
<td>18.3</td>
<td>53.3</td>
<td>35.8</td>
<td>0.466 &lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Satisfied</td>
<td>78.4</td>
<td>31.7</td>
<td>55.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

perceived extent to which the DRI program was effectively transferring appropriate technology.

Most of the satisfied farmers in the two districts pointed out that they liked the extension service because it was frequently providing them with useful information to increase the crop yields and their farm income.

The few farmers who were not satisfied with the transfer of technology in District 1 said that the technical assistance was sporadic and that they were visited rarely by the extension agent. This situation was also mentioned in District 2 by the majority of the respondents who were not satisfied with the transfer of technology. Some farmers pointed out that they did not receive any assistance from the extension service, and others considered that the
technical assistance was not good because of frequent changes in extension agents.

Adoption of Technology

Adoption of crop technology is considered as one of the dependent variables in this study. Through question No. 8 of the interview schedule the respondents were asked if they were using all, a part, or none of the cultural practices recommended by the DRI program.

According to the information provided (Table 11), the tendency of the farmers to adopt was very similar in the two districts in relation to the use of the crop production practices recommended by the extension service. In fact, 40 percent of the farmers in District 1 and 28.4 percent in District 2 pointed out that they were using all of the recommended cultural practices. Most of the farmers, 58.3 percent in District 1 and 68.3 percent in District 2, indicated that they were using only a part of the technical recommendations. A very low number of farmers, 1.7 percent in District 1 and 3.3 percent in District 2, said that they were not using the cultural practices recommended by the DRI extension service.

The majority of the farmers who indicated using all of the recommended cultural practices said that they considered the recommendations as appropriate in increasing their crop yields.

Some of the reasons given by the farmers who were not using
any or only a part of the cultural practices transferred by the DRI program were the following: expensiveness of agricultural inputs which increased production costs; lack of sufficient information about the recommendations; some traditional practices were better than

TABLE 11
A Comparison of the Use of Cultural Practices Recommended by the DRI Program According to the Information Provided by the Farmers by Districts, 1985

<table>
<thead>
<tr>
<th>Use of Cultural Practices</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1.7</td>
<td>3.3</td>
<td>2.5</td>
</tr>
<tr>
<td>In part</td>
<td>58.3</td>
<td>68.3</td>
<td>63.3</td>
</tr>
<tr>
<td>All</td>
<td>40.0</td>
<td>28.4</td>
<td>34.2</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

the new ones; it was risky to apply certain new practices; pesticides and fertilizers were sometimes scarce and of poor quality; lack of sufficient financial resources; the new technology was not always favorable for small farmers; some practices were time-consuming; the kind of land was not appropriate to apply some new recommendations; and the uncertainty due to changes in weather conditions did not encourage use of some of the recommended cultural practices.

Question 9 of the interview schedule provided the data to determine the levels of adoption of technology.
Three questions related to each one of the three previously selected recommendations or cultural practices were asked of the respondents. The level of adoption was determined according to the number of correct responses given, that is, according to the number of cultural practices used by the farmers matching the DRI's recommendations. No adoption, low, fair, and high levels of adoption of technology were assigned if farmers were using none, one, two, or three recommended cultural practices for the growing of their crops, respectively.

Table 12 presents a comparison of the levels of adoption of technology between District 1 and District 2. The statistical analyses applied showed the following:

a) There was a significant difference among farmers in relation to the levels of adoption of technology in District 1.

b) There was not a significant difference in relation to the levels of adoption of technology among farmers in District 2, at the 0.05 level of confidence.

c) There was a significant difference in relation to the levels of adoption of technology by farmers between District 1 and District 2.

In fact, most of the farmers (60 percent) in District 1 had a fair level of adoption of technology, 16.6 percent a high level of adoption, and only 1.7 percent did not adopt any recommended cultural practice.
In District 2, forty five percent of the respondents indicated low levels of adoption of technology, 11.7 percent high levels of adoption, and 10 percent of them did not adopt any cultural practice.

**TABLE 12**

A Comparison of the Levels of Adoption of Technology by Districts, 1985

<table>
<thead>
<tr>
<th>Levels of Adoption</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non adoption</td>
<td>1.7</td>
<td>10.0</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low adoption</td>
<td>21.7</td>
<td>45.0</td>
<td>33.3</td>
<td>0.316</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Fair adoption</td>
<td>60.0</td>
<td>33.3</td>
<td>46.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High adoption</td>
<td>16.6</td>
<td>11.7</td>
<td>14.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although the tendency of the levels of adoption of technology varied between low and fair for both districts, it can be determined that the level of adoption was significantly higher in District 1 than in District 2 based on the preponderant number at the fair level.
Reasons for Non Adoption of Technology

Question No. 13 of the interview schedule provided the information to determine the reasons that did not allow farmers to use or adopt the cultural practices recommended by the DRI program.

This question was applied only to those farmers who previously pointed out that they were using none or only a part of the recommended cultural practices. Farmers had the opportunity to indicate up to five reasons that they considered as limitations in adopting technology. Since the majority of the farmers mentioned more than one reason, the total frequencies obtained were larger than the total number of respondents in each district. They were 135 in District 1 and 152 in District 2.

Table 13 presents the results obtained in relation to the reasons that did not allow farmers to adopt the recommended cultural practices. The reasons are listed following in descending frequency order.

It can be observed that the most frequent reasons considered by the total respondents dealt with economic aspects. These reasons were related to higher costs of production, apprehension in investing more money, and expensiveness of agricultural supplies, considered by 16; 16; and 14.7 percent of the total sample, respectively. Very slight differences in the percentages were observed between the two districts as far as these three reasons were concerned. It is true that most of the new technologies (use of certified seeds, fertili-


TABLE 13

A Comparison of the Farmers' Perception in Relation to the Reasons that Did not Allow them to Adopt the Recommended Cultural Practices by Districts, 1985

<table>
<thead>
<tr>
<th>Reasons</th>
<th>District 1 (n=135)</th>
<th>District 2 (n=152)</th>
<th>Total (n=287)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The costs of production become higher</td>
<td>17.8</td>
<td>14.5</td>
<td>16.0</td>
</tr>
<tr>
<td>Apprehension in investing more money (risk)</td>
<td>17.0</td>
<td>15.1</td>
<td>16.0</td>
</tr>
<tr>
<td>The agricultural supplies recommended are expensive</td>
<td>14.1</td>
<td>15.1</td>
<td>14.7</td>
</tr>
<tr>
<td>The crop production sale price is not favorable</td>
<td>9.6</td>
<td>6.6</td>
<td>8.0</td>
</tr>
<tr>
<td>Lack of adequate technical assistance</td>
<td>0.7</td>
<td>13.2</td>
<td>7.3</td>
</tr>
<tr>
<td>Difficulty in marketing crop products</td>
<td>8.9</td>
<td>4.6</td>
<td>6.6</td>
</tr>
<tr>
<td>The quality of the recommended agricultural supplies is not good</td>
<td>3.7</td>
<td>9.2</td>
<td>6.6</td>
</tr>
<tr>
<td>Not all the cultural practices are easy to apply</td>
<td>4.4</td>
<td>5.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Difficulty in getting the agricultural supplies</td>
<td>6.7</td>
<td>3.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Many intermediaries</td>
<td>6.7</td>
<td>2.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Not all the recommended cultural practices are known</td>
<td>0</td>
<td>5.9</td>
<td>3.1</td>
</tr>
<tr>
<td>No financial resources</td>
<td>4.4</td>
<td>0</td>
<td>2.1</td>
</tr>
<tr>
<td>Insufficient financial resources</td>
<td>3.0</td>
<td>0.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Some traditional practices are better</td>
<td>0</td>
<td>3.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Lack of own farmland</td>
<td>3.0</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
zers, insecticides, and fungicides) raise production costs. Never­
theless, the new cultural practices were proved to be more profitable
because they increased crop yields and improved crop productivity.

It seems that the perception of the respondents was not con­
sistent with the credit policy of the DRI program which enabled
farmers to obtain the necessary resources to apply the recommended
cultural practices. It could support the hypothesis that not all
of the farmers were fully using the credit obtained for the growing
of their crops. This situation also indicated that the credit did
not necessarily encourage all farmers to adopt new crop technology.
There were other factors that intervened probably.

The next most frequent reason was related to the unfavorable
prices farmers received for their crop production. Eight percent
of the total sample gave this reason. Nevertheless, it was more
frequently mentioned in District 1 (9.6 percent) than in District 2
(6.6 percent). This perception seems to be consistent with the
findings found in relation to the principal difficulties faced by the
farmers in marketing their crop production in each district.

Next in the frequency order was mentioned the lack of ade­
quate technical assistance. This reason was considered by 7.3 percent
of the total sample. Nevertheless, a great difference was noticed
between the two districts, since only 0.7 percent of the farmers in
District 1 and 13.2 percent in District 2 perceived this reason as
a limitation for adopting new technology. These results are con­
sistent with the findings obtained previously through the analyses of
extension as a crop productivity limiting factor (Tables 4 and 5), the effectiveness in transferring technology (Table 8), and the farmers' levels of satisfaction in relation to DRI technical assistance (Table 10).

The difficulty in marketing crop production, and the poor quality of the recommended agricultural supplies were the next most frequently mentioned reasons as perceived by the respondents. Although each one of these two reasons was considered by an equal proportion of the total sample (6.6 percent), the frequencies varied from one district to the other. In fact, the difficulty in marketing crop production was more frequently mentioned in District 1 (8.9 percent) than in District 2 (4.6 percent), while the poor quality of the agricultural supplies was more frequently mentioned in District 2 (9.2 percent) than in District 1 (3.7 percent).

Other reasons affecting the adoption of crop technology were related to the difficulty in applying some new cultural practices, the difficulty in getting the agricultural supplies, and the presence of intermediaries in the process of marketing the crop production.

It was also observed that some other less frequently mentioned reasons were perceived only in one of the two Districts. For instance, 5.9 percent of the farmers in District 2 indicated that not all the recommended cultural practices were known, and 3.3 percent considered that some traditional practices were better than the new ones, while in District 1, three percent of the farmers indicated that the financial resources were not sufficient enough to apply
certain recommendations, and three percent considered that the lack of their own farmland was a limitation to adopting all of the recommended cultural practices.

Some other reasons previously selected in the interview schedule were not considered by any farmer as direct limitations to adopting new technology. They were related to inappropriate conditions of credit, inappropriate transportation facilities for agricultural supplies and farm products, difficulties in storing recommended agricultural supplies or farm products, and inappropriate conditions of farmland.

**Crop Production**

Levels of crop production (yield per hectare) is considered as the second dependent variable in this study.

Question No. 12 of the interview schedule provided the data to determine the levels of crop production. A comparison was made between the yields of the crops when they were grown using the recommended cultural practices and when they were grown using traditional cultural practices.

Farmers who pointed out usage of a part or all of the recommendations were asked for their crop yields before and after using the recommended cultural practices. Farmers who used none of the DRI recommendations were only asked for the yields of the crops grown with traditional technology. In this instance, the crop
yields were compared with the average of the district for each crop. Only one farmer in District 1 and two farmers in District 2 said they did not use any of the recommended cultural practices (Table 11). The yields of their crops were lower than the average.

Levels of lower, similar, and higher crop production were assigned when the comparisons of the crop yields per hectare were made. Data were related to the crop production obtained in 1985A.

Table 14 presents a comparison of the levels of crop production between the two districts. The statistical analyses showed that there was a significant difference in relation to the levels of crop production in District 1 and District 2, as well as between these two districts.

### TABLE 14
A Comparison of Levels of Crop Production by Districts, 1985

<table>
<thead>
<tr>
<th>Levels of Crop Production</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>1.7</td>
<td>13.3</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Similar</td>
<td>21.6</td>
<td>45.0</td>
<td>33.3</td>
<td>0.350</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Higher</td>
<td>76.7</td>
<td>41.7</td>
<td>59.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total 100 100 100

Dm. 0.433 0.200

P <0.001 <0.01
In fact, most of the respondents (76.7 percent) in District 1 obtained higher levels of crop production per hectare, while only 1.7 percent obtained lower levels. In District 2, forty five percent of the farmers had similar levels of crop production, less than half of them (41.7 percent) had higher levels, and 13.3 percent had lower levels.

In District 1, the levels of crop production tended to be higher, while in District 2 the tendency varied between similar and higher levels of crop production. It can also be observed that a larger percentage of the respondents in District 1 reached higher levels of crop production in comparison with the respondents in District 2.

These findings seem to be consistent with the extent of effectiveness in transferring technology and with the levels of adoption of technology determined previously for each one of the districts. It could indicate that the transference of technology and the adoption of technology had a positive impact on crop production, and it was more evident in District 1 than in District 2.

Credit

Kinds of Financial Resources

Question No. 14 of the interview schedule provided the information to determine the kinds of financial resources utilized by DRI farmers for the growing of their crops.
Data in Table 15 indicate that most of the farmers, 63.3 percent in District 1 and 80 percent in District 2, utilized only DRI credit for financing their crops. Other farmers utilized personal resources in addition to DRI credit. The percentage of farmers under this situation was higher in District 1 (35 percent) than in District 2 (20 percent). It could indicate that the amount of credit received by these farmers was not sufficient to grow appropriately their crops.

### TABLE 15

A Comparison of the Kinds of Financial Resources Utilized by DRI Farmers to Grow their Crops by Districts, 1985

<table>
<thead>
<tr>
<th>Kinds of Financial Resources</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRI credit</td>
<td>63.3</td>
<td>80.0</td>
<td>71.7</td>
</tr>
<tr>
<td>Personal resources</td>
<td>1.7</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td>DRI credit plus personal resources</td>
<td>35.0</td>
<td>20.0</td>
<td>27.5</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

One of the respondents in District 1 utilized only personal resources, representing 1.7 percent of the sample in that district and just 0.8 percent of the total sample. This farmer was not provided with DRI credit because he did not meet all the requirements demanded
by the DRI program. Nevertheless, he was receiving technical assistance from the DRI extension program.

It can be determined that the majority of the farmers (99.2 percent) in both districts were provided with DRI credit to allow them to apply the recommended cultural practices.

Length of Time Utilizing DRI Credit

Question No. 16 of the interview schedule provided the information to determine how long the respondents had been utilizing DRI credit.

Table 16 shows that farmers in District 2 had been benefited by the DRI credit program during a longer length of time than farmers in District 1. In fact, most of the respondents (64.4 percent) in District 1 had been utilizing DRI credit for less than two years, and only 35.6 percent during two to five years. In District 2, most of the farmers (60 percent) had been receiving DRI credit for more than five years, 26.7 percent during two to five years, and only 13.3 percent for less than two years.

The data are consistent with the length of time the DRI program had been providing its services to the farmers in each district.
TABLE 16
A Comparison of the Length of Time Farmers Had Been Utilizing DRI Credit by Districts, 1985

<table>
<thead>
<tr>
<th>Length of Time</th>
<th>Percent by District</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District 1 (n=59)</td>
</tr>
<tr>
<td>Less than one year</td>
<td>5.1</td>
</tr>
<tr>
<td>Between one and two years</td>
<td>59.3</td>
</tr>
<tr>
<td>Between two and five years</td>
<td>35.6</td>
</tr>
<tr>
<td>More than five years</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Difficulty in Obtaining DRI Credit

In this study, credit, in terms of difficulty in obtaining a loan, is considered as one of the independent variables.

Question No. 17 of the interview schedule provided the data to determine the levels of difficulty, according to the perception of the farmers.

The statistical analyses applied showed the following (Table 17):

a) There was a significant difference in relation to the levels of difficulty in obtaining DRI credit in District 1 and in District 2.

b) There was not a significant difference in relation to the levels
of difficulty in obtaining DRI credit between District 1 and District 2, at the 0.05 level of confidence.

In fact, most of the farmers in District 1 (80 percent) perceived the process of getting loans as simple, 10 percent as very simple, and 10 percent as difficult. In District 2, eighty three point three percent of the farmers considered the level of difficulty as simple, and the remainder (16.7 percent) as difficult.

TABLE 17
A Comparison of the Farmers' Perception in Relation to the Difficulty in Obtaining DRI Credit by Districts, 1985

<table>
<thead>
<tr>
<th>Levels of Difficulty</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very difficult</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult</td>
<td>10.0</td>
<td>16.7</td>
<td>13.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>80.0</td>
<td>83.3</td>
<td>81.7</td>
<td>0.100</td>
<td>N.S.</td>
</tr>
<tr>
<td>Very simple</td>
<td>10.0</td>
<td>0</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dm.</td>
<td>0.400</td>
<td>0.333</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although the difficulty was slightly more evident in District 2 than in District 1, the process of obtaining DRI credit tended to be simple in the two districts. It could explain, at least in part,
why the majority of the farmers in the two districts had been utilizing DRI credit.

The results could also explain, at least in part, why credit was perceived by farmers as a less important limiting factor of crop productivity.

Timeliness of DRI Credit

Question No. 18 of the interview schedule provided the data to determine timeliness of farmers receiving loans.

The statistical analysis showed that there was not a significant difference between District 1 and District 2 in relation to the timeliness of farmers receiving DRI credit, at the 0.05 level of confidence (Table 18).

TABLE 18
A Comparison of the Farmers' Perception in Relation to Timeliness of DRI Credit by Districts, 1985

<table>
<thead>
<tr>
<th>Percent by District</th>
<th>District 1 (n=59)</th>
<th>District 2 (n=60)</th>
<th>Total (n=119)</th>
<th>X^2</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeliness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delayed</td>
<td>8.5</td>
<td>20.0</td>
<td>14.3</td>
<td>0.804</td>
<td>N.S.</td>
<td></td>
</tr>
<tr>
<td>Timely</td>
<td>91.5</td>
<td>80.0</td>
<td>85.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It can be observed that most of the respondents, 91.5 percent in District 1, and 80 percent in District 2 perceived DRI credit as timely.

**Adequacy of the Amount of DRI Credit**

Question No. 19 of the interview schedule provided the data to determine if the amount of credit received by the farmers was adequate to put in practice all of the technical recommendations to grow their crops.

The statistical analysis indicated that there was not a significant difference between District 1 and District 2 in relation to the perceived adequacy in the amount of DRI credit at the 0.05 level of confidence (Table 19).

**TABLE 19**

A Comparison of the Farmers' Perception in Relation to the Adequacy in the Amount of Money of DRI Credit by Districts, 1985

<table>
<thead>
<tr>
<th>Levels of Adequacy</th>
<th>District 1 (n=59)</th>
<th>District 2 (n=60)</th>
<th>Total (n=119)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not adequate</td>
<td>16.9</td>
<td>11.7</td>
<td>14.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairly adequate</td>
<td>71.2</td>
<td>73.3</td>
<td>72.3</td>
<td>0.052</td>
<td>N.S.</td>
</tr>
<tr>
<td>Adequate</td>
<td>11.9</td>
<td>15.0</td>
<td>13.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data show that most of the respondents, 71.2 percent in District 1 and 73.3 percent in District 2, perceived DRI credit as fairly adequate regarding the amount of money lent.

Only 11.7 percent of the farmers in District 2 perceived the amount of credit as not adequate, while 16.9 percent of the farmers in District 1 did. Inversely, only 11.9 percent of the farmers in District 1 and 15 percent in District 2 considered the amount of credit as adequate to put in practice the technical recommendations.

As it was previously pointed out, the DRI credit program finances almost all of the technical activities or cultural practices required for the growing of the crop. The amount of credit is determined by the extension agent based upon a detailed plan of investments which includes all of the costs of the cultural practices.

Since most of the farmers considered the amount of credit as fairly adequate for the growing of their crops, it could be assumed that those farmers were either using larger amounts of agricultural inputs than those recommended, or they were spending part of the credit for other purposes. If this was true, it seems that there was not sufficient supervision of credit by the DRI program.

Regardless, those assumptions and according to the perception of the farmers, it can be determined that DRI credit tended to be fairly adequate to put into practice all of the technical recommendations on their crops.
Interest Rates of DRI Credit

Question No. 20 of the interview schedule provided the data to determine the perceived levels of interest rates of DRI credit as perceived by the farmers.

The statistical analysis showed that there was not a significant difference between District 1 and District 2 in relation to the perceived levels of interest rates of DRI credit, at the 0.05 level of confidence (Table 20).

<table>
<thead>
<tr>
<th>Levels of Interest Rates</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>30.0</td>
<td>33.3</td>
<td>31.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>63.3</td>
<td>60.0</td>
<td>61.7</td>
<td>0.033</td>
<td>N.S.</td>
</tr>
<tr>
<td>High</td>
<td>6.7</td>
<td>6.7</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The pattern of the levels of interest rates as perceived by the respondents was very similar in the two districts. Most of the farmers, 63.3 percent in District 1 and 60 percent in District 2, considered credit interest rates as moderate. Only 6.7 percent of
the farmers in each one of the districts pointed out that interest rates were high.

It has been considered that the rate of interest of DRI credit is one of the lowest among all of the different agricultural credit programs around the country.

It can be determined, according to the perception of the majority of the farmers, that the interest rates of DRI credit tended to vary between moderate and low in both districts.

Terms for Repaying Loans

Question No. 21 of the interview schedule provided the data to determine the characteristics of DRI credit in relation to the terms for repaying loans as perceived by the farmers.

The statistical analysis indicated that there was not a significant difference in perception between farmers in District 1 and farmers in District 2, at the 0.05 level of confidence, regarding the conditions of terms to pay back loans (Table 21).

The characteristics of DRI credit regarding the terms established for repaying loans was perceived very similarly by the respondents in the two districts. In fact, most of the farmers, 85 percent in District 1 and 76.7 in District 2, considered the terms as moderate. A very low number of farmers, 1.7 percent in District 1 and 6.7 percent in District 2, pointed out the terms as short.
According to the farmers' perception, it can be determined that the terms for repaying loans under the DRI credit program tended to be moderate.

### TABLE 21

A Comparison of the Farmers' Perception in Relation to the Terms Established for Repaying Loans by Districts, 1985

<table>
<thead>
<tr>
<th>Type of Term</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>1.7</td>
<td>6.7</td>
<td>4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>85.0</td>
<td>76.7</td>
<td>80.8</td>
<td>0.050</td>
<td>N.S.</td>
</tr>
<tr>
<td>Long</td>
<td>13.3</td>
<td>16.6</td>
<td>15.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Satisfaction in Relation to the DRI Credit Program**

Information provided by the respondents through question No. 22 of the interview schedule was used to determine the farmers' levels of satisfaction in relation to the DRI credit program.

The statistical analysis showed that there was not a significant difference between the two districts with relation to the levels of satisfaction at the 0.05 level of confidence (Table 22).

In fact, the tendencies of the levels of satisfaction were very similar in both districts. Most of the respondents, 86.6
percent in District 1 and 73.3 percent in District 2, were satisfied with the DRI credit program. Only one farmer, representing 1.7 percent of the sample in District 1, manifested dissatisfaction with the program because he was not provided with DRI credit.

TABLE 22
A Comparison of the Farmers' Levels of Satisfaction in Relation to the DRI Credit Program by Districts, 1985

<table>
<thead>
<tr>
<th>Level of Satisfaction</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not satisfied</td>
<td>1.7</td>
<td>0</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairly satisfied</td>
<td>11.7</td>
<td>26.6</td>
<td>19.2</td>
<td>0.134</td>
<td>N.S.</td>
</tr>
<tr>
<td>Satisfied</td>
<td>86.6</td>
<td>73.3</td>
<td>80.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results are consistent with the perception of the farmers in relation to other characteristics of the credit, such as the levels of difficulty in obtaining loans, timeliness to receive a loan, and the levels of interest rates.

Some of the reasons given by the farmers to support their satisfaction were the following: the DRI program provides the funds needed to apply technical recommendations; this type of credit has helped increase crop yields; DRI credit makes it easier to obtain agricultural supplies; difficulties in growing crops have
decreased with DRI credit; DRI credit is simple to obtain; its rates of interest are lower than in other types of credit; and it is timely.

Some of the farmers who were fairly satisfied pointed out that the DRI credit is sometimes difficult to obtain, or that the amount of money is not sufficient enough, or that the credit is not timely.

It can be determined that the DRI program met the needs of the majority of the farmers in relation to the provision of financial resources to put in practice the technical recommendations for the growing of their crops.

Marketing

Major Uses of Crop Production

Question No. 23 of the interview schedule provided the information to determine the major uses of the crop production obtained by the farmers.

Table 23 shows that the major use of crop production was marketing in District 1, and marketing and family consumption in District 2.

In District 1, seventy percent of the farmers marketed all of their crop production, 15 percent used it for marketing, family consumption and seed, and 13.3 percent for marketing and seed. The farmers who sold all of their crop production were growing sorghum
or sesame, two crops used for industry. The few farmers who used their crop production for marketing, family consumption, and seed were growing corn.

### TABLE 23

A Comparison of the Major Uses of Crop Production by Districts, 1985

<table>
<thead>
<tr>
<th>Major Uses</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>70.0</td>
<td>30.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Marketing and family consumption</td>
<td>1.7</td>
<td>55.0</td>
<td>28.3</td>
</tr>
<tr>
<td>Marketing and seed</td>
<td>13.3</td>
<td>11.7</td>
<td>12.5</td>
</tr>
<tr>
<td>Marketing, family consumption, and seed</td>
<td>15.0</td>
<td>3.3</td>
<td>9.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

In District 2, thirty percent of the farmers sold all of their crop production, 11.7 percent used it for marketing and seed, and 55 percent for marketing and family consumption. The use of a part of the crop production for family consumption can be explained since farmers in this district were growing green peas and green beans.

It can be observed that 28.3 percent of the farmers in District 1 and 15 percent in District 2 used a part of their crop production for seed. This practice is not recommended since the seed obtained is not of good quality. The DRI program has recommended the use of
new certified seed for each one of the crops involved in this study. It was determined that these farmers did not adopt this technology. It could explain, at least in part, the findings obtained in Tables 11 and 12, in relation to the levels of adoption of technology. None of the farmers used their crop production for family consumption and/or for seed, only. It shows that the major use of crop production was for sale since it represented the principal source of the farm income.

Difficulty in the Marketing Process

In this study, marketing, in terms of difficulty in marketing crop production, is considered as one of the independent variables. Question No. 24 of the interview schedule provided the data to determine the levels of difficulty, according to the perception of the farmers.

The statistical analyses showed the following (Table 24):

a) There was a significant difference in farmers' perception in relation to the levels of difficulty for marketing crop production in District 1 and in District 2.

b) There was not a significant difference in farmers' perception in relation to the levels of difficulty for marketing crop production between District 1 and District 2, at the 0.05 level of confidence.
TABLE 24

A Comparison of the Farmers' Perception in Relation to the Difficulty in Marketing Crop Production by Districts, 1985

<table>
<thead>
<tr>
<th>Levels of Difficulty</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very difficult</td>
<td>10.0</td>
<td>0</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult</td>
<td>65.0</td>
<td>73.3</td>
<td>69.2</td>
<td></td>
<td>0.100 N.S.</td>
</tr>
<tr>
<td>Easy</td>
<td>23.3</td>
<td>26.7</td>
<td>25.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very easy</td>
<td>1.7</td>
<td>0</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dm.</td>
<td>0.250</td>
<td>0.250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In fact, most of the farmers in District 1 (65 percent) considered the process of marketing their crop production as difficult, 10 percent as very difficult, 23.3 percent as easy, and only 1.7 percent as very easy. In District 2, most of the farmers (73.3 percent) perceived the marketing process as difficult and the remainder (26.7 percent) as easy.

Although the process of marketing crop production was considered as slightly easier in District 1 than in District 2, it tended to be difficult in both districts. It could explain, at least in part, why most of the farmers perceived marketing as the most limiting factor of crop productivity.
Sale Price of Crop Production

Question No. 25 was used to obtain the opinion of the respondents in relation to the prices they received for their crop production.

The statistical analysis showed that there was not a significant difference in farmers' perception between District 1 and District 2 in relation to the conditions of the sale price for the crop products at the 0.05 level of confidence (Table 25).

The data indicated that most of the respondents, 68.3 percent in District 1 and 61.7 in District 2, perceived prices as unfavorable. It was also observed that 15 percent of the farmers in District 1 and 38.3 percent in District 2 considered the sale prices as just. In District 1, only five percent of the farmers pointed out favorable prices and 11.7 percent unfavorable sale prices.

Although the sale conditions seemed to be perceived slightly more just in District 2 than in District 1, the perception of sale prices of crop production tended to be unfavorable in both districts.

These results could also explain, at least in part, why marketing was considered by the farmers as the principal limitation for better crop productivity.
TABLE 25

A Comparison of the Farmers' Perception in Relation to the Conditions of the Sale Price for Crop Production by Districts, 1985

<table>
<thead>
<tr>
<th>Conditions of the Sale Price</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>Dm.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very unfavorable</td>
<td>11.7</td>
<td>0</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavorable</td>
<td>68.3</td>
<td>61.7</td>
<td>65.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Just</td>
<td>15.0</td>
<td>38.3</td>
<td>26.7</td>
<td>0.183</td>
<td>N.S.</td>
</tr>
<tr>
<td>Favorable</td>
<td>5.0</td>
<td>0</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very unfavorable</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Membership in Marketing Organizations

Question No. 26 of the interview schedule provided the data to determine farmers' membership in marketing organizations.

Table 26 presents a comparison of the membership of farmers in marketing organizations between District 1 and District 2. The statistical analysis showed a significant difference between the two districts.

The data indicated that a very low number of respondents were members of these types of organizations. In District 1, only a small minority of the farmers (15 percent) were members of two
TABLE 26
A Comparison of Farmers' Membership in Marketing Organizations by Districts, 1985

<table>
<thead>
<tr>
<th>Membership</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
<th>$X^2_{1 df}$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>85.0</td>
<td>96.7</td>
<td>90.8</td>
<td>3.606</td>
<td>0.058</td>
</tr>
<tr>
<td>Yes</td>
<td>15.0</td>
<td>3.3</td>
<td>9.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

pre-cooperative groups organized by the DRI program. In this instance, farmers felt they were receiving fairer prices for their products. In District 2, the situation was more critical since only 3.3 percent of the farmers were members of private marketing organizations. Nevertheless, they did not sell their products to those organizations.

The majority of the farmers were selling their production to intermediaries under perceived unfavorable conditions of sale prices.

It can be determined that the majority of the farmers covered by the DRI program were not organized for marketing their crop production. They lacked sufficient appropriate marketing organizations.
Marketing Channels

Question No. 27 of the interview schedule provided the data to determine where the farmers sold their crop production.

Table 27 presents a comparison of the channels used by the farmers for marketing their crop production. The statistical analysis was not applied because of inadequacies in some cell frequencies.

The data showed that the majority of the farmers, 81.7 percent in District 1 and 100 percent in District 2, sold their crop production to intermediaries. Only 18.3 percent of the farmers in District 1 used a marketing organization for selling their products.

It can be determined that the intermediaries were the principal channel through which farmers marketed their farm production. It could indicate that the farmers covered by the DRI program, and affected by this unfavorable situation, were restraining their possibilities for improving farm incomes since the sale prices they received from the intermediaries were not the best.

These results could also support, at least in part, why marketing was considered by the farmers as the principal limitation for better crop productivity.
TABLE 27

A Comparison of the Channels Used by the Farmers for Marketing Crop Production by Districts, 1985

<table>
<thead>
<tr>
<th>Marketing Channels</th>
<th>District 1 (n=60)</th>
<th>District 2 (n=60)</th>
<th>Total (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the farm at retail</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In the market place at retail</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>To intermediaries</td>
<td>81.7</td>
<td>100.0</td>
<td>90.8</td>
</tr>
<tr>
<td>To farmer cooperatives, pre-cooperative groups or other marketing organizations</td>
<td>18.3</td>
<td>0</td>
<td>9.2</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The Chi-square ($X^2$) test was not calculated because of inadequacies in some cell frequencies.

Marketing Difficulties

Question No. 28 of the interview schedule provided the information to determine the most salient difficulties farmers faced in marketing their crop production.

The respondents had the opportunity to indicate up to five difficulties they considered were problems in the process of marketing their products. Since the majority of the farmers pointed out more than one difficulty, the total frequencies obtained were larger than
the total number of respondents in each district. They were 145 in District 1 and 218 in District 2.

Table 28 presents the results obtained in relation to the identification of the most salient difficulties faced by the farmers in the process of marketing their crop products. The difficulties are listed following a descending frequency order.

The most frequent difficulty mentioned by 25.1 percent of the total sample was that the intermediaries were the only buyers of crop production. A little higher proportion was observed in District 1, where 25.5 percent of the farmers mentioned this difficulty as compared with 24.8 percent of the farmers in District 2.

Unfavorable sale prices offered for crop products was the next difficulty considered by 23.2 percent of the total sample. A much higher proportion was observed in District 1, where 32.4 percent of the farmers mentioned this difficulty, as compared with 17 percent of the farmers in District 2. These results are consistent with the findings obtained in Table 25, where it was found that 38.3 percent of the farmers in District 2 felt they received just prices for their crop production, compared with 15 percent of the farmers in District 1.

Those two difficulties seem to be closely related since it has been demonstrated that, in most of the cases, the intermediaries have been considered as the worst marketing channels because of unfavorable price conditions they offer to the farmers for their crop production.
<table>
<thead>
<tr>
<th>Marketing Difficulties</th>
<th>Percent by District</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District 1 (n=145)</td>
</tr>
<tr>
<td>The only buyers are intermediaries</td>
<td>25.5</td>
</tr>
<tr>
<td>Unfavorable sale prices</td>
<td>32.4</td>
</tr>
<tr>
<td>Lack of farmer cooperatives or similar marketing org.</td>
<td>14.5</td>
</tr>
<tr>
<td>Lack of or inappropriate price support policy</td>
<td>9.6</td>
</tr>
<tr>
<td>Few buyers or few market channels</td>
<td>15.9</td>
</tr>
<tr>
<td>Too much crop production in the area</td>
<td>0</td>
</tr>
<tr>
<td>Lack of or inadequate government assistance</td>
<td>2.1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

The third marketing difficulty considered by 17.6 percent of the total sample was related to the lack of farmer cooperatives or similar marketing organizations. A higher proportion was observed in District 2, where 19.7 percent of the farmers mentioned this difficulty as compared with 14.5 percent of the farmers in District 1. These findings are consistent with the results obtained in Table 26, where it was found that only 3.3 percent of the farmers...
in District 2 were members of any marketing organization compared with 15 percent of the farmers in District 1.

The lack of or inappropriate price support policy was another marketing limitation considered by 13.5 percent of the total sample. A higher proportion was observed in District 2, where 16 percent of the farmers mentioned this difficulty as compared with 9.6 percent of the farmers in District 1. It seems that the government price support policies did not benefit small farmers as they did with large farmers. In fact, prices for small volumes of crop production are imposed by the chain of intermediaries, and according to the supply and demand of the product. On the other hand, there are not appropriate price support policies appropriate for perishable products. In this instance, the situation was more critical in District 2, where the crops grown were green peas and green beans, as compared with District 1, where the crops grown were sorghum, sesame, and corn.

The amount of crop production in the area as a marketing difficulty was considered only in District 2 by 14.2 percent of the farmers. In fact, green peas and green beans are harvested by the farmers generally three times in a year, almost at the same time. These perishable products can not be stored for any length of time. Crop production has to be sold as quickly as possible. As the volumes of crop production increase, the amount offered increases and the sale price decreases.
Few buyers or few market channels were considered as another marketing difficulty by 9.9 percent of the total sample. A higher proportion was observed in District 1, where 15.9 percent of the farmers mentioned this difficulty as compared with six percent of the farmers in District 2. It is not easy to determine the real reason for this tendency. Nevertheless, the farmers' perception in relation to this difficulty seemed to be related to the first one listed when the respondents considered the intermediaries as the only buyers of the crop production.

Finally, the lack of or inadequate government assistance was also considered as a difficulty in marketing crop production by 2.1 percent of the respondents in District 1 and by 2.3 percent in District 2. It seemed that this claim was related by the farmers to an inadequate marketing policy of the DRI program which had not benefited them.

The lack of or inappropriate transportation facilities, and the lack of or inappropriate storage facilities were not considered by the farmers in any of the two districts as marketing difficulties. In fact, the intermediaries or the pre-cooperative groups picked up most of the crop products directly from the farms as soon as they were harvested and packed up.
Satisfaction in Relation to the DRI Marketing Program

Information provided by the respondents through question No. 29 of the interview schedule was used to determine the farmers' levels of satisfaction in relation to the DRI marketing program.

The statistical analysis showed that there was not a significant difference between the two districts in relation to the levels of satisfaction (Table 29), at the 0.05 level of confidence.

<table>
<thead>
<tr>
<th>Levels of Satisfaction</th>
<th>Percent by District</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District 1 (n=60)</td>
<td>District 2 (n=60)</td>
</tr>
<tr>
<td>Not satisfied</td>
<td>75.0</td>
<td>96.7</td>
</tr>
<tr>
<td>Fairly satisfied</td>
<td>25.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Satisfied</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

In fact, the tendency of the levels of satisfaction was similar since most of the respondents, 75 percent in District 1 and 96.7 percent in District 2, were not satisfied with the DRI marketing program. Only 25 percent of the farmers in District 1 and 3.3 percent in District 2 were fairly satisfied with this program.
The results are consistent with the perception of the farmers in relation to other characteristics of the marketing process, such as the levels of difficulty for marketing their crop production, the conditions of sale prices for crop production, the availability of farmers' marketing organizations, and the marketing channels available to sell the crop production.

The majority of the farmers claimed that they did not have an appropriate marketing program to help them sell their crop production under more favorable conditions. Some of the farmers who were fairly satisfied were those who made use of the facilities offered by the pre-cooperative groups in District 1.

It can be determined that the DRI marketing program had not met the expectations and needs of the farmers in relation to an appropriate marketing policy which facilitates the marketing of crop products under more favorable conditions.

**Relationships Between Variables**

Data used to determine the relationships or degrees of association between dependent and independent variables are presented in Appendix B.

The independent variables transfer of technology (extension), in terms of effectiveness in transferring technology; credit, in terms of difficulty in obtaining credit; and marketing, in terms of difficulty in marketing crop production, were related to the dependent
variables adoption of technology, in terms of levels of adoption of recommended cultural practices, and crop production, in terms of changes in crop yields. The variable, adoption of technology, was considered as an independent variable when it was related to the dependent variable crop production. Seven hypotheses of association between variables were stated.

The Goodman and Kruskal Coefficient "gamma" (G) was used as a measure of correlation to determine the degree of association between the independent and the dependent variables. The gamma values vary between -1, indicating a perfect negative relationship or association, and +1, indicating a perfect positive relationship or association. A value of 0 indicates no association; i.e., the variables may be independent of each other (8, p. 412).

Table 30 shows the sizes of the samples (n), the gamma (G) values, and the levels of probability (P) used to determine statistically significant differences of the variables that were measured. Those farmers who did not use any of the selected crop practices recommended by the DRI program (non adoption category) were not included in determining changes in crop production (lower, similar, higher), since it was not possible to make a comparison between the crop yields "before" and "after" adoption of the recommended cultural practices. Only one farmer in District 1 and two farmers in District 2 were included in the non adoption category. The missing values in the set of data in Table 30 correspond to these farmers.
TABLE 30
Relationships of the Selected Independent Variables with Adoption of Technology and Crop Production by Districts, 1985

<table>
<thead>
<tr>
<th>Variables</th>
<th>District 1</th>
<th>District 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>G</td>
<td>P</td>
</tr>
<tr>
<td>Adoption of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension</td>
<td>60</td>
<td>1.000</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Credit</td>
<td>60</td>
<td>0.369</td>
<td>N.S.</td>
</tr>
<tr>
<td>Marketing</td>
<td>60</td>
<td>0.392</td>
<td>N.S.</td>
</tr>
<tr>
<td>Crop Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension</td>
<td>59</td>
<td>0.932</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Credit</td>
<td>59</td>
<td>0.546</td>
<td>N.S.</td>
</tr>
<tr>
<td>Marketing</td>
<td>59</td>
<td>0.331</td>
<td>N.S.</td>
</tr>
<tr>
<td>Adoption</td>
<td>59</td>
<td>0.966</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
The following are the results of the tests performed in relation to each one of the stated hypothesis:

**Hypothesis 1** "There is not an association between adoption of agricultural technology and effectiveness in transferring technology."

As it can be observed from Table 30 the gamma values obtained were 1.000; 0.918; and 0.942 for District 1, District 2, and the total sample, respectively. These values indicated a strong positive association between the two variables.

In fact, it can be seen from the data in Table 1, Appendix B, that the levels of adoption tended to be higher as the extent of effectiveness in transferring technology tended to be more effective.

The few farmers who did not adopt (1.7 percent in District 1; 10 percent in District 2; and 5.8 percent in the total sample) were those who provided the information that said that the transfer of technology was not effective. The majority of the farmers who reported low levels of adoption (21.6 percent in District 1; 45 percent in District 2; and 33.3 percent in the total sample) were those who felt that the information received in the transfer of technology process was slightly effective. Most of the farmers who obtained fair and high levels of adoption (76.7 in District 1; 45 percent in District 2; and 60.9 in the total sample) were those who felt that the information provided in the transfer of technology process was effective or fairly effective.
The test of significance indicated that the relationships observed were statistically significant (Table 30), so the null hypothesis is rejected. The gamma values were not likely to have occurred only by chance. It is concluded, therefore, that there was a significant association between adoption of agricultural technology and effectiveness in transferring technology.

Hypothesis 2. "There is not an association between adoption of agricultural technology and difficulty in obtaining credit."

As it can be observed from Table 30, the gamma values obtained were 0.369; 0.085; and 0.268 for District 1, District 2, and the total sample, respectively. These values indicated low positive but not significant associations between the two variables in District 1 and in the total sample, and a highly insignificant association in District 2.

From the data in Table 2, Appendix B, it can be seen that the respondents who obtained fair and high levels of adoption (76.7 percent in District 1; 45 percent in District 2; and 60.9 percent in the total sample) tended to consider as simple the process of obtaining DRI credit. Only 10 percent of the farmers in District 1 and five percent in the total sample, under this situation, considered this process as very simple. Similarly, most of the farmers who obtained low levels of adoption or who did not adopt tended to perceive as simple the process of obtaining credit. Only 1.7 percent of the farmers in District 2 and 0.8 percent in the total sample,
under this situation, considered as difficult the process of obtaining credit. In other words, the majority of the respondents (80 percent in District 1; 83.3 percent in District 2; and 81.7 percent in the total sample) considered as simple the process of obtaining credit, but only 11.7 percent of the farmers in District 1; 10 percent in District 2; and 10.8 percent in the total sample adopted all of the selected recommended cultural practices.

The test of significance indicated that the tendencies observed were not statistically significant (Table 30) for the purposes of this study, so the null hypothesis is accepted. It is concluded, therefore, that there was not a significant association between adoption of agricultural technology and difficulty in obtaining credit.

The findings indicated that only 14.2 percent of the total sample adopted all of the recommended cultural practices, that 80 percent adopted partially those new technologies, and that 5.8 percent did not adopt any recommendation. The findings also indicated that DRI credit was not difficult to obtain, and that the majority of the farmers (99.2 percent) (Table 15) were provided with financial resources by the DRI program for growing their crops. It can be inferred that credit was not necessarily a determinant factor to facilitate or to encourage adoption of technology. It could be also inferred that not all the financial resources were invested by the farmers in the growing of their crops.
Hypothesis 3. "There is not an association between adoption of agricultural technology and difficulty in marketing crop production."

As it can be observed from Table 30, the gamma values obtained were 0.392; 0.147; and 0.185 for District 1, District 2, and the total sample, respectively. These values indicated a low positive, but insignificant association between the two variables.

From the data in Table 3, Appendix B, it can be seen that more than half of the respondents (55 percent in District 1; 53.3 in District 2; and 54.2 in the total sample) considered the process of marketing crop production as difficult and presented low or fair levels of adoption. The farmers who did not adopt technology (1.7 percent in District 1; 10 percent in District 2, and 5.8 percent in the total sample) also considered the marketing process as difficult. Only 6.7 percent of the farmers in District 1; 1.7 percent in District 2; and 4.1 percent in the total sample, perceived this process as easy or very easy and presented high levels of adoption of technology.

The test of significance indicated that the relationships observed were not statistically significant (Table 30) for the purposes of this study, so the null hypothesis is accepted. The low associations observed in the data could be merely due to sampling error. It is concluded that there was not a significant association between adoption of agricultural technology and difficulty in marketing crop production.
The findings indicated that 74.2 percent of the total sample had difficulties in marketing crop production and that 25.8 percent did not. The results show also that 39.1 percent of the farmers had low levels of adoption or that they did not adopt any recommended cultural practices, and that 60.9 percent had fair to high levels of adoption. It can be inferred that the difficulty in marketing crop production was not necessarily a determinant factor impeding many farmers to adopt technology. Nevertheless, this factor could be affecting, at least in part, the adoption process. It could indicate the presence of other factors or variables limiting the adoption of agricultural technology.

Hypothesis 4. "There is not an association between increase in crop yields and effectiveness in transferring technology."

As it can be observed from Table 30, the gamma values obtained were 0.932; 0.914; and 0.940 for District 1, District 2, and the total sample, respectively. These values indicated a strong positive association between the two variables.

In fact, it can be seen from the data in Table 4, Appendix B, that the proportion of the farmers increases as the levels of crop yields become higher and the extent of effectiveness in transferring technology also become more effective.

The few farmers who had a lower level of crop yield (zero percent in District 1; 10.3 percent in District 2; and 5.1 percent in the total sample) were those who provided the information
considering that the transfer of technology was not effective or slightly effective. The farmers who obtained a similar level of crop yield (22 percent in District 1; 46.6 percent in District 2; and 34.2 percent in the total sample) provided different information in relation to the effectiveness of the transfer of technology, ranging from not effective to very effective. Finally, 78 percent of the farmers in District 1; 43.1 percent in District 2; and 60.7 percent in the total sample, obtained a higher level of crop yield. The majority of these farmers provided information considering the transfer of technology as fairly effective or effective. Only 1.7 percent of the farmers in District 1; 5.2 percent in District 2; and 3.4 percent in the total sample, with a higher level of crop yield, provided information considering the transfer of technology as slightly effective.

The test of significance indicated that the differences observed were statistically significant (Table 30), so the null hypothesis is rejected. The gamma values are not likely to have occurred by chance. It is concluded, therefore, that there was a significant association between increase in crop yields and effectiveness in transferring technology.

Hypothesis 5. "There is not an association between increase in crop yields and difficulty in obtaining credit."

As it can be observed from Table 30, the gamma values obtained were 0.546; -0.015; and 0.349 for District 1, District 2, and
the total sample, respectively. These values indicated a moderate positive but insignificant association between the two variables in District 1, a low positive but insignificant association in the total sample, and an insignificant negative association in District 2.

From the data in Table 5, Appendix B, it can be seen that 79.6 percent of the farmers in District 1; 75.9 percent in District 2; and 77.8 percent in the total sample, considered credit as simple to obtain and had a similar or a higher level of crop yield. Only 8.6 percent of the farmers in District 2 and 4.3 percent in the total sample considered credit as simple to obtain and had a lower level of crop yield. The data from District 1 and from the total sample seemed to indicate that there was a tendency of crop yields to be higher when the farmers considered as simple the process of obtaining credit, while in District 2 the crop yields tended to be similar or higher when the process of obtaining a credit was also considered as simple.

The test of significance indicated that the tendencies observed were not statistically significant (Table 30) for the purposes of this study, so the null hypothesis is accepted. The low and insignificant associations observed in the data could be merely due to sampling error. It is concluded that there was not a significant association between increase in crop yields and difficulty in obtaining credit.
Hypothesis 6 "There is not an association between increase in crop yields and difficulty in marketing crop production."

As it can be observed from Table 30, the gamma values obtained were 0.331; 0.292; and 0.172 for District 1, District 2, and the total sample, respectively. These values indicated a low positive but insignificant association between the two variables.

From the data in Table 6, Appendix B, it can be seen that a high proportion of the respondents (64.4 percent in District 1; 72.4 percent in District 2; and 68.4 percent in the total sample) corresponded to those farmers who considered the process of marketing crop production as difficult. The majority of those farmers had similar or higher levels of crop yield. Only 10.3 percent of the farmers in District 2 and 5.1 percent in the total sample obtained a lower level of crop yield. On the other hand, the majority of the farmers (100 percent in District 1; 89.7 percent in District 2; and 94.9 percent in the total sample) reported similar or higher levels of crop yields. Due to the large proportion of farmers considering the marketing process as difficult and the large proportion of farmers in the higher level of crop yields, the data seemed to indicate that in District 1 and in the total sample the level of crop yield tended to be higher when the marketing process was difficult, while in District 2 the level of crop yield tended to be similar when the marketing process was difficult.

The test of significance indicated that the tendencies observed were not statistically significant (Table 30) for the purposes
of this study, so the null hypothesis is accepted. The low association observed in the data could be merely due to sampling error. It is concluded that there was not a significant association between increase in crop yields and difficulty in marketing crop production.

**Hypothesis 7.** "There is not an association between increase in crop yields and adoption of agricultural technology."

As it can be observed from Table 30, the gamma values obtained were 0.966; 0.964; and 0.985 for District 1, District 2, and the total sample, respectively. These values indicated a strong positive association between the two variables.

In fact, it can be seen from the data in Table 7, Appendix B, that the levels of crop yield tended to be higher as the levels of adoption tended also to be higher.

The few farmers who obtained a lower level of crop yield (zero percent in District 1; 10.3 percent in District 2; and 5.1 percent in the total sample) were non adopters or presented low levels of adoption. The farmers who obtained a similar level of crop yield (22 percent in District 1; 46.6 percent in District 2; and 34.2 percent in the total sample) tended to have low levels of adoption, while the farmers who obtained a higher level of crop yield (78 percent in District 1; 43.1 percent in District 2; and 60.7 percent in the total sample) tended to have fair to high levels of adoption.

The test of significance indicated that the tendencies observed were statistically significant (Table 30), so the null hypothesis
is rejected. The gamma values were not likely to have occurred only by chance. It is concluded, therefore, that there was a significant association between increase in crop yields and adoption of agricultural technology.

In conclusion, no statistically significant associations were found between the independent variables credit and marketing and each one of the dependent variables adoption of technology and crop production.

A strong positive association was found between the independent variable transfer of technology (extension) and each one of the dependent variables adoption of technology and crop production. From the findings it can also be inferred a significant positive association between adoption of technology and crop production.
CHAPTER V
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The development of the traditional rural sector in Colombia has been slow due to its many technological, economic, and social problems. Most of this sector is characterized by low agricultural production and productivity, due principally to its limitations in relation to availability of and access to appropriate farm technology, availability of sufficient financial resources, and availability of adequate marketing systems and facilities.

As a strategy for accelerating the development of the rural sector, the government established the Integrated Rural Development Program - DRI - in 1975. Its purpose is oriented to improve the economic and social conditions of the rural population.

The DRI program includes the agricultural production component which is aimed at improvement of the economic situation of rural families by increasing farm income through increased agricultural production and productivity.

Agricultural production and productivity can improve when the different factors of the agricultural production component (research, extension, credit, and marketing) are available for efficient
application by the farmers on their farms. Nevertheless, this condition is not always present in DRI areas. The availability of appropriate technology, the effectiveness in transferring this technology, the availability of sufficient financial resources, the availability of adequate marketing systems and facilities, the farmers' interest and motivation to adopt technology, etc., are not always the same, varying from one DRI district to another. In this case, agricultural productivity could be limited to the extent in which these factors are lacking.

**Purposes and Objectives of the Study**

The general purposes of this study were:

1. To determine the extent to which selected factors were limiting crop productivity in areas of integrated rural development as perceived by farmers, and to identify relevant characteristics of some of these factors.

2. To determine the extent to which these selected factors were associated with the adoption of agricultural technology and with the increase of crop yields.

3. To determine the levels of farmers' satisfaction as related to the selected crop productivity limiting factors.

The specific objectives of this study were:

1. To determine the extent to which research, extension, credit, marketing, farmland, and other factors were limiting crop
productivity at the farm level in areas of integrated rural development as perceived by farmers.

2. To determine the extent to which the DRI program was effectively transferring agricultural technology in areas of integrated rural development.

3. To determine the extent to which farmers had adopted recommended crop production practices, and to determine some of the reasons why farmers had not adopted new technology in areas of integrated rural development.

4. To determine changes in crop production in areas of integrated rural development.

5. To determine some relevant characteristics of the DRI credit program and the DRI marketing program in areas of integrated rural development as perceived by farmers.

6. To determine the farmers' satisfaction levels in relation to the DRI technical assistance program, the DRI credit program, and the DRI marketing program.

7. To determine the extent of association between adoption of technology and a) effectiveness in transferring technology (technical assistance), b) difficulty in obtaining credit, and c) difficulty in marketing crop production.

8. To determine the extent of association between increase in crop yields and a) effectiveness in transferring technology,
b) difficulty in obtaining credit, c) difficulty in marketing crop production, and d) adoption of technology.

Research Methodology

This study was conducted in two districts where the Integrated Rural Development program is being carried out, the South Tolima District (District 1), the newer one, and the Fusagusagá District (District 2), the older one. The principal crops grown and selected in each district were sesame, sorghum, and corn in District 1 and green peas and green beans in District 2.

A proportionate stratified random sample was drawn to assure that the total number of farmers growing the various crops selected in this study were equally represented in the sample.

Sixty DRI farmers were selected at random for the total number of clients in each district for a total sample of 120 respondents to be interviewed. The sample in District 1 was composed of 30 sesame growers, 18 sorghum growers, and 12 corn growers. The sample in District 2 was composed of 40 green peas growers and 20 green beans growers.

An interview schedule was used to collect the data. It was pretested and some adjustments were made to avoid misunderstandings and to improve the validity of the questionnaire. Questions were related to the components of the research model and to the objectives previously stated. Specific questions were used to determine the
characteristics of the independent and dependent variables as perceived by farmers. These variables as used in this study were the following:

**Independent Variables:**
- Transfer of technology, in terms of effectiveness in transferring technology;
- Credit, in terms of difficulty in obtaining credit; and
- Marketing, in terms of difficulty in marketing crop production.

**Dependent Variables:**
- Adoption of technology, in terms of levels of adoption of recommended cultural practices; and
- Crop production, in terms of changes in crop yields.

The data obtained through the questions were also used to determine the extent of association between independent and dependent variables, as well as to measure other variables related to the extent of limitation of crop productivity factors, the characteristics of the DRI transfer of technology process, some of the reasons why farmers did not adopt crop recommendations, the characteristics of the DRI credit program, the characteristics of the DRI marketing program, the most salient difficulties in marketing crop products, and the levels of farmers' satisfaction in relation to the DRI technical assistance program, the DRI credit program, and the DRI marketing program.
After the respondents were interviewed, data were coded and processed through the facilities of the System Network Computer Center (SNCC) at Louisiana State University.

The statistical methods applied to analyze the data were the Chi-Square ($X^2$) goodness-of-fit test, the Chi-Square ($X^2$) test of independence when the data were measured at a nominal level, the Kolmogorov-Smirnov (K-S) one-sample and two-sample tests, and the Goodman and Kruskal "gamma" (G) procedure when the data were measured at an ordinal level.

The Chi-Square ($X^2$) goodness-of-fit test was used to determine differences in frequency distribution in relation to the crop productivity limiting factors in each district.

The Chi-Square ($X^2$) test of independence was used to determine differences in frequency distributions between District 1 and District 2 in relation to the following variables: crop productivity limiting factors, means of transferring technology, timeliness of DRI credit, farmers' membership in marketing organizations, and marketing channels used.

The Kolmogorov-Smirnov (K-S) one-sample test was used to determine differences in frequency distribution in each district in relation to the following variables: effectiveness in transferring technology, adoption of technology, levels of crop production, difficulties in obtaining DRI credit, and difficulty in marketing crop products.
The Kolmogorov-Smirnov (K-S) two-sample test was used to determine differences in frequency distribution between District 1 and District 2 in relation to the following variables: extent of limitation of crop productivity factors, effectiveness in transferring technology, adoption of technology, crop production, difficulty in obtaining DRI credit, sufficiency of DRI credit, interest rates of DRI credit, terms for repayment of loans, difficulty in marketing crop products, sale price of crop products, and farmers' satisfaction in relation to DRI technical assistance, the DRI credit program, and the DRI marketing program.

Percentages, frequencies, and averages were used to present and describe the following variables: length of time of DRI services, size of the farms and amount of farmland in crops and pasture, land tenure status, use of recommended cultural practices, reasons for non adoption of technology, kinds of financial resources, length of time utilizing DRI credit, major uses of crop production, and marketing difficulties.

The Goodman and Kruskal Coefficient "gamma" (G) was used to test the hypothesized associations between the independent and dependent variables.

The 0.05 level of probability was used to indicate statistically significant differences among categories, variables, or between districts.
Findings

The following are the principal findings obtained in this study:

1. **Length of Time of DRI Services.** Farmers in District 2 were exposed for longer periods of time, as expected, to the different activities of the DRI extension program, compared with the farmers in District 1.

2. **Size of Farms.** The average size of farm in District 1 was nine hectares compared with 4.4 hectares in District 2. It confirms that one of the characteristics of the two districts was the high concentration of "minifundia". Nevertheless, this situation was more critical in District 2 than in District 1.

3. **Amount of Farmland Dedicated to Crops and Pasture.** The average amount of farmland per farm dedicated to these activities was 8.3 hectares in District 1 compared with 4.3 hectares in District 2. The ratio between the average amount of farmland utilized in crops and pastures and the average size of farm showed that farmers in District 1 utilized an average of 92.2 percent of their farmland in agricultural production compared with 97.7 percent in District 2. It indicates that farmers in District 2 utilized more intensively their land resource.
4. **Land Tenure Status.** Ownership was the predominant land tenure status in the two districts (71.7 percent in District 1 and 76.7 percent in District 2), followed by lessees and share-tenants. It supported one of the policies of the DRI program in the sense that land tenure status must not be a major constraint in DRI areas.

5. **Crop Productivity Limiting Factors in each District.** In District 1, the most frequent limiting factor, as perceived by the farmers, was marketing (39.8 percent), followed by climatic conditions (25.8 percent), farmland (23.4 percent), credit (5.5 percent), research (3.9 percent), and extension (1.6 percent). These differences were statistically significant (P<0.001).

In District 2 the most frequent limiting factor, as perceived by the farmers, was also marketing (40.9 percent), but followed by extension (25.2 percent), research (15.7 percent), climatic conditions (15 percent), farmland (1.6 percent), and credit (1.6 percent). These differences were statistically significant (P<0.001).

A comparison between District 1 and District 2 in relation to the farmers' perception about the limitation of each one of the selected factors showed the following:

5.1. **Research.** Twenty point eight percent of the total sample reported research as a limiting factor. However, this situation was less critical in District 1 where only 8.3 percent of the farmers mentioned this as a limitation compared with District 2 where
33.3 percent of the farmers did. This difference was statistically significant (P=0.002).

5.2. **Extension.** Technical assistance or transfer of technology was reported as a limiting factor by 28.3 percent of the total sample. There was a marked difference in perception between the respondents of the two districts in relation to this factor. In District 1, very few farmers (3.3 percent) considered the lack of technical assistance or its inadequacy as a limitation for better crop productivity, while more than half of the farmers (53.3 percent) in District 2 did. Extension was the less frequent factor mentioned by the respondents in District 1, while in District 2 it was, after marketing, the second most frequently mentioned limiting factor. The difference in relation to this factor between District 1 and District 2 was statistically significant (P=0.001).

5.3. **Credit.** Only 7.5 percent of the total sample perceived credit as a limiting factor of crop productivity. It was the less frequent factor mentioned by the respondents considering the two districts together. Just 3.3 percent of the farmers in District 2 and 11.6 percent in District 1 perceived credit as a problem to grow their crops. This difference was not statistically significant at the 0.05 level of confidence.

5.4. **Marketing.** This factor was considered by the majority of the total sample (85.8 percent) as the most critical limitation in crop
productivity. Marketing was the most frequently mentioned factor in each of the two districts. Eighty-five percent of the farmers in District 1 and 86.7 percent in District 2 perceived marketing as the principal factor limiting better crop productivity on their farms. This difference was not statistically significant at the 0.05 level of confidence.

5.5. Farmland. This factor was reported as a limitation by 26.7 percent of the total sample. There was a marked difference in perception between the respondents of the two districts in relation to farmland. Fifty percent of the farmers in District 1 and only 3.3 percent in District 2 considered farmland as a limiting factor of crop productivity. This difference was statistically significant (P=0.001).

5.6. Climate. This factor was the second most frequent limiting factor mentioned by the total sample (43.3 percent). The situation was most critical in District 1 where 55 percent of the farmers mentioned climatic conditions as a limitation of crop productivity compared with District 2 where 31.7 percent of the farmers did. This difference was statistically significant (P=0.017).

6. Extent of Limitation. No significant statistical differences in perception were found, at the 0.05 level of confidence, between District 1 and District 2 in relation to the extent of limi-
tation of each one of the crop productivity limiting factors. Nevertheless, the following tendencies were observed:

6.1 Research. The extent of limitation of this factor seemed to be slightly lower in District 1 than in District 2. Farmers affected by research in District 1 assigned only a low extent of limitation to research, while in District 2, fifty five percent of the respondents perceived the extent of limitation as low, 40 percent as fair, and five percent as high. The tendency of the extent of limitation for this factor was low in District 1 and between low and fair in District 2.

6.2 Extension. The perceived extent of limitation of extension seemed to be lower in District 1 than in District 2. In District 1, no one assigned a high extent of limitation to this factor, while in District 2, about 28 percent of the farmers did. However, the tendency of the extent of limitation of extension was between low and fair in the two districts.

6.3 Credit. Hundred percent of the farmers in District 2 and 57.1 percent in District 1 assigned a low extent of limitation to this factor. The tendency of the extent of limitation of credit was considered as low in District 2 and between low and fair in District 1.

6.4 Marketing. The perceived extent of limitation of marketing seemed to be slightly higher in District 2 than in District 1. The tendency of the extent of limitation varied between low and fair
for both districts. However, in comparison with the other limiting factors, and taking into account the number of farmers affected particularly by this factor, marketing presented the highest perceived extent of limitation in the two districts. In fact, 21.6 percent of the respondents in District 1 and 28.8 percent in District 2 perceived the extent of limitation of this factor as high.

6.5. **Farmland.** This factor was considered more critical in District 1 than in District 2. In fact, 16.7 percent of the farmers in District 1 perceived the extent of limitation of farmland as high, 33.3 percent as fair, and 50 percent as low. In District 2, the only two farmers who perceived this factor as a limitation assigned to it a high extent of limitation. The extent of limitation for this factor tended to be between low and fair in District 1 and high in District 2.

6.6. **Climate.** Only 18.2 percent of the farmers in District 1 and 21.1 percent in District 2 perceived the extent of limitation of this factor as high. The tendency of the extent of limitation for climate varied between low and fair for both districts.

7. **Generation and Adaptation of Crop Technology.** In District 1, fifty percent of the recommended cultural practices (selected for this study) were generated by research programs, 30 percent by research and extension programs, 10 percent by the extension program, and 10 percent by farmers. All those crop technologies were adapted
to local conditions by the extension program. In District 2 both the generation and adaptation of the selected cultural practices were carried out by the extension program.

8. Effectiveness in Transferring Technology. Fifty one point seven percent of the respondents in District 1 considered the transfer of technology as effective and only 6.7 percent as not effective. In District 2, forty percent of the farmers perceived the extent of effectiveness as fairly effective and 8.3 percent as effective. The tendency of the extent of effectiveness in transferring technology varied between fairly effective and effective in District 1 (80 percent), while in District 2 it varied between slightly and fairly effective (71.7 percent).

The differences in extent of effectiveness in District 1 were statistically significant (P<0.001). The differences in extent of effectiveness in District 2 were not statistically significant at the 0.05 level of confidence. The difference in extent of effectiveness between District 1 and District 2 was statistically significant (P<0.01).

9. Means of Transferring Technology. By far, the most frequent means of information of cultural practices as perceived by farmers was the DRI extension agent in both, District 1 (63.3 percent) and District 2 (66.6 percent), followed by the combination of the DRI extension agent and a friend or neighbor (28.3 percent in District 1 and 10 percent in District 2). Following in frequency was the
combination of the DRI extension agent and written material (6.7 percent in each District). A friend or neighbor as a means of information accounted for 1.7 percent in District 1 and 3.3 percent in District 2. In District 2, farmers mentioned other means or combination of means with very low frequencies such as radio and agricultural supply and input dealers. The Chi-Square ($X^2$) test was not calculated because of inadequacies in some cell frequencies.

10. Satisfaction in Relation to DRI Technical Assistance. Farmers in District 1 tended to be more satisfied with the DRI technical assistance than did the farmers in District 2. In fact, 78.4 percent of the respondents in District 1 and 31.7 percent in District 2 reported satisfaction with the DRI technical assistance program. More than half of the farmers in District 2 (53.3 percent) were fairly satisfied and 15 percent not satisfied, while in District 1 only 18.3 percent of the farmers were fairly satisfied and just 3.3 percent not satisfied with DRI technical assistance. The differences between District 1 and District 2 were statistically significant ($P<0.01$).

11. Adoption of Technology. The level of adoption of technology was higher in District 1 than in District 2. Most of the farmers (60 percent) in District 1 had a fair level of adoption of technology, 16.6 percent a high level of adoption, and only 1.7 percent did not adopt any recommended cultural practice as compared with District 2 where 45 percent of the farmers had low levels of adoption of
technology 11.7 percent a high level of adoption, and 10 percent did not adopt any recommended cultural practice.

The differences in relation to levels of adoption of technology by farmers in District 1 were statistically significant (P<0.001). The differences in relation to levels of adoption of technology by farmers in District 2 were not statistically significant at the 0.05 level of confidence. There was a significant statistical difference in relation to the levels of adoption of technology by farmers between District 1 and District 2 (P<0.005).

12. Reasons for non Adoption of Technology. Farmers expressed that the following reasons, listed in descending frequency order, did not allow them to use or to adopt the cultural practices recommended by the DRI program:

- Higher production costs (16 percent in total sample, 17.8 percent in District 1, and 14.5 percent in District 2).
- Apprehension in investing more money (risk) (16 percent in total sample, 17 percent in District 1, and 15.1 percent in District 2).
- Expensive agricultural supplies recommended (14.7 percent in total sample, 14.1 percent in District 1, and 15.1 percent in District 2).
- Unfavorable sale prices (8 percent in total sample, 9.6 percent in District 1, and 6.6 percent in District 2).
- Inadequate technical assistance (7.3 percent in total sample, 0.7 percent in District 1, and 13.2 percent in District 2).
- Difficulty in marketing crop production (6.6 percent in total sample, 8.9 percent in District 1, and 4.6 percent in District 2).
- Poor quality of the recommended agricultural supplies (6.6 percent in total sample, 3.7 percent in District 1, and 9.2 percent in District 2).
- Difficulty in applying some cultural practices (5.2 percent in total sample, 4.4 percent in District 1, and 5.9 percent in District 2).
- Difficulty in getting agricultural supplies (4.9 percent in total sample, 6.7 percent in District 1, and 3.3 percent in District 2).
- Many intermediaries (4.5 percent in total sample, 6.7 percent in District 1, and 2.6 percent in District 2).
- Not all the recommended cultural practices are known (3.1 percent in total sample, zero percent in District 1, and 5.9 percent in District 2).
- Lack of financial resources (2.1 percent in total sample, 4.4 percent in District 1, and zero percent in District 2).
- Insufficient financial resources (1.8 percent in total sample, three percent in District 1, and 0.7 percent in District 2).
- Better traditional practices in some cases (1.8 percent in total sample, zero percent in District 1, and 3.3 percent in District 2).
- Lack of own farmland (1.4 percent in total sample, three percent in District 1, and zero percent in District 2).
Some other reasons previously selected such as inappropriate conditions of credit, inappropriate transportation facilities, difficulties in storing farm production and agricultural supplies, and inappropriate conditions of farmland were not considered by any of the farmers as direct limitations to adopting recommended cultural practices.

13. Crop Production. Levels of crop production (yield per hectare) were higher in District 1 than in District 2. Most of the farmers (76.7 percent) in District 1 obtained higher levels of crop production per hectare, while only 1.7 percent obtained lower levels. In District 2, forty five percent of the farmers had similar levels of crop production, 41.7 percent higher levels, and 13.3 percent lower levels of crop production.

The differences in levels of crop production were statistically significant in District 1 (P<0.001), in District 2 (P<0.01), as well as between District 1 and District 2 (P<0.001).

14. Kinds of Financial Resources (Credit). Most of the farmers (63.3 percent in District 1 and 80 percent in District 2) utilized only DRI credit for financing their crops. Thirty five percent of the farmers in District 1 and 20 percent in District 2 utilized personal resources in addition to DRI credit. Only 1.7 percent of the farmers in District 1 utilized personal resources for growing the crops.
15. **Length of Time Utilizing DRI Credit.** Farmers in District 2 benefited by the DRI credit program during a longer period of time than did the farmers in District 1. Most of the respondents (64.4 percent) in District 1 had been utilizing DRI credit for less than two years, and only 35.6 percent during two to five years. In District 2, sixty percent of the farmers had been receiving DRI credit for more than five years, 26.7 percent during two to five years, and only 13.3 percent for less than two years.

16. **Difficulty in Obtaining DRI Credit.** In District 1, eighty percent of the farmers perceived the process of getting a loan as simple, 10 percent as very simple, and 10 percent as difficult. In District 2, most of the farmers (83.3 percent) considered the level of difficulty as simple, and the remainder (16.7 percent) as difficult. Although the difficulty was slightly more evident in District 2 than in District 1, the process of obtaining credit tended to be simple in the two districts.

The differences in relation to the levels of difficulty in obtaining DRI credit were statistically significant in District 1 (P<0.001) and in District 2 (P<0.001), while the difference in relation to the levels of difficulty in obtaining DRI credit between District 1 and District 2 was statistically not significant at the 0.05 level of confidence.
17. **Timeliness of DRI Credit.** Most of the respondents (91.5 percent in District 1 and 80 percent in District 2) perceived the DRI credit as timely. The remaining (8.5 percent in District 1 and 20 percent in District 2) perceived the DRI credit as delayed. These differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.

18. **Adequacy in the Amount of DRI Credit.** Most of the respondents (71.2 percent in District 1 and 73.3 percent in District 2) perceived DRI credit as fairly adequate regarding the amount of money lent. Only 11.7 percent of the farmers in District 2 and 16.9 percent in District 2 perceived the amount as not adequate, while 11.9 percent of the farmers in District 1 and 15 percent in District 2 considered the amount of credit as adequate to put in practice the technical recommendations. The differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.

19. **Interest Rates of DRI Credit.** Most of the farmers (63.3 percent in District 1 and 60 percent in District 2) considered credit interest rates as moderate. Only 6.7 percent of the farmers in each one of the districts pointed out that interest rates were high. The differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.
20. **Terms for Repaying Loans.** Most of the farmers (85 percent in District 1 and 76.7 percent in District 2) considered the terms established for repaying loans as moderate. A very low proportion of farmers (1.7 percent in District 1 and 6.7 percent in District 2) pointed out the terms as short. The differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.

21. **Satisfaction in Relation to the DRI Credit Program.** The tendencies of the levels of satisfaction were very similar in both Districts. Most of the respondents (86.6 percent in District 1 and 73.3 percent in District 2) were satisfied with the DRI credit program. Only 1.7 percent of the farmers in District 1 manifested dissatisfaction with the program. These differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.

22. **Major Uses of Crop Production.** In District 1, seventy percent of the farmers marketed all of their crop production, 15 percent used it for marketing, family consumption, and seed, 13.3 percent for marketing and seed, and only 1.7 for marketing and family consumption. In District 2, fifty five percent of the farmers used their crop production for marketing and family consumption, 30 percent for marketing, 11.7 percent for marketing and seed, and only 3.3 percent for marketing, family consumption, and seed.
23. **Difficulty in the Marketing Process.** Most of the farmers (65 percent) in District 1 considered the process of marketing crop production as difficult, 10 percent as very difficult, 23.3 percent as easy, and only 1.7 percent as very easy. In District 2, most of the farmers (73.3 percent) perceived the marketing process as difficult and the remainder (26.7 percent) as easy. Although the process of marketing crop production was considered as slightly easier in District 1 than in District 2, it tended to be difficult in both districts.

The differences in relation to the levels of difficulty in the marketing process were statistically significant in District 1 (P<0.001), and in District 2 (P<0.001), while the difference in relation to the levels of difficulty in the marketing process between District 1 and District 2 was not statistically significant at the 0.05 level of confidence.

24. **Sale Price of Crop Production.** Most of the respondents (68.3 percent in District 1 and 61.7 in District 2) perceived prices received for crop production as unfavorable. Fifteen percent of the farmers in District 1 and 38.3 percent in District 2 considered the sale prices as just. In District 1, only five percent of the respondents perceived the prices as favorable, while 11.7 percent as very unfavorable. The differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.
25. **Membership in Marketing Organizations.** In District 1, only a small minority of the farmers (15 percent) were members of two pre-cooperative groups organized by the DRI program. In District 2, the situation was more critical since only 3.3 percent of the farmers were members of private marketing organizations; nevertheless, they did not sell their products to those organizations. The differences between District 1 and District 2 were statistically significant (P=0.058).

26. **Marketing Channels.** The majority of the farmers (81.7 percent in District 1 and 100 percent in District 2) sold their crop production to intermediaries. Only 18.3 percent of the farmers in District 1 used a marketing organization for selling their products. The Chi-Square ($X^2$) test was not calculated because of inadequacy in some cell frequencies.

27. **Marketing Difficulties.** Farmers considered the following most salient difficulties in marketing their crop production; they are listed in descending frequency order:

- Only intermediaries as buyers (25.1 percent in total sample, 25.5 percent in District 1, and 24.8 percent in District 2).
- Unfavorable sale prices offered for the crop products (23.2 percent in total sample, 32.4 percent in District 1, and 17 percent in District 2).
- Lack of farmer cooperatives or similar marketing organizations
(17.6 percent in total sample, 14.5 percent in District 1, and 19.7 percent in District 2).
- Lack of or inappropriate price support policy (13.5 percent in total sample, 9.6 percent in District 1, and 16 percent in District 2).
- Few buyers or few marketing channels (9.9 percent in total sample, 15.9 percent in District 1, and six percent in District 2).
- Too much crop production in the area (8.5 percent in total sample, zero percent in District 1, and 14.2 percent in District 2).
- Lack of or inadequate government assistance (2.2 percent in total sample, 2.1 percent in District 1, and 2.3 percent in District 2).

The lack of or inappropriate transportation facilities, and the lack of or inappropriate storage facilities were not mentioned by the farmers in any of the two districts.

28. Satisfaction in Relation to the DRI Marketing Program. The tendency of the levels of satisfaction was similar in both districts. Most of the respondents (75 percent in District 1 and 96.7 percent in District 2) were not satisfied with the DRI marketing program. Only 25 percent of the farmers in District 1 and 3.3 percent in District 2 were fairly satisfied with this program. None of the farmers in either of the two districts reported satisfaction with the DRI marketing program. The differences between District 1 and District 2 were not statistically significant at the 0.05 level of confidence.
29. Tests of Null Hypotheses of Association

29.1. The null hypothesis 1 was rejected; therefore, there was a significant association between adoption of agricultural technology and effectiveness in transferring technology \( (P < 0.001 \text{ for District 1, District 2, and total sample}) \).

29.2. The null hypothesis 2 was accepted; therefore, there was not a significant association at the 0.05 level of confidence between adoption of agricultural technology and difficulty in obtaining credit.

29.3. The null hypothesis 3 was accepted; therefore, there was not a significant association at the 0.05 level of confidence between adoption of agricultural technology and difficulty in marketing crop production.

29.4. The null hypothesis 4 was rejected; therefore, there was a significant association between increase in crop yields and effectiveness in transferring technology \( (P < 0.001 \text{ for District 1, District 2, and total sample}) \).

29.5. The null hypothesis 5 was accepted; therefore, there was not a significant association at the 0.05 level of confidence between increase in crop yields and difficulty in obtaining credit.
29.6. The null hypothesis 6 was accepted; therefore, there was not a significant association at the 0.05 level of confidence between increase in crop yields and difficulty in marketing crop production.

29.7. The null hypothesis 7 was rejected; therefore, there was a significant association between increase in crop yields and adoption of agricultural technology ($P < 0.001$ for District 1, District 2, and total sample).

Conclusions

Most of the conclusions in this study are specific for the circumstances of the DRI districts of South Tolima (District 1) and Fusagasuga (District 2), and are not necessarily valid for other DRI districts. Findings show that the performance of certain variables can change from one district to the other.

Using the objectives as a base, the following conclusions are drawn from this study:

1. Some progress in agricultural production has been evident in both districts as supported by some improvements in crop production in terms of increase of yields of crop per hectare. Nevertheless, the level of agricultural development is not yet at the desired level. Agricultural development, in terms of efficiency in crop productivity, is taking place slowly since it has been affected by certain
limiting factors. This situation has been more critical in District 2 than in District 1.

The appropriate conditions to accelerate agricultural development have not always been present among the different factors of the DRI agricultural production component. The extent of limitation of research, extension, credit, marketing, as well as farmland and climatic conditions varies from one district to another, affecting adoption of technology and crop production and productivity.

In District 2, improved crop productivity has been limited because marketing of agricultural production has not been efficient, technology has not been properly transferred to many farmers, and because of lack of a more appropriate technology to solve pressing agronomic problems. In District 1, better crop productivity has also been limited because marketing systems have not been efficient and because climatic conditions and the quality of farmland have been adverse for most of the farmers for the growing of their crops.

An ideal situation to accelerate agricultural development should be present when appropriate crop technology is generated and adapted according to local farming conditions, and when it is properly and effectively transferred to the farmers, supported by adequate credit facilities and efficient marketing systems, all of them under an appropriate integrated framework or environment to encourage its adoption by willing and motivated farmers in order to improve their crop production and productivity. These conditions could assure a proper impact on agricultural and rural development.
Among the factors included in the DRI agricultural production component, inappropriate marketing conditions for crop products was perceived by the farmers as the principal constraint limiting better crop productivity, and credit facilities were perceived as the least important limitation of crop productivity in the two districts totally.

Research as a limiting factor was more critical in District 2 than in District 1. Its extent of limitation was perceived as low in District 1 and between low and fair in District 2. The marked difference in farmers' perception in relation to the availability of appropriate crop technology seemed to be related to the kinds of agronomic problems faced by the farmers in the two districts. In District 2, where research was considered as one of the principal limiting factors of crop productivity, the most pressing technological problems were those dealing with pests and diseases. Most of the actual means to prevent and control pests and diseases were too expensive, the reason why many of the farmers did not adopt or adopted only partially the recommended crop practices. In addition, this district was not adequately supported by research programs to generate appropriate technology as in the case of District 1 where extension, research, and farmers were working in a more integrated environment. This situation could explain, at least in part, why District 1 has been more successful than District 2 in generating appropriate technology to overcome farm problems.
Extension was considered as a major limitation of crop productivity in District 2, while in District 1 it was considered as a less important limiting factor. The marked difference in farmers' perception in relation to this factor seemed to be consistent with the quality of technical assistance provided to the farmers by the two districts. In District 2, where transfer of technology was considered as slightly or fairly effective by most of the farmers, technical assistance was sporadic in some cases or it was not provided in others. On the other hand, the quality of technical assistance also depended to a large extent on the capabilities of the extension agents. In District 1, where this factor was not perceived as a major limitation, the extension personnel had been provided with more training opportunities. These situations could explain, in part, why farmers in District 1 adopted more recommended cultural practices than farmers in District 2.

Credit was not considered by the farmers as a major constraint of crop productivity. The extent of limitation for this factor was low in District 2 and between low and fair in District 1. In spite of the fact that this factor was not significantly related to adoption of technology, and changes in crop yields, the tendency, in both districts, showed that credit encouraged and promoted the adoption of technology, especially, when adoption represented higher production costs, (i.e., use of fertilizers, pesticides, etc.) and when it was accompanied by other factors such as appropriate profitable technology, low risk, security of marketing, etc.
According to the proportion of farmers affected, marketing was perceived as the principal factor limiting better crop productivity. Its extent of limitation varied between low and fair in both districts. In spite of the fact that there were not significant relationships between marketing and adoption of technology and changes in crop yields, it is obvious that an appropriate marketing system encourages farmers to adopt technology, which in turn improves crop productivity due to larger amounts of agricultural product and more favorable marketing conditions (i.e., prices).

There was a marked difference in perception in relation to farmland as a limiting factor of crop productivity. The tendency of the extent of limitation for this factor was perceived by the farmers as high in District 2 and between low and fair in District 1. This difference was consistent with the characteristics of the soils in both districts. In District 1, where the soils are of poorer quality than in District 2, this factor was perceived as one of the principal limitations of crop productivity. However, it seemed that this situation did not prevent most of the farmers to adopt technology, but it increased production costs due to higher applications of fertilizers.

Climate was the second most important limiting factor considered by the farmers in the two districts together, but the situation was perceived as more critical in District 1 than in District 2. Its extent of limitation varied between low and fair in both districts. The marked difference in farmers' perception in relation to this
factor seemed to be related to the preponderant climatic conditions in each district. District 1, where this factor was considered as one of the principal limitations of crop productivity, and more critical than in District 2, was characterized by excessive dryness of the soils due to lack of and inappropriate distribution of rainfall. This situation is one of the reasons for poor fertility of the lands in many areas of that district. In District 2, the problem was related to dampness, which was also affecting somewhat crop productivity since its soils were more fertile than in District 1.

2. Transfer of technology was significantly more effective in District 1 than in District 2. The tendency of the extent of effectiveness in transferring technology varied between fairly effective and effective in District 1, and between slightly effective and fairly effective in District 2.

These tendencies, and the marked difference between the two districts, seemed to be consistent with the quality of the technical assistance provided to the farmers. This situation was also reflected in the levels of adoption and crop yields. In District 1, where the transfer of technology was considered as effective by most of the farmers, the levels of adoption of technology and the increase in crop yields were higher than in District 2, where the transfer of technology was perceived as only slightly or fairly effective.

The success or effectiveness in transferring technology do not depend only on the capabilities of the extension agent but also on
many other interrelated factors such as the characteristics of the recommended cultural practice, the means and channels used to disseminate information, the motivation of the farmers, the social, economic, cultural, technological, and environmental conditions of the farmers, and the setting where transfer is taking place.

The effectiveness in transferring agricultural technology plays an outstanding role in the adoption process and, therefore, in the development of the agricultural sector.

3. The levels of adoption of recommended cultural practices tended to be fair in District 1 and low in District 2. Adoption of agricultural technology was significantly higher in District 1, the newer one, than in District 2, the older one. Therefore, longer periods of exposure to extension programs did not necessarily represent higher levels of adoption of technology.

The majority of the farmers were aware of the new technologies recommended by the DRI program. Nevertheless, some farmers did not adopt any recommendations or partially adopted only some of them. Therefore, awareness of new crop technology did not necessarily mean adoption. There were several reasons that did not allow farmers to adopt new technologies.

The following reasons were considered as limitations in adopting recommended crop practices: increase in production costs, apprehension in investing more money (risk and uncertainty), expensiveness of agricultural inputs and supplies, unfavorableness of crop produc-
tion sale price, inadequacy of technical assistance, difficulty in marketing crop production, poor quality of recommended agricultural inputs and supplies, presence of too many intermediaries in the marketing process, ignorance of some recommended cultural practices, inadequacy of financial resources, relative advantage of traditional practices compared with the new ones, lack of owned farmland or inappropriate conditions of farmland, and uncertainty due to changes in weather conditions.

The most frequently perceived reasons that did not allow farmers to adopt technology were related to economic circumstances. This perception was not consistent with the DRI credit policy which facilitated the procurement of the necessary financial resources to apply recommended cultural practices. Therefore, credit did not necessarily encourage all the farmers to adopt all the recommendations. It means that there were other reasons that intervened probably. It seemed that risk and uncertainty, derived from the need of investing more money in growing the crops, were the most powerful economic reasons limiting adoption of new technology.

Agriculture is an uncertain and continuously risky enterprise. Since risk and adoption are related, attempts must be made to reduce risk and increase security to encourage higher levels of adoption of technology.
Reasons related to difficulties in marketing crop production followed in importance as limitations in adopting new technology. This perception seemed to be also related to the uncertainty of farmers in obtaining favorable prices for their crop products which could compensate for the investment associated with new technology. Therefore, favorable marketing conditions should be offered to the farmers to encourage higher levels of adoption of technology.

Following in importance, reasons related to inadequate technical assistance were perceived as limitations in adopting agricultural technology. This situation was consistent with the farmers' perception in relation to the effectiveness in technology transfer. It supports the hypothesis that effectiveness in transferring technology is directly related to adoption. Therefore, new technology should be properly transferred to be accepted and adopted by the farmers.

Other reason for nonadoption was related to the inappropriateness of some recommended cultural practices. New agricultural technologies that were difficult to apply or that had a relative disadvantage in comparison with the traditional technologies were not adopted. Since appropriateness of new technology is also related to adoption, attempts should be made to provide farmers with technologies that meet their needs and expectations.

Adoption of technology is related to crop production (crop yields per hectare), but not necessarily to crop productivity (net profit per hectare). Crop productivity depends on production costs
and/or sale price of crop products. Therefore, cost-saving technologies and/or favorable marketing conditions are important prerequisites to improve crop productivity.

Higher levels of adoption will take place when profitable and low risk technology, appropriate for the needs and conditions of the farmers, supported by adequate financial resources and favorable marketing conditions, is properly transferred to them. This situation could assure improvements in agricultural productivity.

4. Crop production, in terms of crop yields per hectare, increased after farmers used the recommended cultural practices. It was more evident in District 1, where crop production was significantly higher as compared with District 2. In District 1, the levels of crop production tended to be higher after using new technology, while in District 2 they tended to be similar or higher.

Those tendencies were consistent with the extent of effectiveness of the DRI program in transferring technology and with the levels of adoption of technology determined for each district. Effectiveness in transferring technology and adoption of technology had a positive impact on crop production. Therefore, effectiveness in transferring technology, adoption of technology, and crop production were directly related, as it was expected.

5.1. Farmers in both districts perceived similarly the characteristics of DRI credit. DRI credit was simple to obtain, timely, fairly adequate in terms of amount of money to apply the recommended
cultural practices, with interest ranging between low and moderate, and with moderate terms for repayment. It required technical assistance from the DRI program, however.

The amount of money to put in practice the technology recommended by the DRI program was considered only as fairly adequate by most of the farmers. Most of them tried to utilize part of the credit for other expenditures not related directly to their crops. In this case, the remaining amount of money was not enough to apply completely the package of recommended cultural practices.

Under the above circumstances, DRI credit can be considered as very favorable for the farmers and it should encourage the adoption of technology.

5.2. Farmers in both districts perceived similarly the characteristics of the marketing process. It was considered as difficult and characterized by relatively large amounts of crop products for sale, few and inappropriate marketing channels, prevailing large chains of intermediaries, unfavorable prices offered, unorganized farmers and lack of appropriate marketing organizations, inadequate price support policies, and inadequate government assistance.

Intermediaries were felt to be restraining crop productivity and farm incomes since they manipulated prices and market mechanisms to obtain better benefits in comparison with those perceived by small farmers. This chain must be reduced if improvements in farm productivity are to take place.
6.1. Farmers in District 1 were significantly more satisfied than farmers in District 2 in relation to DRI technical assistance. Most of the farmers in District 1 tended to be satisfied, while most of the farmers in District 2 tended to be only fairly satisfied. These tendencies were consistent with the tendencies observed in each district concerning the extent of limitation of extension as a crop productivity limiting factor, and concerning the extent to which the DRI program was effectively transferring agricultural technology.

It can be said that farmers in District 1 met their needs as far as technical assistance was concerned, while farmers in District 2 only met their needs partially.

6.2. The majority of the farmers in both districts were satisfied with the DRI credit program. This situation was consistent with the farmers' perception in relation to the other characteristics of DRI credit.

The DRI credit program met the needs of the majority of the farmers in relation to the provision of financial resources to encourage the adoption of technology. When it did not occur, it was because of the presence of other more powerful factors which limited adoption of technology.

6.3 Farmers in both districts tended to be dissatisfied with the DRI marketing program. This situation was consistent with the
farmers' perception in relation to the characteristics of the marketing process in DRI areas.

The DRI marketing program had not met the needs and expectations of the farmers. There was not an appropriate marketing program, based on adequate policies, which helped and facilitated farmers to market their crop products under more favorable conditions.

7.1. Adoption of agricultural technology and effectiveness in transferring technology presented a high positive association in both districts; that is, the more effective the transfer of technology the higher the level of adoption of technology.

7.2. Adoption of agricultural technology and difficulty in obtaining credit presented a low positive but not statistically significant association in District 1, and a highly insignificant association in District 2.

Credit was not necessarily a determinant to facilitate or to encourage by itself adoption of technology by some farmers. The impact of credit in crop productivity depends on the presence or absence of other factors, at least that was the situation observed in the two districts.

7.3. Adoption of agricultural technology and difficulty in marketing crop production presented a low positive but insignificant association in both districts.
The difficulty in marketing crop production was not necessarily a determining and unique factor that impeded many farmers to adopt new technology. Nevertheless, this factor could be affecting, in part, the adoption process. This situation could indicate the presence of other factors limiting the adoption of agricultural technology.

7.4. Increase in crop yields (crop production) and effectiveness in transferring technology presented a high positive association in both districts; that is, the more effective the transfer of technology the higher the level of crop yields.

7.5. Increase in crop yields and difficulty in obtaining credit presented a moderate positive but insignificant association in District 1, and an insignificant negative association in District 2.

7.6. Increase in crop yields and difficulty in marketing crop production presented a low positive but insignificant association in both districts.

7.7. Increase in crop yield and adoption of agricultural technology presented a high positive association in both districts; that is, the higher the level of adoption of technology the higher the level of crop yields.
Recommendations

According to the analysis of data and the conclusions drawn in this study, the following recommendations are made:

- The findings obtained in this study should be tested in other DRI areas to determine their validity under differing conditions. Similar studies should be conducted in other districts.

- More "appropriate" agricultural technology should be developed to improve crop production and productivity. New technology should meet the needs and expectations of the farmers, taking into account their economic, social, and cultural realities, as well as the environmental conditions of the regions and the farms.

- Appropriate agricultural technology should be generated to solve the most pressing production problems faced by farmers. Research should be oriented to 1) develop appropriate crop varieties more resistant to pests and diseases; more resistant to dampness, drought, and climatic changes, and less consumption of costly inputs (i.e., fertilizers, pesticides, etc.); with faster vegetative maturity, and good acceptance in the market and for family consumption; 2) find less expensive means to prevent and control pests, diseases, and weeds; and 3) find better systems to improve soil conditions at lower costs to increase fertility levels.
- Research should be oriented to develop less expensive technologies in order to decrease production costs and increase profitability, as well as to reduce risk and uncertainty. Efforts should be devoted to generate appropriate agricultural technologies that require more labor and less capital.

- New agricultural technologies should be adapted and tested under local farming conditions and should be proved as efficient in terms of crop productivity and profitability before any attempt to transfer them to farmers is done.

- Farmers, extension personnel, and researchers should participate, coordinately, in designing and implementing programs for generating agricultural technologies; much more emphasis should be given in following a farming systems research and extension strategy to generate appropriate agricultural technologies for small or traditional farmers.

- Government should define a more appropriate policy for agricultural research for small and traditional farmers and should support its implementation with more financial resources and more qualified personnel.

- Extension agents should contact farmers more frequently to assist them more effectively.

- The agency in charge of providing the extension services should
replace quickly those extension agents who have to leave their areas of work. Continuity in providing appropriate technical assistance should be kept in mind as a condition for success in transferring technology.

- Extension agents should be adequately recruited and selected. They should like to work with rural people; understand the rural living, customs, and traditions; have ability to communicate with farmers; possess technical qualifications, as well as a certain degree of homophily, etc.

- Recommended cultural practices should be adequately transferred to farmers taking into account their social, economic, technological, and cultural characteristics. The most appropriate means (i.e., interpersonal contacts farmer-extension agent) or strategies of communication should be used to transfer technology.

- Government should analyze the possibility to implement a program (or strategy) for distributing agricultural inputs of good quality, when they are the basis of technological recommendations, at lower prices, in appropriate amounts and packaging to encourage their use among small farmers.

- The DRI credit program should revise its policy concerning the amount of money lent and make pertinent adjustments if it is considered that the credit is, sometimes, insufficient for farmers to apply all the recommended cultural practices.
- Supervision of credit should be improved. The DRI program should pay more attention to assure that the moneys lent to farmers are invested completely in the growing of the crops. Emphasis should be given through the education process to encourage farmers to be responsible for the engagements and obligations they acquire when they obtain a loan.

- The DRI program should devote much more effort to help solve agricultural marketing problems in DRI areas. Adjustments should be made in the structure of commercialization for the traditional rural sector if improvements in crop productivity and agricultural development are to take place.

- Appropriate marketing policies and adequate price incentives (i.e., stability in prices) should exist for efficient agricultural marketing in DRI areas.

- Group action should be the base for improving marketing conditions in DRI areas. The DRI program should encourage the organization of the farmers in operationally efficient cooperatives or in other type or marketing organization to assure some bargaining power on the market. It should result in provision of larger quantities of crop products for marketing, more efficient use of transportation facilities and basic infrastructure, etc., disincentive for intermediaries, and more favorable prices for crop production. Cooperatives or other marketing organizations
should also be used to integrate other development activities.

- The DRI program should provide appropriate support and supervision to those formal marketing organizations to assure success, by means of training in organization, management, etc., provision of associative credit, development of basic infrastructure, etc.

- Provision of improved basic marketing infrastructure should be implemented within an appropriate structure of commercialization.

- The chain of intermediaries should be reduced to improve the agricultural market structure and to benefit producers and consumers.

- The information system on prices and terminal markets should be improved in terms of timeliness and greater coverage of farmers.

- The DRI program should stimulate the participation of more efficient and secure channels of commercialization.

- The DRI program should conduct studies to determine the feasibility to develop agro-industries in DRI areas to process surplus of crop production.

- The DRI program should revise its policy pertaining land tenure in DRI areas to determine the feasibility to include this component in those districts where land tenure status is considered as a constraint of agricultural and rural development.
The DRI program should devote much more effort, through appropriate research projects, to develop technologies more appropriate to improve the quality of the soils, especially in some areas of District 1. Farmland in use could increase the fertility level and farmland not in use could be adequated for agricultural purposes.

As it was pointed out agricultural productivity could increase when the different factors of the agricultural production component are appropriately available to be used and applied efficiently by the farmers on their farms. The development process in the traditional rural sector in Colombia is not an easy task, but it could be possible with a major effort and participation by the government and the rural people, and with a better coordination and integration among the agencies involved in the rural sector.


APPENDIX A

INTERVIEW SCHEDULE
INTERVIEW SCHEDULE

Farmer's name ____________________________ Interview No. ______
District ____________________ Municipality ____________________
Village ________________________ Crop ________________________
Interviewer's name ____________________________________________

1. How long have you been receiving services from the DRI program?
   ____ years   ____ months
   1[ ] - less than one year
   2[ ] - between one and two years
   3[ ] - between two and five years
   4[ ] - more than five years

(Go to question 2, page 238)

GENERAL ASPECTS

30. How many hectares of farmland do you have?
    ________ hectares
    1[ ] - five or less than five hectares
    2[ ] - between five and ten hectares
    3[ ] - between ten and fifteen hectares
    4[ ] - more than fifteen hectares
31. How many hectares of crops and grassland do you grow?

_______ hectares

1. __ - five or less than five hectares
2. __ - between five and ten hectares
3. __ - between ten and fifteen hectares
4. __ - more than fifteen hectares

32. What is your land tenure status?

1. __ owner 2. __ lessee 3. __ share-tenant 4. __ other (specify)

33. How satisfied are you with the DRI program in general?

0. __ not satisfied 1. __ fairly satisfied 2. __ satisfied

33.1 Why do you say this? _________________________________

34. To what extent has your farm income improved since you have been receiving services from the DRI program?

0. __ none 1. __ little 2. __ some 3. __ a lot
## CROP PRODUCTIVITY LIMITING FACTORS

2. Which of the following factors do you consider are limiting better crop productivity on your farm?

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<th>(EXTENSION) Lack of or inadequate transfer of technology or technical assistance for growing crops</th>
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<th>(CREDIT) Lack of or insufficient financial resources for growing crops</th>
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<th>(MARKETING) Lack of or inappropriate facilities for marketing the crop production</th>
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<th>(FARMLAND) Lack of or inadequate farmland for growing crops</th>
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6. Other limiting factor? Specify ____________________________

3. To what extent are those factors limiting better crop productivity on your farm?

(Check only those factors selected in question 2)

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Generation of Appropriate Technology

(Information provided by agricultural researchers and extension personnel at DRI district level or obtained from review of literature).

- Select the most important crops or the most important combination of crops in each district.

- Select the three most important recommended cultural practices for each crop or combination of crops.

4. What are the most important cultural practices recommended by the DRI program?

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<th>Technologies</th>
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4.1. These technologies were generated by:
(check only one)

1. Research [ ] [ ] [ ]
2. Extension [ ] [ ] [ ]
3. Research and Extension [ ] [ ] [ ]
4. Farmer (local technology of production) [ ] [ ] [ ]
5. Other source (specify) ____________________ ____________________ ____________________

4.2. These technologies were adapted to local conditions by: ____________________ ____________________ ____________________
Transfer of Technology

(The same crop and the same recommended cultural practices selected on question 4 must be used)

Crop _______________

5. What are the DRI's recommendations for:

- (Cultural practice 1) ________________ | C | I

- (Cultural practice 2) ________________ | C | I

- (Cultural practice 3) ________________ | C | I

(correct answers): 0 | NE | 1 | SE | 2 | FE | 3 | E

6. Through what means of information did you learn about these recommendations? (Indicate all that apply).

1 | DRI's extension agent
2 | a friend or neighbor
3 | experimental station
4 | written material (newspaper, magazine, bulletin, leaflet, handout, etc.)
5 | radio
6 | Other(s) means(s) _____________________________ (specify)
7. How satisfied are you in relation to the dissemination of agricultural information or the technical assistance you are receiving from the DRI program? Would you say:

[ ] not satisfied.  [ ] fairly satisfied  [ ] satisfied

0 1 2

7.1. Why do you say this? ______________________________________

Adoption of Technology

(The same crop and the same recommended cultural practices selected on questions 4 and 5 must be used on question 9)

8. Do you use the cultural practices recommended for your crops by the DRI program?

[ ] none  [ ] in part  [ ] all

0 1 2

Why? ______________________________________

9. What cultural practices (technologies) do you use for:

- (Cultural practice 1) ______________________

[ ] 0 1 2

- (Cultural practice 2) ______________________

[ ] 0 1 2

- (Cultural practice 3) ______________________

[ ] 0 1 2

(correct answers): 0 1 2 3

NA LA FA HA

0 1 2 3

(If the answer to the question 8 was "in part" or "all", ask:)

10. How satisfied are you with the use of the cultural practices recommended for your crops by the DRI program? Would you say:

[ ] not satisfied  [ ] fairly satisfied  [ ] satisfied

0 1 2

10.1. Why do you say this? ______________________________________
(If the answer to the question 8 was "in part" or "all", ask:)

11. How were the yields on your crop when you used the recommended cultural practices in comparison with your traditional cultural practices (local technology)?

| 0 | lower | 1 | similar | 2 | higher |

(If the answer to the question 8 was "none", ask only questions 12.1 and 12.3)

12. What were your crop yields per hectare?

12.1 Before using the recommended cultural practices

____________________(kg./ha.)

12.2 After using the recommended cultural practices

____________________(kg./ha.)

12.3 If crop yields were affected by climatic conditions or other uncontrollable cause, specify. ___________________________

(If the answer to the question 8 was "none" or "in part", ask:)

13. Which of the following reasons have not allowed you to use (adopt) the cultural practices recommended by the DRI program? (Indicate up to five only).

Reasons

1 | 0 | Not all the cultural practices are known
2 | 1 | Some traditional practices are better
3 | 2 | Not all the new cultural practices are easy to apply
4 | 3 | Not all the new cultural practices are appropriate for the crops
5 | 4 | Lack of adequate technical assistance
6 [ ] The costs of production become higher
7 [ ] Lack of financial resources (credit)
8 [ ] The financial resources (credit) are not sufficient
9 [ ] Many requirements and red tape in obtaining a loan
10 [ ] The credit is not timely
11 [ ] The interest rate of the credit is high
12 [ ] The terms for repaying loans are too short
13 [ ] Difficulty in getting the agricultural supplies
14 [ ] The agricultural supplies recommended are expensive
15 [ ] The quality of the recommended agricultural supplies is not good
16 [ ] Difficulty in bringing the agricultural supplies to the farm
17 [ ] Difficulty in storing the recommended agricultural supplies
18 [ ] Apprehension in investing more money (risk)
19 [ ] Difficulty in marketing the crop production
20 [ ] The crop production sale price is not favorable
21 [ ] Many intermediaries
22 [ ] Inappropriate transportation facilities for the crop production
23 [ ] Difficulty in storing the crop production
24 [ ] Lack of own farmland
25 [ ] Farmland is inappropriate to apply new technology
26 [ ] Other(s), (specify) ______________________________
CREDIT

14. What kind of financial resource do you utilize for growing your crops? (check only one).

1 - DRI credit
2 - personal resources
3 - DRI credit plus personal resources
4 - Other (specify) ________________________________

15. If you do not utilize DRI credit indicate why. ________________________________

(If the DRI credit is not utilized, ask questions that apply only)

16. How long have you been utilizing DRI credit for growing your crops? (check only one).

1 - less than one year
2 - between one and two years
3 - between two and five years
4 - More than five years

17. What is your opinion in the process of getting a loan?

1 - very difficult  2 - difficult  3 - simple  4 - very simple

18. How opportune is the receipt of the loan?

1 - delayed  2 - timely

19. Is the amount of credit you receive adequate to put in practice all the recommendations to grow your crop?

0 - not adequate  1 - fairly adequate  2 - adequate
20. What is your opinion of the interest rates applied to the credit you receive?

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<th>moderate</th>
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</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
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21. What is your opinion of the terms you have for repaying loans?

<table>
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<tr>
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<th>long</th>
</tr>
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<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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<td></td>
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22. How satisfied are you with the DRI credit program? Would you say:

<table>
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<th>fairly satisfied</th>
<th>satisfied</th>
</tr>
</thead>
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<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

22.1 Why do you say this? ________________________________

MARKETING

23. What is the major use of your crop production? (check only one).

1|   | - marketing
2|   | - family consumption
3|   | - seed
4|   | - marketing and family consumption
5|   | - marketing and seed
6|   | - family consumption and seed
7|   | - marketing, family consumption, and seed
8|   | - other (specify) ________________________________
24. How difficult is the process of marketing your crop production?

| 1 | very difficult | 2 | difficult | 3 | easy | 4 | very easy |

25. What is your opinion of the prices you receive for your crop production?

1 | | very unfavorable
2 | | unfavorable
3 | | just
4 | | favorable
5 | | very favorable

26. Are you a member of any marketing organization?

| 0 | no
| 1 | yes

26.1 If "yes", which? ________________________________

27. Where do you sell your crop production?
(Indicate in priority order according to the amount of product sold. Begin with number 1 as the larger amount).

1 | | on the farm at retail
2 | | in the market place at retail
3 | | to intermediaries
4 | | to farmer cooperatives, pre-cooperative groups, or any other marketing organization
    (specify) ________________________________
5 | | Other(s) (specify) ________________________________
28. Which of the following do you consider are the most salient difficulties for marketing your crop production? (Indicate up to five only).

1[☑] - Too much crop production in the area
2[☑] - Few buyers or few market channels
3[☑] - The only buyers are intermediaries
4[☑] - Lack of farmer cooperatives or similar marketing organizations
5[ ] - Unfavorable sale prices
6[ ] - Lack of or inappropriate price support policy
7[ ] - Inappropriate quality of the product
8[ ] - Lack of or inadequate government assistance
9[ ] - Lack of or inappropriate transportation facilities
10[ ] - Lack of or inappropriate storage facilities
11[ ] - Other(s) ____________________________ (specify)

29. How satisfied are you with the DRI marketing program? Would you say:

[ ] not satisfied [ ] fairly satisfied [ ] satisfied

29.1 Why do you say this? ____________________________

(Go to question 30, page 236)
APPENDIX B

RELATIONSHIPS BETWEEN VARIABLES
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<thead>
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<th>Levels of Adoption of Technology</th>
<th>Not Effective</th>
<th>Slightly Effective</th>
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### Table 2

**Relationship Between Credit and Adoption of Technology by District, 1985**

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<th>Levels of Difficulty in Obtaining Credit</th>
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<tbody>
<tr>
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<tr>
<td>High Level</td>
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</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

| **District 2 (Percents)**       |               |           |        |             |       |
| Non Adoption                   | 0             | 1.7       | 8.3    | 0           | 10.0  |
| Low Level                      | 0             | 8.3       | 36.7   | 0           | 45.0  |
| Fair Level                     | 0             | 5.0       | 28.3   | 0           | 33.3  |
| High Level                     | 0             | 1.7       | 10.0   | 0           | 11.7  |
| Total                          | 0             | 16.7      | 83.3   | 0           | 100.0 |

| **Total (Percents)**            |               |           |        |             |       |
| Non Adoption                   | 0             | 0.8       | 5.0    | 0           | 5.8   |
| Low Level                      | 0             | 5.8       | 27.5   | 0           | 33.3  |
| Fair Level                     | 0             | 5.0       | 38.4   | 3.3         | 46.7  |
| High Level                     | 0             | 1.7       | 10.8   | 1.7         | 14.2  |
| Total                          | 0             | 13.3      | 81.7   | 5.0         | 100.0 |
### TABLE 3

Relationship Between Marketing and Adoption of Technology by District, 1985

<table>
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<th>Levels of Adoption of Technology</th>
<th>Levels of Difficulty in Marketing Crop Production</th>
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<th>Easy</th>
<th>Very Easy</th>
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### TABLE 4
Relationship Between Transfer of Technology and Crop Production by District, 1985

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TABLE 5
Relationship Between Credit and Crop Production
By District, 1985

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TABLE 6

Relationship Between Marketing and Crop Production by District, 1985

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VITA

Luis Eduardo Chaves E. was born in Bogotá, Colombia, on November 13, 1942. After his secondary education at Colegio Nacional Camilo Torres, he entered the College of Agriculture at the National University of Colombia, at Bogotá, receiving the degree, with honorable mention, of "Ingeniero Agrónomo" in 1966.

Upon completion of his studies he was hired by the Colombian Agricultural Institute (ICA) to work in the Methodology of Extension Program, at Tibaitatá. In January 1968 he was moved to Palmira, to work as coordinator between Extension and Research, and part of his time was dedicated to work as an extension agent.

He attended a three months course on agricultural extension and agricultural development at Borgo a Mozzano, Lucca, Italy, beginning in October 1968. After returning he was appointed as extension supervisor in the ICA's Regional Area 5, at Palmira (Cauca Valley).

In August 1969, he was granted a fellowship from the W. K. Kellogg Foundation to undertake a program of study to obtain the degree of Master of Sciences at Cornell University, majoring in Extension Education and minoring in Farm Management.

After returning with the M.S. degree in 1971, he was appointed as National Coordinator of the Rural Extension Service, at Bogotá.

In June 1972, he attended a month course on Rural Extension at the International Centre at Wageningen, the Netherlands. In October
1972, he was moved to Ibagué, Tolima, to work as Regional Director of Rural Development.

The author was granted a fellowship from the Organization of American States (OEA) and the Government of Spain to attend a three month course on Integrated Rural Development at Escuela Central de Capacitación Agraria, San Fernando de Henares, Spain.

In November 1979, he was appointed as Director of ICA's Regional Area 6, at Ibagué. In January 1981, he was moved to Bogotá to work in the Division of Rural Development and, after three months, he was appointed as Director of that Division.

In January 1983, he was granted a fellowship from the Organization of American States (OEA) to undertake a program of study in the Department of Extension and International Education, at Louisiana State University, to obtain the Degree of Doctor of Education, majoring in Extension Education and minoring in Socio-economics. In May 1984, when the OEA's fellowship ended, he was granted a fellowship from the W. K. Kellogg Foundation to properly complete his graduate study program.

The author had been teaching rural development at the Universidad of Tolima, Ibagué and in the Graduate Program, National University of Colombia-ICA, at Bogotá.

During his stay at Louisiana State University he was nominated to membership in the Honor Society Phi Kappa Phi and the Honor Society of Agriculture Gamma Sigma Delta.

He is married to Gloria and they have a son, Mauricio Alberto.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Luis Eduardo Chaves

Major Field: Extension Education

Title of Dissertation: Some Factors Associated with the Effectiveness of the Agricultural Production Component in Areas of Integrated Rural Development in Colombia as Perceived by Farmers

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signature]
[Name]

[Signature]
[Name]

[Signature]
[Name]

Date of Examination:
April 28, 1986