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PRESENT UTILIZATION OF LAND :

FIELD CROPS OF THE AMATOLA BASIN

by

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PRESENT UTILIZATION OF LAND : FIELD CROPS OF THE AMATOLA BASIN

1. INTRODUCTION

This investigation was commissioned by the Agricultural and Rural Development Research Institute in June, 1980.

The aim of the study is to provide a bench-mark of the field husbandry situation in the Amatola Basin for purposes of land utilization, planning and for educational and evaluation purposes.

Inevitably such an investigation overlaps other surveys which have been commissioned; for example, soils, climate and the socio-economic situation are pertinent. The findings of these studies will not be repeated here, but will be referred to wherever necessary in order to orientate the reader.

2. METHODOLOGY

This section outlines the choice of sampling areas; the orientation and planning of the survey; sources of information; sampling and interviewing procedures; analysis of the data.

2.1 Choice of research area

The research area was predetermined to constitute the area known as the Amatola Basin in the Middledrift magisterial district of the Republic of Ciskei.

Because there are many factors influencing farming systems and progressiveness in farming, it is desirable that certain physical factors such as climate and land utilization should vary as little as possible in any study of the influence of personal, socio-psychological and other human factors related to land utilization (Wilkening, 1953). The Amatola Basin is assessed by Hill, Kaplan, Scott *et al.* (1977) as an area of relatively high agricultural potential.

Communities are the social units with which rural families identify themselves, and the influence which a community can have on farming systems, communication and the farming practices which are adopted has been shown by a number of researchers (Lionberger, 1952; Bertrand, 1958; Crouch and Chamala, 1981). Bekker and De Wet (1981) state that the residents of the Amatola Basin 'form a community in both a spatial as well as in a kinship sense' and that the community is historically a cohesive one.

It can be concluded, therefore, that from both a physical and a community point of view the Amatola Basin provides a sound basis for a study of land utilization and crop production.

The area consists of 836 homesteads comprising 13 villages, with an estimated total *de facto* population of 3830 people.

2.2 Orientation and Planning

The orientation and planning of this study was commenced in June, 1980, and took approximately 3 months to complete. The object of this stage of the project was to obtain a clear idea of the farming situation and of the communities residing there, and to gather data and information for the planning of the survey.

Other than the 1959 betterment report, there was no factual information available on land utilization and crop production in the area.

Information with regard to land ownership was obtained from the Tribal Authority and the Magistrate's Office, and it was cross-checked for accuracy.

Soil maps were obtained and existing arable areas used by present owners were delineated. The relative importance of

ecotope/

ecotope areas according to the soil survey (du Preez and Botha, 1981) was also delineated on the soil map.

2.3 <u>Information sources</u>

A wide range of rural research studies, in particular those from less developed countries of Africa, were consulted in the planning of this study (Union of South Africa, 1955; Bembridge, 1972; Ruthenberg, 1971; Lele, 1979).

Information on soils and climate was obtained from recent studies commissioned for the Amatola Basin (du Preez and Botha, 1981; Steyn, 1981).

Technical information on crop production was obtained from the Department of Agronomy at Fort Hare University, as well as from the Department of Agriculture and Fisheries. Historical background information and information on other institutional aspects, such as land tenure, was obtained from the Tribal Authority, from local teachers and from government officials.

There was practically no information available locally on the farming economy in terms of input figures, farming practices, output figures, etc.. The same situation applied to demographic information on individual crop farmers, such as personal and socio-psychological factors, which are pertinent to the study of land utilization and crop production. Such information was obtained from rural families themselves.

2.4 <u>Orientation of the community</u>

The co-operation of farming communities is a vital part of any rural research exercise both for the research itself, and for the implementation of its findings.

The/

The problems, justification and objectives of the study were discussed at length in a meeting which involved the recently constituted project management committee, village leaders and representatives of the farming committee.

2.5 Selection and training of enumerator

Because certain questions in this study are of necessity somewhat subjective, it is possible that different enumerators might place different interpretations on some answers (Selltiz, Jahoda, Deutsch and Cook, 1964; Oppenheim, 1966). To overcome the possibility of bias, the interviewing of farmers in the sample was carried out by a selected, experienced senior extension officer of the Ciskei Department of Agriculture.

The enumerator received intensive training in research methodology and interviewing procedure, and he assisted also in planning the survey. During the training period, role playing was used to simulate interview situations, to test techniques and the value of specific questions, and to overcome any possible initial trepidation on the part of the interviewer. Although the language of the interview was in Xhosa, the enumerator preferred the final transcript to be in English.

In summary, experience of this exercise showed the importance of the field interviewer in shaping the content and approach of research among the rural people themselves.

2.6 Questionnaire objective and design

In order to fulfil the objectives of this study, a questionnaire for farmers was compiled. Several studies were consulted to aid in the design of coded questionnaires (Frutchey, 1959; Gallup, 1962; Prewitt, 1980; Murphy and Sprey, 1980).

Questionnaires/

Questionnaires used in personal interviews have the advantage of flexibility, thus enabling the trained interviewer to ensure that the respondent understands the questions and the purpose of the study. This approach also enables the interviewer to probe further when particular responses are encountered; it also permits subjective assessments and ratings to be made of attitudes, opinions, knowledge, etc.. There is also the undisputable advantage of fullness and spontaneity of answers.

Because the rural population consisted of a high percentage of illiterate people, interviewing supplemented by field observation and measurement was the only feasible way of obtaining reasonably accurate information.

2.6.1 Farmers' questionnaire

The questionnaire for farmers was pre-tested with five farmers with varying degrees of education and experience as judged by the local extension officer. Generally the questions were easily understood and readily answered, but for the sake of absolute clarity, a number of questions were rephrased. Based on this pre-testing the questionnaire was finalised and for reference purposes has been lodged with ARDRI.

Questionnaires were periodically discussed and checked with the enumerator. To collect and process information from farmers took approximately 12 months.

2.7 Scale construction

Research workers in agriculture have employed various types of adoption of farm practice scales as a measure of the relevant rates of such adoption (Rogers, 1962; Crouch, 1981). In the social sciences it is necessary to have measuring criteria whereby qualitative data can be numerically arranged. The basic requirement of a scale is that it should

differentiate/

differentiate between individuals who differ qualitatively (Good and Hatt, 1952; Siepker, 1969).

Scales were constructed for the purposes of correlation analysis and for measuring innovativeness (Crouch, 1981) and managerial aptitude (Burger, 1971).

2.8 Norms for success

Economically, the most important norm for crop-farming success would be net income per unit of land. The general lack of records did not allow precise variable costs to be determined. In order to assess approximate crop-farming incomes, information on certain direct costs was obtained from farmers. In the assessment of gross production, crop, vegetable and fruit values were standardised (Economics and Markets, 1981).

Because maize plays a major role in the economy of the area and is the major crop and staple diet, maize yield was considered to be a suitable measure of farming efficiency. Yield is partly a consequence of innovation. There is ample evidence that the higher the yield, the greater the profit per hectare. Norms for yield potential were obtained from the University of Fort Hare (Marais, 1981). Norms for adoption of practices for successful crop production were selected from literature from the Department of Agriculture and Fisheries, from the expertise of crop scientists and from the author's own experience over many years.

Since there has been very little research into personal, socio-psychological and communication factors in Ciskei, findings were assessed in terms of results from research into rural areas in various less developed countries in Africa.

2.9 Method of sampling

The choice of the population to be sampled is greatly influenced by the available data base. Since accurate soil

maps/

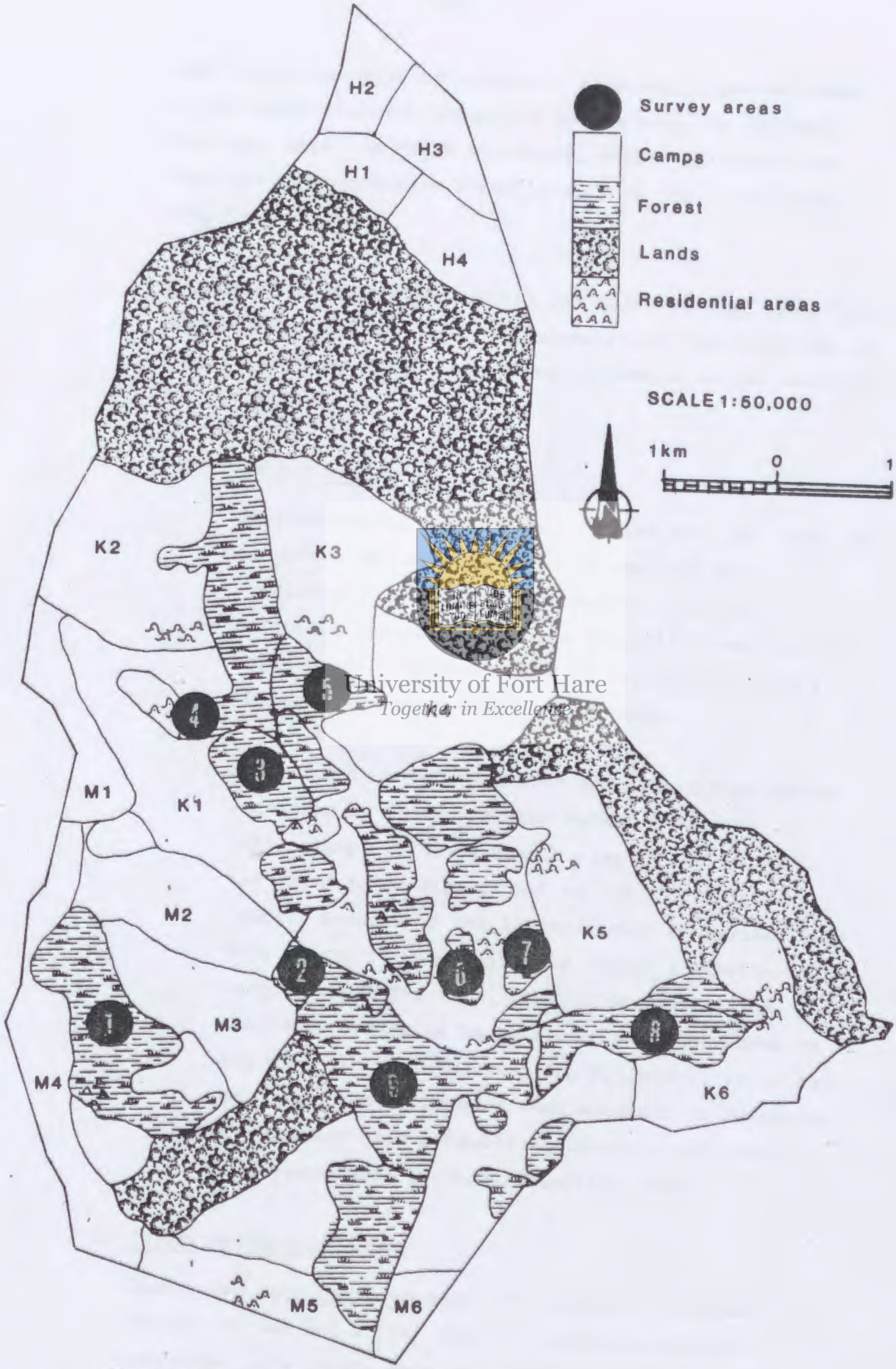


Fig.1 Land use of Amatola Basin showing survey areas

maps were available. Selection of sampling areas was based on the major ecotopes occurring in the area, as derived from soil maps (du Preez and Botha, 1981). It was found that the major ecotopes occurred in 7 of the 13 villages (Fig 7).

Individual land holdings within the major ecotope areas were delineated. A stratified random sample of land holdings in each ecotope was drawn from lists of farmers within each of the 7 villages.

2.9.1 Sample size

In considering sample size, factors such as costs and resources and desired level of accuracy were considered. Available information from local officials indicated that the population was fairly homogeneous. On this basis it was decided that a 20 per cent sample would be adequate.

According to a recent income and expenditure survey conducted by the Bureau for Market Research (Steenekamp, 1975), a sample size of 400 (0,10%) was found to be significant at the 95% confidence level. Because of the larger number of variables in this study, it was decided to accept a considerably larger sample fraction. Stratification of the sample according to major ecotopes further adds to the efficiency of the sampling procedure, which can be considered to be more than adequate to determine the present crop production situation and trends with reasonable accuracy (Barnett, 1974).

2.10 Interviewing procedure

Interviews with *de facto* heads of households took an average of one and a half hours to complete and were completed in a single session. The interview moved from

questions/

questions eliciting simple background information to more complex, open-ended questions about attitudes towards crop farming and about motivational factors.

Interviews were supplemented, throughout the 1980/81 crop production cycle, with observation of various cropping practices, measurement of lands and taking of sample maize yields.

2.11 Qualitative reliability

Every possible precaution was taken during interviews to explain the objectives and background to the survey, and questions were phrased in such a way as to avoid evoking attitudes of bias and prejudice among the respondents. Notwithstanding all these precautions, it would be injudicious to assume that the data are completely accurate throughout. The interview questionnaire method has, however, been accepted by various investigators as being sufficiently accurate for assessing situational trends (Oppenheim, 1966). To ensure greater accuracy, field observations and actual measurements were made of certain crop production variables. It is felt, therefore, that the research procedure has achieved a realistic picture of the problems and constraints of crop production in the Amatola Basin.

2.12 Data analysis

With the presentation of these results the authors wish to point out that personal and socio-psychological characteristics, institutional factors, and adoption behaviour can certainly not be divided into water-tight compartments. Statistics are only an aid to revealing a complex situation, and should be looked upon as providing qualitative approximations, because figures have no emotional value (van Zyl, 1965).

The data were analysed in the following phases:

1. Through/

1. Through an initial computer tabulation it was possible to get a general appreciation of the survey data.

2. Correlation analysis was used for the inter-correlation between variables.

3. Multiple step-wise regressions were used according to least squares procedure to explore the variance in dependent variables of innovativeness and yield per hectare.

3. AGRO-ECOLOGY OF THE AMATOLA BASIN

3.1 Introduction

The physical environment is basically concerned with climate, soil and vegetation into which the farming system must be fitted in order to ensure optimum sustained land utilization.

Because farmers must modify the impact of environment on crop and livestock production, an understanding of the climate-plant-animal relationship influencing productivity directly and indirectly is extremely important (McDowell, 1972). The conservation of limited land resources is of paramount importance. There is abundant evidence, from many parts of the world, that man is the most important single factor in the environment. Misuse of land in many countries, including Ciskei, has been brought about through ignorance of the natural factors governing agricultural productivity, as well as through economic pressures for production at the cost of the land (Ivy, 1977).

Stability in agriculture can be achieved only through appreciation of the natural factors governing production, and the application of land utilization systems which ensure sustained productivity. It is not within the scope of this study to give a detailed description of the physical environment of the Amatola Basin. This has been well documented by other researchers (du Preez and Botha, 1981; Mentis et al, 1981; Steyn, 1981).

The object of this section is to outline briefly the physical environment and the inter-related factors in order to orientate the reader.

3.2 Agro-Ecological areas

The Amatola Basin incorporates the following pedo-ecological regions according to Hill, Kaplan Scott and Partners (1977):

3.2.1 The Amatola Plateaux

This unit has a humid bio-climate with an annual rainfall in excess of 1 000 mm. The Ehlers classification of the temperature regime is dominantly 46/15. The soils are dystrophic, with low inherent fertility. Soil depth is generally good, but some slopes are rather steep for arable use. The area is suitable for the production of virus-free seed potatoes.

3.2.2 Amatola Foothills

The bio-climate over the greater part is Humid/Mild Subhumid/Mild Subarid, but some Inselbergs on the southern fringe are Mild Subarid. The mean annual rainfall may range from 600 to 900 mm. The Ehlers temperature regime is classified as 57/25 (15) or 67/25 in the cooler and warmer parts respectively. The potential for dryland cropping is very limited because of the shallow, steep or stony soils. The major part of the Amatola Basin is suited to afforestation and grazing.

3.2.3 Mountain Basin

The bio-climate is Subhumid/Mild Subarid to Subhumid, with an annual rainfall range of between 600 mm and 800 mm. The Ehlers temperature regime is classified

as/

as 67/25 in the warmer parts, to 57/25 (15) in the cooler parts. Soils of dolerite origin dominate. Slope gradients, however, are not always favourable for crop production, except on the river terraces.

The natural veld is dominantly mixed and can be reinforced. In the moister parts, where soils permit, planted pastures are possible.

3.3 Natural environment

3.3.1 Geographical situation

The Amatola Basin (Ebenezer Mhlambiso) Administrative Area is situated in the Ciskei, a self-governing National State of South Africa. It lies between 32°31' S.Lat and 32°45' S.Lat. and 26°57' E. Long and 27°02' E. Long. on the eastern slopes of the Amatola mountain range ± 14 kilometers north of the Middledrift Village. It is bounded on the East by the Wolf River and Fort Cox Administrative Area in the Keiskammahoek district; on the west by Mabandla and Mgqalo's location, Victoria East district; on the North by ministerial grazing in both districts of Victoria East and Keiskammahoek, and on the south by Fort Cox College of Agriculture and Forestry and Zibis location.

3.3.2 Topography

The Basin is elongated along the north-south axis and is approximately 6751 hectares in extent; an area of 2817 hectares has a slope of less than 20 percent, while an area of 3934 hectares has a slope greater than 20 percent. Except in the north where the land rises steeply to an altitude of 1807 m, most of the rim of the Basin has an altitude of about 1050 m, while the lowest portion is at 480 m. Generally, then, the land is steeply sloping.

3.4 Climate

3.4.1 Introduction

An appraisal of the climate of the Amatola Basin made on the basis of general descriptions of Ciskeian macro climates such as those by Schultze (1965), Whitmore (1957) and Els (1971), suggests that the temperature regime of the region imposes no serious limitations on the production of a wide variety of crops.

3.4.2 General description of climate

The Amatola Basin lies within an area which can be considered as being relatively humid by Ciskei standards. According to Laker's climatic classification of the Ciskei, 60 per cent of the area falls within the Humid Mountains and Highlands Zone and 40 per cent within the dry-subhumid Basin Zone (Laker, 1978; Map 3,3, Ciskei Report 1978). The mean annual precipitation for these areas is 800 mm and 650 mm respectively, while 50 per cent of the Ciskei falls within the semi-arid zones with a mean annual precipitation of less than 600 mm.

3.4.2.1 Spatial variation of precipitation

Rainfall characteristics are based on data derived from three locations (A, B and C) and these may be considered to be representative of the area.

Table 3.1/

Table 3.1 : Location of localities representative of climate in the Amatola Basin

Localities	Co-ordinates	Altitude (M)	Distance from Coast (km)	Mean Annual Precipitation (mm)
A	Amatola Basin 32 40'S Lat 27 E Long	800	82	993
B	Amatola Basin 32 45'S Lat 27 E Long	600	75	648
C	Fort Cox College 32 46'S Lat 27 2' E Long	585	70	579

3.4.2.2 Variation with Season and Locality

Table 3.2 : Monthly rainfall (mm) at 3 localities representative of the Amatola Basin

Locality	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
A	110	130	140	65	50	31	29	36	70	102	118	112
B	65	82	98	45	37	20	20	25	43	71	70	72
C	63	72	82	43	36	18	22	29	38	57	65	59

It is quite evident that June and July are the driest months. On average less than 7 per cent of the mean annual precipitation occurs during these two months. March is generally the wettest month of the year.

3.4.2.3 Temperature

According to Schulze, mean summer temperatures range from 10 to 13°C. Although these temperatures indicate a relatively moderate climate, extremes do occasionally occur due

to/

to 'berg winds'. These winds can cause severe damage to crops through scorching and mechanical injury. The average daily maximum is 29°C in January and 20,6°C in July, but extremes as high as 44°C and 31,5°C have been recorded in two respective months.

Winds are mainly southerly and northerly to north-westerly, the latter often very strong, especially in Autumn. Cold snaps are accompanied by unpleasant southerly winds lasting for a day or two, usually when the Amatola mountains are "snow clad" (Schulze, 1965).

Site B is situated 75 km from the coast and 600 m above sea level, while the most northerly boundary of the area lies at 1860 m above sea level.

A striking feature of the Ciskei is that the average rainfall can differ considerably over a very short distance (Marais, 1978). Considerable spatial variation of rainfall in the Amatola Basin is even more pronounced. For instance, locality A, which is situated only 7 km from B, annually receives 345 mm more rain than B.

Differences are even more striking when the rainfall at the three localities under consideration are contrasted with precipitation at stations in the adjacent mountains. The lowest precipitation (579 mm) occurs at locality C (Fort Cox College) and this increases quite rapidly towards the Amatola mountains to a value of 1100 mm on the highest peak.

The mean annual precipitation for the Basin is indicated in Table 2 and Fig 2.

3.4.3 Suitability of climate for maize production

The calculations were made for the period between the months of October and March. The water budgets were drawn up for maize on fallow land. It has been assumed that 33 and a third per cent of the rainfall can be conserved in the soil during the months April to October and that the maize occupies the land from November to March.

Estimated yields were also calculated for maize during an average year (i.e. 50% of the time) for stations A, B and C (Table XI).

Table 3.3 : Grain yields estimated on the basis of water available for maize at 3 representative localities in the Amatola Basin

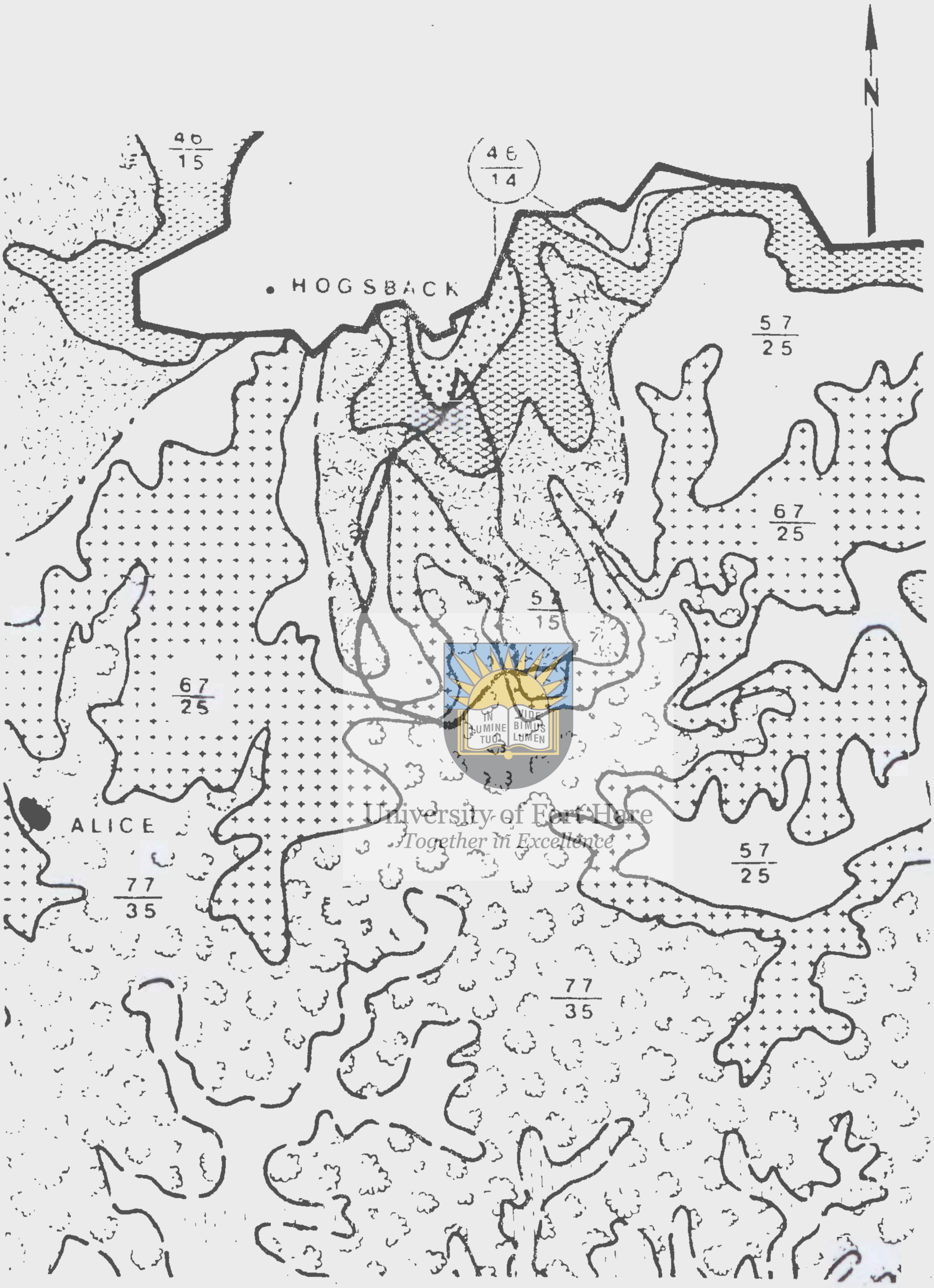
Station	Water available (mm)	Yield T/ha
A	806	8
B	521	4,4
C	460	3,2

On the basis of data presented in Table XI it would appear that rainfed crops do not impose a high risk in the Amatola Basin.

3.4.4 Climatic regions based on temperature requirement of crops according to Ehlers

According to Ehlers codes, five different zones are identifiable in the Amatola Basin (Fig 2). The temperatures prevailing in these agro-ecological

zones/



Scale: 1 : 250 000

FIG. 2 AGRO-ECOLOGICAL REGIONS AFTER EHLERS zones are indicated in Table 3.4. Ehlers (1974) divided the country into relatively homogeneous temperature zones which he termed agro-ecological regions. The temperature regime of each zone is characterized by a code consisting of two numbers and a letter, thus:

$$\frac{\text{Number (Characterizing Summer Temp)}}{\text{Number (Characterizing Winter Temp)}}$$ Letter (Characterizing frost incidence)

e.g. $\frac{77}{25}$ A

The code indicating the temperature regime of a region is interpreted by means of a key (Table I appendix 1).

The number above the line (e.g. 77) is read horizontally on the key to indicate the mean temperature of the three warmest months (Summer) in °C.

The bottom number, read horizontally gives the mean temperature of the 3 winter months. The top number, read vertically, gives the mean night temperature of the 3 summer months.

The bottom number read vertically gives the mean night temperature of the 3 winter months.

The letter after the number, indicating frost, is interpreted as follows:

No letter: General frost over whole area

A : Frost free only at higher altitudes in the zone

B : Frost free at higher altitudes; some frost in plains and valleys

C : Entire zone frost free

Table 3.4 : Temperatures prevailing in agro-ecological zones $^{46}/14$, $^{57}/15$, $^{57}/25$, $^{67}/25$ & $^{77}/35$ for Amatola Basin

Period	Region $^{46}/_{14}$	Region $^{57}/_{15}$	Region $^{57}/_{25}$	Region $^{67}/_{25}$	Region $^{77}/_{35}$
	Ehlers Temp. Range (°C)	Ehlers Temp. Range (°C)	Ehlers Temp. Range (°C)	Ehlers Temp. Range (°C)	Ehlers Temp. Range (°C)
Mean of 3 Summer Months (D, J, F)	15,5-19	19-21	119-21	21-22	22-24,5
Mean night temp. of 3 Summer months	10,0-15	15-20	15-20	15-20	15,0-20
Mean of 3 Winter Months (J, J, A)	5-11	5-11	11-13	11-13	13-15,5
Mean night temp. of 3 Winter months	0-5,4	0-5,4	5,4-10	5,4-10	5,4-10

3.4.4.1 Agronomic crops adapted to the temperature zones in Amatola Basin

Crop adaptation on the basis of temperatures prevailing in the Ehlers agro-ecological regions in the Amatola Basin is reported in Tables 3.5, 3.6, 3.7 and 3.8.

Table 3.5/

Table 3.5 : Crops well adapted to prevailing temperature in Ehlers agro-ecological zones $^{67}/_{25}$, $^{57}/_{25}$, $^{77}/_{35}$[1]

$^{67}/_{25}$	$^{57}/_{25}$ + $^{57}/_{15}$	$^{77}/_{35}$
Potatoes*	Potatoes*	Potatoes*
Oats	Oats	Oats
Barley	Barley	Barley
-	Rye	-
Wheat	Wheat	Wheat (Sub-Opt.)
Maize	Maize	Maize
Grain sorghum	-	Grain sorghum
Japanese millet	Japanese millet	Japanese millet
Sunflower	Sunflower	Sunflower
Soybean	Soybean	Soybean
-	Dry beans	-
Lima bean	Lima bean	Lima bean
Tobacco (Flue cured) (Sub-opt.)	-	Tobacco (Flue cured)

Region $^{46}/_{14}$ has not been described in this table because it is situated at high altitudes and suitably only for Afforestation. Regions $^{57}/_{25}$ and $^{57}/_{15}$ have been grouped together as they are very similar.

*Potatoes not adapted to midsummer temperatures. Well adapted if planted in August and late January.

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(1) A more detailed list of adapted crops in the agro-ecological regions is presented in Appendix I.

Table 3.6/

Table 3.6 : Pasture crops adapted to the Ehlers temperature zones in Amatola Basin

67/25 (Largest fraction)	57/25 and 57/15	77/35
Tef	Tef	-
Lucerne	Lucerne	Lucerne
Lupins	Lupins	Lupins
-	-	*Cenchrus ciliaris*
Rhodes	-	Rhodes grass

Table 3.7 : Vegetable crops adapted to the Ehlers temperature zones in Amatola Basin

67/25 (Largest area)	57/25 and 57/15	77/35
Swiss chard	Swiss chard	Swiss chard
Onions	Onions	Onions
Asparagus	Asparagus	Asparagus
Watermelon	-	Watermelon
Beetroots	Beetroots	Beetroots
Cauliflower	Cauliflower	Cauliflower
Sweet peppers	Sweet peppers	Sweet peppers
Pumpkins	Pumpkins	Pumpkins
Carrots	Carrots	Carrots
Lettuce	Lettuce	Lettuce
Radish	Radish	Radish
Peas	Peas	Peas
Beans	Beans	Beans
Tomatoes	Tomatoes	Tomatoes
Sweet potatoes	Sweet potatoes	Sweet potatoes

Table 3.8/

Table 3.8 : Fruit crops adapted to the Ehlers temperature zones in Amatola Basin

$^{67}/_{25}$ (Largest fraction)	$^{57}/_{25}$ and $^{57}/_{15}$	$^{77}/_{35}$
Apricots	Apricots (M)	-
Grapes	Grapes	Grapes
Peaches	Peaches	Peaches
Pecan nuts (M)	-	Pecan nuts
Plums	Plums	Plums (M)
Loquat	Loquat	Loquat
Figs	Figs	Figs
Pears	Pears	Pears
Oranges: Navel (M)	-	Navel
-	-	Valencia (M)
Prickly pears	Prickly pears	Prickly pears
Gooseberries	Gooseberries	Gooseberries
-		Granadilla

Note: Two types of fruit crops need to be singled out, viz. (i) citrus; and (ii) peaches.

3.5 Soils

For detailed planning purposes any assessment of arable potential must be given in terms of phases of soil series. The main determinants of suitability for arable use are:

(i) the inherent diagnostic characteristics of a soil (as reflected by its series classification);

(ii) effective soil depth (i.e. the depth of soil available for unrestricted root development);

(iii) slope; and

(iv) rockiness.

For this reason effective depth, slope and rockiness phases

of/

of soil series were used as mapping units during the detailed soil survey of the Amatola Basin by Du Preez & Botha (1981).

The actual final evaluation of the suitability of any specific area of land will not only depend upon the inherent qualities of land, but also upon the type(s) of farming system(s) envisaged (Hensley & Laker, 1980). An area of land which may be unsuitable for crop production under a modern agricultural system using large implements, may be well suited to it under a small-farming system in which animal traction or hand cultivation is used. This is only one of a large number of examples.

If a good, basic soil map (such as the one by Du Preez & Botha, 1981) is available, then a series of interpretations catering for different types of farming systems, from traditional peasant farming to modern mechanized agriculture, can be made from such a map (Laker, 1978).

A total of twenty soil series representative of ten different soil forms were identified in the Basin at slopes less than 20 per cent (Table 3.9).

Table 3.9/

Table 3.9 : Soil forms and series indentified at slopes less than 20 per cent in the Amatola Basin (after Du Preez et al 1981)

Soil form	Soil series	Sequence of diagnostic horizons
Arcadia	Arcadia	Vertic A
Clovelly	Clovelly	Orthic A Yellow-brown apedal B
Glenrosa	Saintfaiths Williamson	Orthic A Lithocutanic B
Hutton	Doveton Makatini Marikana Shigalo	Orthic A Red apedal B
Katspruit	Katspruit	Orthic A G-horizon
Oakleaf	Jozini	Orthic A Neocutanic B
Shortlands	Glendale Shortlands	Orthic A Red structured B
Swartland	Swartland	Orthic A Pedocutanic B Saprolite
Valsrivier	Arniston Herschel Sunnyside Valsrivier Waterval	Orthic A Pedocutanic B Unconsolidated material
Mispah	Klipfontein Mispah	Orthic A Hard rock of hardpan ferricrete

The mapping units with slopes less than 20 per cent are presented in Table 3.10.

Table 3.10/

Table 3.10 : Areas of mapping units with slopes less than 20 per cent in the Amatola Basin (after Du Preez et al 1981)

Map Symbol	Soil series	Area (ha)			
		Slope phase (%)			
		0 - 5	5 - 12	12 - 20	0 - 20
1	Arcadia	2,5	32,9	62,1	97,5
2	Clovelly	79,3	78,7	24,0	182,0
3	Saintfaiths/ Williamson	38,4	225,6	605,5	869,5
4	Doveton	0,0	28,5	56,0	84,5
5	Makatini/ Marikana	0,0	17,2	46,9	64,1
6	Shigalo	0,0	3,0	0,0	3,0
7	Katspruit	42,1	8,6	8,0	58,7
8	Jozini	0,0	47,2	132,0	179,2
9	Jozini (plinthite phase)	5,2	144,8	89,6	239,6
10	Jozini (mudstone phase)	6,4	125,3	85,5	217,2
11	Glendale/ Shortlands	2,0	96,7	108,5	207,2
12	Swartland	0,5	3,7	21,9	26,1
13	Arniston	0,0	15,8	10,0	25,8
14	Herschel/ Valsrivier	73,7	103,6	22,7	200,0
15	Sunnyside	0,0	7,2	9,2	16,4
16	Waterval	1,0	15,3	19,5	35,8
17	Klipfontein/ Mispah	11,3	109,7	189,2	310,2
	TOTAAL	262,4	1063,8	1490,6	2816,8

The areas characterized in Table 3.10 are not all suitable for crop production. Extremely few of the soils are stable enough against erosion to permit cultivation at slopes of more than 12 per cent. Some of the soils are unsuitable for cultivation even at 0-5 per cent slopes due to inherent limitations (shallow, depth, poor drainage, high swelling clay contents, etc). Significant areas will have to be excluded due to excessive rockiness. The actual "arable area" will be determined by the type(s)

of/

of farming system(s) recommended - as previously indicated.

A full outline of the combined slope, depth and rockiness phases is given in Table

A large portion of the Basin falls within the dry subhumid basin zone and the relatively steep slope of the soils together with a high clay content, emphasizes the need for water conservation in dryland crop production (du Preez et al 1981).

The fallowing of suitable arable soils in summer and the cultivation of winter cereals must be given serious consideration. The following reasons are given in support of the above statement:

(a) Approximately 85 per cent of the annual precipitation occurs during the summer (Feb-March);

(b) Winter crops such as wheat and oats are better adapted to clay soils than summer crops.

It was also established from the soil survey that the high potential Clovelly soils in the Basin were not utilized for dryland crop production by the local inhabitants largely because of their situation and relative inaccessibility. Land of high or even moderately high agricultural potential is extremely limited, not only in the Greater Ciskei, but also in the Basin (Laker 1982). It is therefore vitally important that these soils in the Basin be used for dryland crop production.

The Doveton soils in the Amatola Basin are also very important for crop production but a large area has been favoured for afforestation. In this regard according to Du Preez et al (1981), future land use planning at the Basin should consider these soils for dryland crop production.

3.5.1 Research

Soil fertility generally does not receive much

attention/

attention when land is selected for cropping purposes (Laker 1975). Soil physical characteristics and environmental conditions (especially climate) basically determine the cropping potential of the land. Soil analysis with regard to soil fertility is very important in crop production.

Results from recent ecotope evaluations on three sites in the Basin indicate that the area has a relatively high potential for summer and winter crops. Gross returns for all six wheat cultivars on three ecotope trials were R487 (2,02 tons) per ha., the best mean return for maize on the three sites was R536 per ha.. Climatic conditions were very favourable when these trials were conducted (Marais 1982).

3.6 Water resources

3.6.1 Underground water

Although the underground water situation has not been investigated in detail, there is nevertheless little doubt, according to Hill et al (1981) that the water requirement cannot be met by boreholes owing to the restricted recharging area. Of the two existing boreholes one apparently yields only 0,3 l/sec.. Therefore it would appear to be unrealistic to develop long-term supply schemes on the strength of underground water.

3.6.2 Perennial rivers/streams

The Amatola River, which flows from north to south, is reasonably close to most villages. It is the only one that can be considered to be perennial. The water quality is good, with low turbidity and salt concentrations, and appears to be suitable for irrigation.

There/

There are at least twenty streams in the Basin which flow intermittently and are probably as predictable as the weather.

3.6.3 Earthfill dams

According to Hill et al (1981), the steep nature of the bed grade of most streams gives a poor ratio of storage/height. It has also been determined that the perennial flow of the Amatola River is insufficient to meet demands (stock, irrigation, etc..)

There are eight small earth dams used mainly as stock watering points.

3.6.4 Domestic water

The residents draw water from the nearest spring or stream or from the Amatola River. From the survey it was determined that each household requires an average supply of 82 litres of fresh water daily. It was also calculated that, on average, the women spend two to three hours each day fetching water for home use and consumption.

3.7 Vegetation

The vegetation of the Ciskei has been classified into twelve main veld types (Coetzee 1975, p. 78), but for this study only the three veld types included in the Amatola Basin will be discussed briefly.

3.7.1 False thornveld of the Eastern Province

This veld type is currently covered mainly with a very inferior type of vegetation, and is very badly eroded. Veld rehabilitation and erosion control must be regarded as matters of the highest priority. This veld type comprises 49 per cent of the natural veld.

3.7.2 Dohne/

3.7.2 Dohne sourveld

This veld type occurs in the higher rainfall belt on the mountains. Steep slopes severely limit the cropping potential of this area; consequently, natural grazing and forestry are the only effective means of utilizing it. This region also forms the all-important catchment area for the Amatola River and comprises 45 per cent of the natural veld.

3.7.3 Valley bushveld

This veld type is confined to the deeply dissected valley in the southern part of the Amatola Basin. It is a scrub forest region dominated by tree - *Euphorbia* (Naboom), frequently interspersed with *Aloe bainessii* (Boomaalwyn), and it merges directly into forest on the upper slopes. Where the forest has been destroyed, it merges into grassveld or thornveld. On the upper western aspects there is a zone of bush-clump *Accacia karroo* thornveld with mixed grass. This veld type is very limited and comprises only 6 per cent of the natural veld.

According to the findings of Mentis *et al* (1981), the veld condition for Dohne Sourveld in the Basin is 69 per cent below its potential. False thornveld which makes up the major type (49%) is 85,5 per cent below its potential, and Valley Bushveld 83,5 per cent below. Generally, the basal cover is very low, especially in the Valley Bushveld, which indicates that the veld is highly unstable and is susceptible to severe erosion. From available data the Basin was overstocked by 1405 large stock (360%).

In view of the evidence derived from the survey, it is believed that drastic action should be taken to ensure that efficient veld management is implemented.

4. CHARACTERISTICS/

4. CHARACTERISTICS OF CROP FARMERS

4.1 Introduction

Certain socio-psychological factors which may hinder crop reform programmes are defined in this section. The degree to which these characteristics are present will vary from farmer to farmer, but each tends to affect, where it exists, the manner in which individuals will react to programmes designed to improve crop production.

Small-holder farming is a dynamic business, which involves both human and non-human resource inputs (Ruthenberg, 1971). The non-human resource inputs may be categorised as land, capital and development inputs which may be initiated with capital. The human resource input may be subdivided into two distinctly different and mutually exclusive inputs of labour, decision-making and management. These two general classes of resource inputs are closely inter-related, since a part of the task of the human resource is to make and implement decisions concerning the allocation of non-human resource inputs such as tillage, seed, fertilizer, pest control, etc.. These decisions will be influenced by both institutional factors and the farmer's own personal character traits.

The human element is thus a key factor in crop production because of its importance in decision-making, which is fundamental to good management and successful crop farming. Many studies support the contention that those factors which make up the human potential must be known in order to bring about change in agricultural production effectively (Kolbe, 1965; Rogers and Shoemaker, 1971; Lele, 1979; Heyer, Roberts and Williams, 1981).

Most variables in this study are not new to agricultural development studies and the effects of these variables have

been/

been researched in a number of less developed countries. It is often difficult to determine causality in the case of relationships formed between efficiency, innovativeness and other variables. Certain variables which are significantly related have predictive qualities and logically there may be a hypothesised causal relationship. Empirically, cause and effect is difficult to establish. However, from the point of view of practical application certain cause and effect relationships must be assumed in planning crop improvement programmes.

It often appears that changing one variable effects change in another. Because of the great number of intervening and related variables that may be involved in the process of change, it is often difficult to attach direct causality or determine the degree of causality in a single variable.

To study the inter-relationships between combinations of variables, a correlation matrix involving 17 crop production and socio-psychological variables was computed and is presented in Table 4.1. Only those correlation coefficients of immediate relevance to this study will be discussed in this and the following chapter.

Table 4.1 Intercorrelation of crop practices and socio-psychological variables of Amatola crop farmers, 1981 (N = 70).

Significance —— $P < 0,05$

Significance ═══ $P < 0,01$

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Autumn/winter ploughing	1.00																
2	Cutworm	-0.05	1.00															
3	Weed control	0.25	0.20	1.00														
4	Cultivate before planting	0.02	0.09	-0.04	1.00													
5	Planting method	-0.18	-0.09	-0.18	0.29	1.00												
6	Stalk borer control	-0.10	0.67	0.20	0.17	0.08	1.00											
7	Plant population	0.36	0.12	0.78	0.29	0.33	0.11	1.00										
8	Sex/Female	0.03	-0.14	0.08	-0.22	-0.11	-0.17	-0.29	1.00									
9	Age	-0.01	0.23	-0.21	0.10	0.05	0.21	-0.24	-0.13	1.00								
10	Farming experience	0.04	0.16	-0.13	0.08	0.05	0.16	-0.14	-0.22	0.60	1.00							
11	Education	0.11	0.29	-0.25	0.34	0.07	0.14	-0.31	-0.12	0.01	-0.00	1.00						
12	Outside employment	0.01	0.05	0.31	-0.01	0.01	-0.03	0.20	0.14	-0.11	-0.04	0.18	1.00					
13	Vocational training	0.25	0.57	0.18	0.52	-0.09	0.45	0.07	-0.24	0.13	0.21	0.63	0.36	1.00				
14	Family size	0.09	0.08	-0.04	0.13	0.17	-0.03	-0.28	-0.14	-0.03	0.02	0.06	-0.03	0.01	1.00			
15	Soil fertility practices	0.00	0.21	0.22	0.13	0.10	0.37	0.22	-0.19	-0.01	0.29	0.21	0.30	0.55	0.11	1.00		
16	Crop practice adoption	0.40	0.72	0.57	0.47	0.07	0.71	0.31	-0.18	0.10	0.12	0.22	0.59	0.73	0.28	0.61	1.00	
17	Managerial aptitude	0.03	0.31	0.24	0.14	-0.19	0.27	0.06	-0.29	-0.09	-0.06	0.38	0.24	0.51	0.19	0.45	0.74	1.00

4.2 Personal factors

4.2.1 Sex of de facto heads of households

The well-known effects of migration resulting in a large proportion of women as de facto heads of households is shown in Fig. 3.

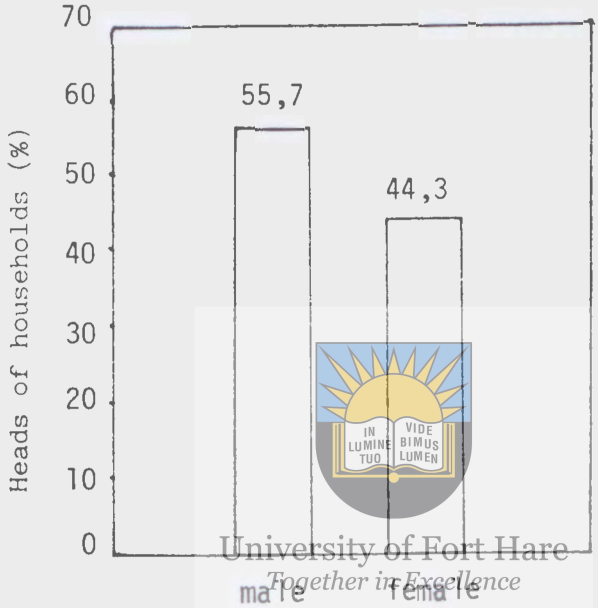


Fig. 3 : Distribution of de facto heads of households according to sex, 1981 (N=70)

The flow of labour and its social disruption of rural communities was documented as long ago as 1936 (Hunter, 1936), and since then numerous other researchers have described the patterns of urbanisation and the resultant problem of poverty in the rural areas (Wilson, 1972; Mayer, 1980; Manona, 1981). Manona (1981) in his study of an area close to Amatola Basin aptly sums up the impact of migration on agriculture: ".... this prolonged absence of able-bodied men causes a serious shortage of labour which makes cultivation and rearing stock largely dependent on women and children. Many men settle permanently at home only when they are too sick or old to undertake farming effectively".

This demographic imbalance, with 44 per cent of de facto heads of households being women, has resulted

in/

4.2.4 Age of heads of households

As is typical of farm populations, the age distribution of de facto heads of households was slanted towards the upper ages (Fig. 4), with 44 per cent of heads of households being over 60 years of age. Although chronological age has an impairing effect on physical ability, which is of great importance on family holdings, it can be concluded from research findings that increased age will not seriously impair managerial ability at any rate not up to the age of 60 to 65 years.

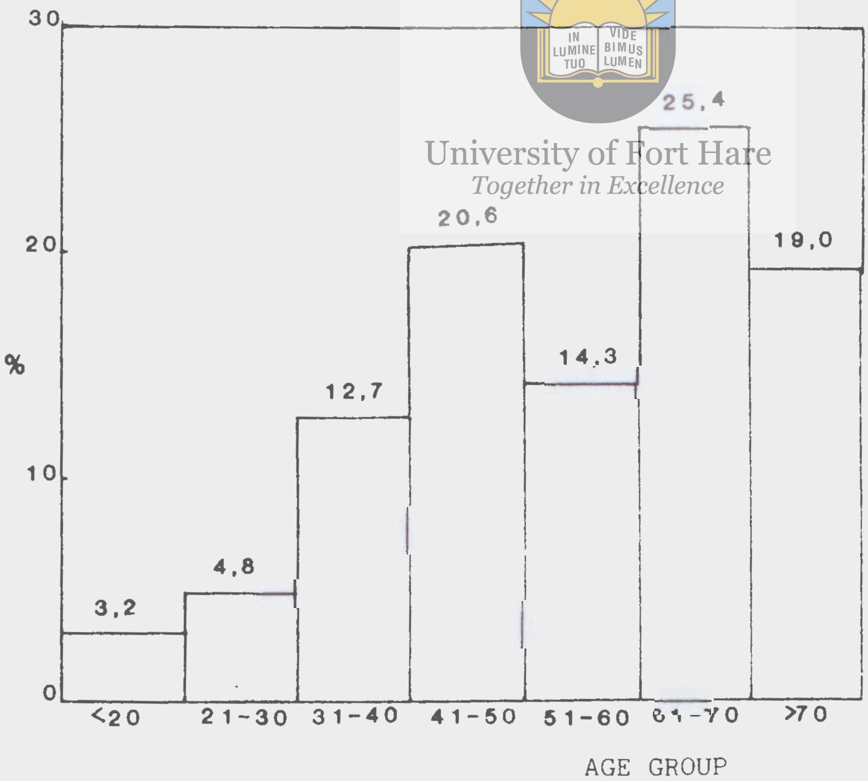


Fig. 4 : Distribution of de facto heads of households according to age group, 1981 (N = 70)

Aside from health issues, it can be concluded that approximately 60 per cent of de facto heads of households (farmers have the necessary physical capability and mental capacity to carry out farming operations.

Table 4.2/

Table 4.3 : Distribution of Amatola Basin de facto heads of households according to years of farming experience, 1981 (N = 65)

Years' experience	No.	%
0 - 5	8	12,1
6 - 10	6	9,1
11 - 15	8	12,1
16 - 20	8	12,1
21 - 25	4	6,1
26 - 30	13	19,7
> 30	19	28,8
TOTAL	66	100,0

4.2.5 Farming experience

The respondents were largely experienced farmers, with almost 80 per cent having been farming for more than 10 years. Thus lack of experience *per se* does not inhibit farming efficiency, although in general long experience seems to act as a constraint because of its association with lower levels of education.

4.2.6 Education level of heads of households

Education and its relationship to farming progressiveness has been studies by numerous researchers, most of whose findings support evidence of a positive correlation between education and the adoption of improved practices and hence farming efficiency (Lionberger, 1960; Rogers and Shoemaker, 1971; Bembridge, 1972).

These studies show that clear-cut relationships between farming efficiency and progressiveness and education are hard to establish, because the number of years of schooling is related to other factors likely to influence farming efficiency.

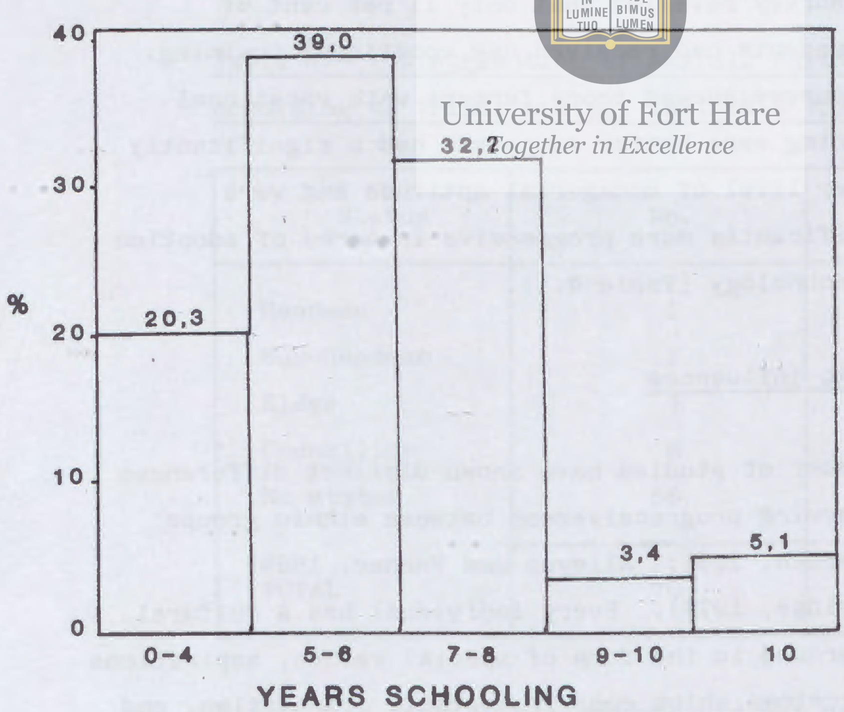


Fig. 5 : Distribution of heads of household according to educational level, 1981 (N = 70)

According to educationalists, people with less than 4 years of education are unlikely to have retained any degree of literacy. Generally speaking, those with 5-6 years of schooling are likely to have a

knowledge/

knowledge of written Xhosa and limited written English. It can be concluded from Fig. 5 that approximately 20 per cent of the de facto heads of households are illiterate, approximately 40 per cent have some degree of literacy, while 40 per cent are reasonably literate and likely to be responsive to written communication.

4.2.7 Vocational training

Research has shown that peasant farmers with some form of vocational training are likely to be more progressive farmers than those with no training.

The survey revealed that only 11 per cent of respondents had received any vocational training. The survey showed those farmers with vocational training were better educated, had a significantly higher level of managerial aptitude and were significantly more progressive in terms of adoption of technology (Table 4.1).

4.2.8 Ethnic influences

A number of studies have shown distinct differences in farming progressiveness between ethnic groups (Pedersen, 1951; Alleyne and Verner, 1969; Bembridge, 1972). Every individual has a cultural background in the form of special values, aspirations and customs which come from ethnic orientation, and such characteristics can play a negative or positive role in the progressiveness of any community. It was not within the terms of reference of this study to go into ethnic influences. Most of the Amatola farmers are Mfengu and belong to the Amahlubi group (Bekker and De Wet, 1981). According to Anthropologists (Soga, 1931), the Mfengu are held to be more independent and less tribally orientated than other groups of the

Ama-Xhosa/

Ama-Xhosa.

4.2.9 Tribal status

Because of the strong sense of authoritarianship, traditionalism and the importance of the family unit in tribal society, factors which are usually negatively related to farming progressiveness, tribal leadership is an important variable in programmes for crop production development. Tribal leadership and influence may be either beneficial or an obstacle to development. This aspect was not investigated, but the chief of the area, Chief Mhlambiso, is a member of the Ciskei Parliament and therefore has direct access to Government.

Table 4.4 : Distribution of Amatola Basin respondents according to tribal status, 1981 (N = 70)

Status	No.	%
Headman	1	1,4
Sub-headman	1	1,4
Elder	4	5,8
Councillor	8	11,4
No status	56	80,0
TOTAL	70	100,0

Eighty per cent of respondents did not have any status in the tribal hierarchy, while the majority (57%) of tribal office bearers in the sample were members of the Chief's Council (Table 4.3).

4.2.10 Managerial aptitude

Efficient crop farming requires the application of scientific principles and concepts of crop production.

Sound/

Sound management of the farming enterprise is the key to efficiency; without this, even with the most up-to-date knowledge of modern crop production farming practices and techniques, there is little likelihood that the enterprise will be efficient or a financial success. Researchers have concluded that farming progressiveness is a personality trait and is largely dependent on a farmer's managerial aptitude (Burger, 1967). Farming is a tool in the hands of the manager and managerial aptitude has been shown to be the most important requirement for farming efficiency.

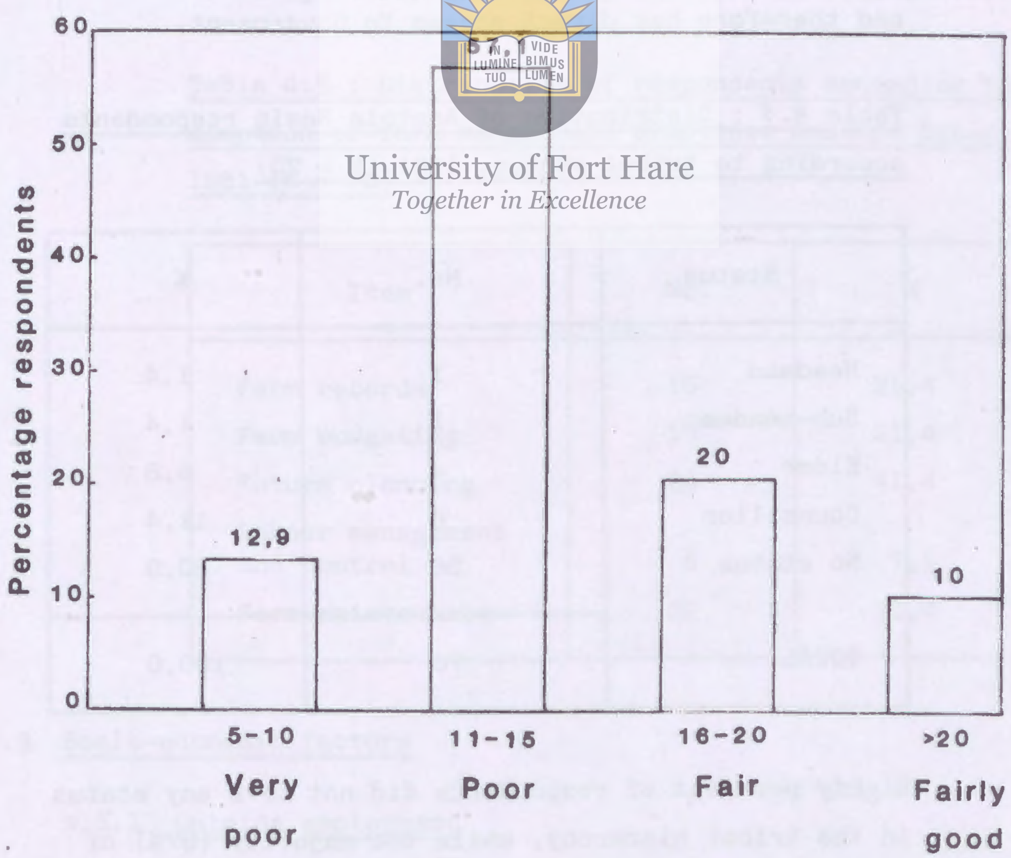


Fig. 6 : Managerial aptitude levels of Amatola crop farmers 1981 (N = 70)

By modern farming standards, the survey showed that approximately/

approximately 10 per cent of respondents have the necessary managerial ability to run a successful commercial farming enterprise at a high level of efficiency (Fig. 6).

Managerial aptitude was shown to be significantly related to level of education and farming progressiveness in terms of adoption of improved farming practices (Table 4.1).

Even taking minimum criteria for important elements of management (Table 4.5), only about 20 per cent of farmers have the necessary managerial aptitude to manage their own farming enterprises (Table 4.4).

Table 4.5 : Distribution of respondents according to adoption of farm management practices Amatola Basin, 1981 (N = 70)

Item	No.	%
Farm records	15	21,4
Farm budgeting	15	21,4
Future planning	29	41,4
Labour management and control	5	7,1
Farm maintenance	22	31,4

4.3 Socio-economic factors

4.3.1 Outside employment

Approximately 60 per cent of the *de facto* heads of crop farming households were employed outside the Amatola Basin, most of them being males (refer 4.2.1). Probably because of their financial resources, farmers who were employed outside the area were significantly

more/

more progressive in terms of adoption of improved crop production practices than those who were not employed, which suggests the need for financial support of farmers who do not have other sources of income (Table 4.5).

Table 4.6 : Distribution of heads of households, Amatola Basin, according to employment status, 1981 (N = 70)

Employment status	No.	%
Home commuter	23	32,9
Employed outside area	18	27,7
Resident in area	29	41,4
TOTAL	70	100,0

The majority were employed in various services, industry, agriculture and mining (Table 4.6).

Table 4.7 : Distribution of Amatola Basin respondents according to type of employment of heads of households, 1981 (N = 70)

Type of employment	No.	%
None	29	41,5
Agriculture	8	11,4
Mining	3	4,3
Industry	9	12,8
Services/Other	21	30,0

According to the socio-economic survey of Bekker and De Wet (1981), the mean family income from outside employment is approximately R750 per family per annum.

4.3.2 Housing standards

In general over the past 25 years, due to income being derived from outside employment, there has been a considerable improvement in housing standards in the Amatola Basin.

Table 4.8 : Distribution of Amatola Basin respondents according to standard of housing, 1981 (N = 70)

Housing standard	No.	%
Traditional thatch	6	8,6
Trad. pole under iron	6	8,6
Wattle daub/brick under iron	58	82,8
TOTAL	70	100,0

There are very few (8,6%) traditionally round Xhosa-type dwellings in the area, with the majority (82,8%) being western type wattle-and-daub or brick-under-iron dwellings. Very few, however, have rain-water tanks.

4.3.3 Transport

Forms of transport are a direct reflection of mobility and living standards. Seventy-six per cent of households have no transport of their own and have to rely on public transport.

Horse transport was claimed to be used by 17 per cent of respondents, while only 7 per cent had any form of motorised transport (Table 4.8).

Table 4.8/

Table 4.9 : Distribution of respondents according to type of transport 1981 (N = 70)

Type of transport	No.	%
Nil	53	75,7
Horse	12	17,2
Motor car	4	5,7
Bakkie	1	1,4
TOTAL	70	100,0

4.3.4 Land tenure

Unlike commercial farming, small-scale farming in the Amatola Basin is not subject to a selective process whereby only those who practise farming efficiently can survive. Arable land holdings in the Amatola Basin are held under quitrent, whereby individuals pay a nominal annual rental and own the land under a deed. Holdings are not a negotiable asset, where market forces can operate and land change hands, allowing more efficient farmers to consolidate a number of holdings into a viable farming proposition. Inheritance is de facto, if not de jure and is assumed and prescribed by traditional succession; and land cannot be used as security for loans or debts.

In addition, if land holdings are too small to provide family subsistence requirements, the outcome is bound to be failure in terms of farming efficiency, even if there are no other constraints (Sadie, 1981).

4.3.5 Local leadership

'Other farmers' are often regarded as important and a knowledgeable source of information. Opinion leaders

tend/

tend to be more progressive farmers, and to be better informed on various aspects of farming. When planning the systematic diffusion of information about crop production practices, it is necessary to identify various influential farmers in the community. When these are used as foci, information can be transmitted through the inter-personal network to all parts of the farming community (Bembridge, 1976).

It was not within the terms of reference of this study to carry out a leadership survey. The finding that 76 per cent of respondents regarded the most successful farmers as being 'better managers' suggests that, with a view to strengthening local leadership, leadership patterns in the area need to be determined.

The fact that only 36 per cent of respondents said they would consult other farmers on crop farming suggests that, as with most traditional societies, local leadership in the area is weak.

4.3.6 Nutrition

An absolute necessity in terms of development outcome is sufficient food. Below certain levels of nutrition, a person lacks not only energy and good health, but also interest and a capacity to develop.

While it is not within the scope of this study to investigate nutritional levels in the area, local production supplies only approximately 25 per cent of calorie requirements for the area (refer 5.8), and health statistics reveal that protein-energy diseases such as kwashiorkor, as well as the nutrition-related diseases of tuberculosis, do occur in the area, which suggests that malnutrition may be a constraint to the development of the area.

4.4 Conclusion

It can be concluded that crop production is limited by the high percentage (60%) of absentee male heads of households.

Low levels of formal education and vocational training suggest that approximately 40 per cent of heads of households are likely to be responsive to written communication. Regarding the 20 per cent of farmers who are illiterate, inevitably some members of the family are bound to be literate and they can pass on information to the farmers concerned.

The age distribution suggests that approximately 60 per cent of farmers have the necessary physical capability of undertaking farming operations on their own account. Low levels of managerial aptitude are a definite constraint to future development of 'middle class' farmers, unless opportunities can be created to attract heads of households who are working outside the area to farm on a fulltime basis. An added constraint is the lack of mobility and transport.

The present system of land tenure, non-viable farming units and general lack of security for farming credit are constraints to the development of crop farming in the Amatola Basin. Share cropping and hiring of land from those unable or unwilling to use their land, offer the only solution for expansion under the present tenure system.

It can be concluded that the pattern of local leadership needs to be further investigated with a view to using the inter-personal network for diffusing information on crop production.

The nutritional status of the population is probably a constraint to any development of the crop-production potential of the area, and this should be investigated further.

5. CROP PRODUCTION IN AMATOLA BASIN

This section deals with the crop farming potential, land utilization, production systems, adoption of maize farming practices, and economic and related aspects of crop production. This qualitative information has value in providing planners with a sound basis for assessing constraints in the crop farming system, as well as in throwing some light on a sector of agricultural production about which little information is available.

5.1 Human carrying capacity in terms of crop production

Human carrying capacity is the number of people and the level of their activities which an area can sustain in perpetuity at an acceptable quality of life without deterioration (Allan, 1972). In less developed countries, human carrying capacity has usually been applied to subsistence farming systems (Conklin, 1959; Allan, 1960). The concept of human carrying capacity requires consideration of such factors as needs beyond the subsistence level, non-farm activities, inputs and outputs, institutional, social, economic and cultural constraints which are not within the terms of reference of this study.

Human carrying capacity is based upon the amount of calories which can be produced in an area. Although a calculation based on calories alone does not take into account the qualitative aspects of the diet, and will not necessarily provide a balance of vitamins and trace elements, it is nevertheless a fair assumption that, if provided with health education, a family should be able to supplement their diet from vegetable gardens and animal proteins. In the Amatola Basin there is also the fact that most families are only partially dependent upon farm activities for their food supply.

Table 5.1 gives an estimate of potential dryland maize yields and calories per hectare based on available data from the area, which indicate that potential yields vary from 3,2 to

8 tons/

8 tons a hectare according to climatic zones (Steyn, 1981).

Table 5.1 : Estimated range of potential maize yields, according to climate and calories and persons per hectare at various yield levels in Amatola Basin

Variable			
Maize yield kg/ha	7000	3500	2500
Million cal (ha)	22,4	11,2	8,0
Persons (ha)	26,4	13,2	9,3

The socio-economic survey showed that the average de facto household had 5,01 members and complete households had 7,36 members (Bekker and De Wet, 1981). Using the standards of Fox (1966) and interpolating the age/sex distribution, it can be computed that the average minimum for each individual in the household is 2324 calories per day. Consequently it can be computed that the average person requires 848260 calories per annum.

Table 5.2 : Carrying capacity of Amatola Basin from present cultivated area, based on a yield of 3,5 tons per hectare

Present cultivated area (ha)	Estimated population No.	Estimated subsistence carrying capacity No.	Surplus carrying capacity No.
1217	5607 de jure	16064	10457
1217	3817 de facto	16064	12247

In terms of the policy of Ciskei to achieve self sufficiency in food production, Table 5.2 shows that the area has the potential to provide the grain subsistence requirements for almost three times the de jure population and more than four times the de facto population. If one takes a more conservative

potential/

potential yield of [illegible] ha from the present cultivated area, then the area could still provide for more than twice the de facto population.

However, any scheme to attract and evolve a bona fide class of farmers with income targets designed to provide subsistence and basic necessities at a high enough level to provide a margin of savings for farm investment, home improvement and improved basic services, may necessitate a small reduction in the number of farming families, or, alternatively, a considerable intensification of the farming system.

5.2 Present land utilization

The betterment planning report shows that 18 per cent of the area is under cultivation (Table 5.3).

Table 5.3 : Land utilization in the Amatola Basin

Land category	ha	%
Cultivated area	1217	17,9
Grazing area	2950	43,4
Indigenous forest	2217	32,6
Residential sites	419	6,1

According to the socio-economic survey of Bekker and De Wet, 1981, the distribution of individual households according to farming enterprises (Table 5.4), shows that 47 per cent of households have crop production holdings.

Table 5.4/

Table 5.4 : Distribution of Amatola households according to farming activities (N = 764), 1981

Category	No.	%
Crops and livestock	270	36,0
Crops and no livestock	87	11,0
Stock and no crops	249	33,0
No farming activity	158	20,0
TOTAL	764	100,0

Twenty per cent of households are apparently not involved in any crop or livestock farming while 34 per cent of crop farmers do not have any livestock (Table 5.4).

Table 5.5 shows that 27 per cent of respondents who had land did not cultivate their lands during the 1980/81 season, which represents a considerable loss of production potential. The majority (86%) cultivated less than 3 ha. From the survey it also became evident that some lands adjoining the forest areas had been abandoned because of crop damage caused by wild pigs.

Table 5.5 : Distribution of respondents according to area cultivated in the Amatola Basin, 1981 (N = 70)

Area cultivated ha	No.	%
Nil	19	27,1
0 - 2	19	27,1
2;1 - 3	25	35,7
3,1 - 4	4	5,7
> 4	3	4,3
TOTAL	70	100,0

Plate 1 - Typical view of arable lands in Amatola Basin, 1982

Plate 2 - An example of poor seedbed preparation and inadequate plant population in Amatola Basin, 1982

5.3 Adoption of crop production practices

5.3.1 Introduction

This study focuses on maize, which is the major food crop of the Amatola Basin. While there are no reliable statistics on maize production, from available evidence it can be estimated that the yield is between 3 and 4 bags per hectare. Yields have become more variable, which suggests that betterment planning has made little, if any, impact on production, and a probable deterioration in soil fertility has taken place due to continuous cropping.

Acceptance or rejection of crop production practices is not a simple dichotomy of behaviour, but involves instead a complex sequence of mental activity which has been segregated into five specific stages: awareness, interest, evaluation, trial, adoption (Lionberger, 1960; Rogers and Shoemaker, 1971). While data showing how individuals go about adopting new cropping practices may be interesting, such information is useful only to the extent that it contributes to the knowledge of why individuals accept and integrate practices into their farming systems. Although this study is specifically concerned with the extent and rate of adoption of maize practices, it must be borne in mind that adoption is a process.

Successful maize production is a complex phenomenon, and many factors can and do cause variations in yields (Mohr, 1975). Respondents were questioned on their maize production practices, and field measurements and observations were made during the 1980/81 season of important practices such as plant population and weed control. These practices have

been/

been recommended by the Department of Agriculture over the past 15 to 20 years, a reasonable time thus having been ensured for respondents to pass through the adoption process for each innovation. The practices studied are all considered necessary by professional agronomists for efficient maize production, and cover the whole production process from land preparation to harvesting.

The present stage in the process of adoption of certain important practices was determined by collecting information as to when the practice was first adopted. The rate at which a practice is adopted after being introduced is influenced by the nature of the practice itself (Rogers and Shoemaker, 1971) and by various other factors.

In general, practices which involve little cost, little change in skills, which produce quick returns and are easily communicated, are likely to be adopted quickly. In contrast, those which require a high financial outlay, require the farmer to learn new skills, do not produce immediate returns and are not easily communicated, are likely to be adopted more slowly.

There is considerable evidence that practices thought to be sound by agricultural advisers are not always regarded as sound by farmers (Belshaw and Hall, 1969; Festehawen, 1969; Carr, 1971), and criteria which farmers use for evaluating innovations are often different from those of trained agriculturists (Collinson, 1968).

Mosher (1966) suggests that the necessary pre-requisites for promoting agricultural development include: (1) essentials, such as modern technology, production incentives and markets; and (2) accelerators,

including/

including research, agricultural extension and credit for inputs. Therefore, effectiveness in promoting maize production technology is dependent on the provision of essentials and other accelerators. Unfortunately the Amatola Basin has in the past lacked certain of these basic essentials and accelerators.

It can be argued from the aforegoing that the apparent failure of the extension service to promote crop production in the Amatola Basin is not entirely due to the operation of the extension system, but is also a result of the environment in which it operates.

While the extension service has promoted maize growing in a fairly standardised way, practices which are promoted uniformly across agro-ecological areas, may not be equally suited to all areas or all farmers.

5.3.2 Perception of erosion from arable land

Perception is the interpretation or reasoning an individual gives to a situation from his own point of view; it is based on his past experiences (Zapata, 1971). From the standpoint of agricultural extension it is clear that, if a farmer has different perceptions to those of an extension worker, the latter will have difficulty in helping him solve his problems, and change will be hindered (Foster, 1962).

Any crop production programme is likely to fail in the long term unless farmers have a positive, educated perception of conservation and erosion of arable land.

There were considerable differences in perception between the enumerator who was an experienced extension worker and farmers (Fig. 7). Forty-one per cent of farmers whose lands were assessed as being eroded did not perceive any erosion on their lands. This finding

has/

has implications for future crop production programmes.

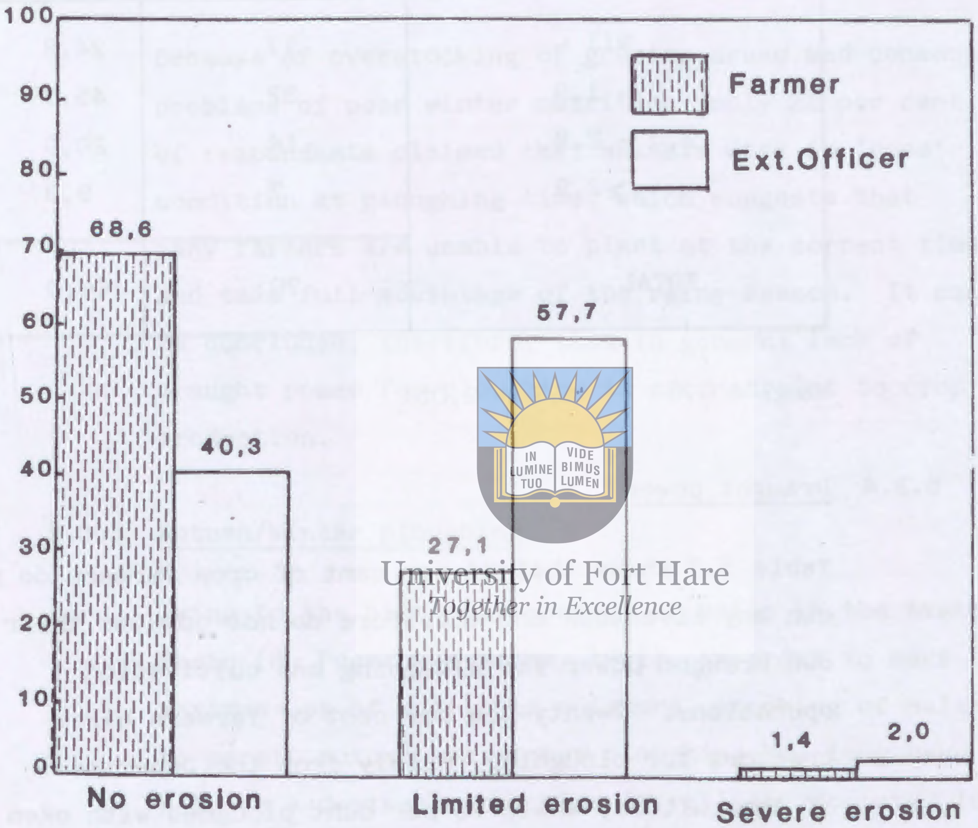


Fig. 7 : Differences in perception of erosion of arable lands between farmers and extension officers in the Amatola Basin, 1981

5.3.3 Area of maize lands

From Table 5.6 it can be seen that 24 per cent of respondents did not plant their maize lands in 1980/81 season. The average area planted to maize was 1,80 ha per farmer.

Table 5.6/

Table 5.6 : Distribution of respondents according to area planted to maize, Amatola Basin, 1981 (N = 70)

Area ha.	No.	%
Nil	17	24,3
0 - 1,9	32	45,7
2,0 - 2,9	14	20,0
>2,9	7	9,9
TOTAL	70	100,0

Mean = 0,8 S/D = 2,051

5.3.4 Draught power

Table 5.7 shows that 54 per cent of crop farmers do not own any livestock and therefore do not possess their own draught power for ploughing and cultivation operations. Twenty-six per cent of farmers hired tractors for ploughing, mainly from the Department of Agriculture, while 73 per cent ploughed with oxen (Table 5.7). The average cost of tractors hired was R15,30 per ha.

Table 5.7 : Distribution of respondents according to method of ploughing Amatola Basin, 1981 (N = 70)

Method	No.	%
Ox drawn		
2 oxen	2	2,8
4 oxen	21	30,0
6 oxen	28	40,0
Tractor		
Own tractor	1	1,4
Hired tractor	18	25,7

Sixty-three/

Sixty-three per cent of farmers said they had inadequate draught power. More than half (59%) were of the opinion that it was possible to hire tractors for ploughing, while 39 per cent said they had to hire animals locally to undertake ploughing operations.

Because of overstocking of grazing areas and consequent problems of poor winter nutrition, only 22 per cent of respondents claimed that animals were in 'good' condition at ploughing time, which suggests that many farmers are unable to plant at the correct time and take full advantage of the rainy season. It can be concluded, therefore, that in general lack of draught power for ploughing is a constraint to crop production.

5.3.5 <u>Autumn/Winter ploughing</u>

Owing to the high clay content of soils in the Amatola Basin (du Preez and Botha, 1981), in order to make maximum use of available moisture, stooking of maize to permit autumn and winter ploughing has long been held as a desirable practice (Fertilizer Society, 1972) and advocated by the Ciskei Department of Agriculture. This practice was carried out by only 20 per cent of respondents (Fig. 8).

Tillage is regarded as one of the most important factors in crop production (Koch and Badenhorst, 1979). According to field observations, the majority of lands (76,7%) were ploughed to a minimum depth of 175 mm. However, this does not necessarily mean that ploughing was well done.

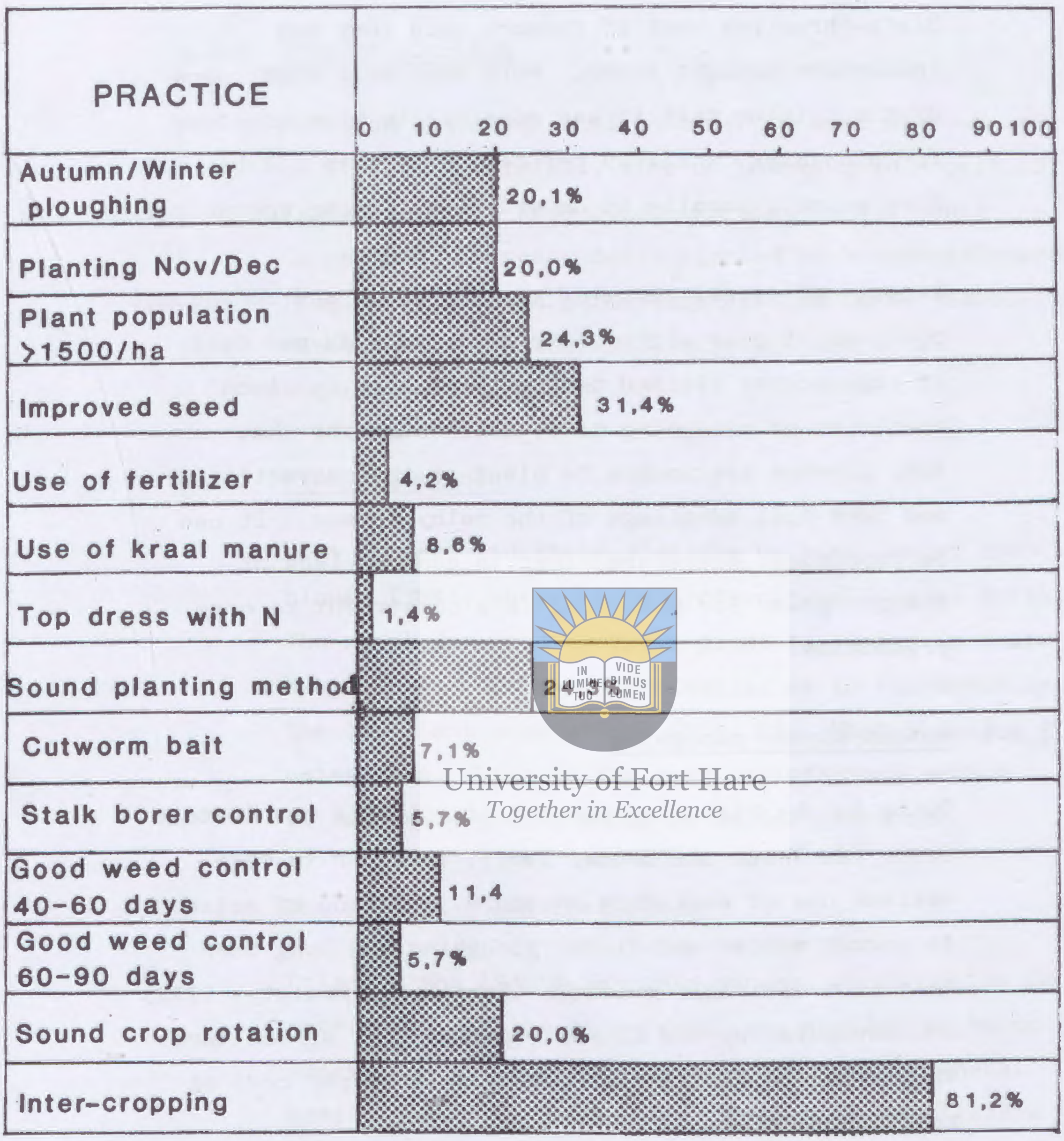


Fig. 8 : Adoption rate of maize production practices in Amatola Basin, 1981 (N = 70)

5.3.6/

5.3.6 Time of planting

Research has shown that in order to make maximum use of available rainfall, time of planting is a critical factor in maize production (Marais, 1978). Only 20 per cent of respondents planted in November/December (Fig. 8). A large percentage planted in September/ October and were therefore more subject to a mid-season drought period.

5.3.7 Planting method

Most farmers did their planting by hand behind the plough (76%), where it is difficult to control depth. The remainder used ox-drawn planters, which in most cases do not operate efficiently, as is evidenced by the low plant populations (Fig. 8). Hand planting using hoes, which is the most satisfactory method of achieving good stands, is seldom practised.

5.3.8 Use of manure and fertilizer

Prior to the 1960's, farmyard manure, which is low in nutrients, was the main fertilizer applied to maize lands. In the past two decades farmers in general have become more dependent on inorganic fertilizers which are easier to apply. Fertilizer represents the greatest single cost item in maize production. There is ample evidence of the economic advantage of using fertilizer to increase production, provided it is applied in accordance with soil nutrient status and climatic conditions (Easton & Buys, 1980; FAO, 1981).

Although 9 per cent of farmers used kraal manure on their lands (Fig. 8), application per hectare was extremely low. The average application was found to be 0,5 tonnes per hectare. Manure is often applied

with/

with the planter, which in any event allows for only small quantities to be applied.

Only 4 per cent of respondents used fertilizer, and these all used considerably less (55 kg per ha) than the standard recommendation of 200 kg per ha. These findings, together with the discovery that continuous dryland cropping is practised, lead one to the conclusion that low soil fertility is a problem of the first magnitude.

Despite the low levels at which fertilizer and manure are used and the declining soil fertility, 30 per cent of farmers considered that soil fertility was 'good', and a further 66 per cent regarded fertility as being 'fair'. This negative perception of declining soil fertility has obvious implications for future extension programmes.

5.3.9 Use of improved seed

Research workers in many parts of the less developed world (FAO, 1981) have shown the impact of improved varieties of seed on yield, provided other basic cultural practices are carried out. Guidelines for the choice of cultivars in Southern Africa are well documented (Geerthson, 1972; Dijkhuis, 1974). Only 31 per cent of respondents used seed of recommended varieties, the majority using their own unselected seed (Fig. 8).

Because of the generally low adoption levels of other cultural practices, the majority of farmers are, in any event, not likely to get a significant response to the use of improved varieties, particularly hybrids. There is, therefore, considerable scope for systematic seed selection from locally grown cultivars.

Plate 3 - An example of poor plant population in Amatola Basin, 1982

Plate 4 - Oxdrawn cultivation - note poor plant population, Amatola Basin, 1982

5.3.10 Cutworm control

Although the incidence of cutworm varies according to seasonal conditions, cutworm outbreaks can seriously affect plant populations (Drinkwater, 1980). The Department of Agriculture has for some years recommended the use of cutworm bait at planting time. Because of the low adoption of pre-planting cultivation in dryland areas, this practice has particular relevance as a precautionary measure. Only 8.1 per cent of farmers adopted this practice (Fig. 8). Although the effect of cutworm on plant population was not studied, it can safely be assumed that it is a contributory factor to low plant populations.

5.3.11 Plant population

Optimum plant populations have been determined for different yield potentials in Southern Africa (Van Niekerk, du Toit and Pretorius, 1972) and for Ciskei by Marais (1978). The latter was adopted as a norm for the present areas. On this basis optimum plant populations for approximately 1 m rows are 20 000 plants per hectare. Only 24 per cent achieved an average plant population of 15 000 per ha with a coefficient of uniformity of less than 50 per cent (Fig. 8). Therefore low plant populations are a major cause of low yields.

5.3.12 Stalk borer control

The maize stalk borer is the most important pest of maize in South Africa. Total losses in maize yield ascribed to this pest have been assessed at approximately 10 per cent (Walters, Drinkwater, Van Rensburg and Boshoff, 1980). Losses between areas can vary widely from almost no loss to complete crop failure. Stalk borer is known to be present in most areas of Ciskei and for this reason application of insecticides as a control measure has been advocated for many

years/

years. Only 6 per cent of farmers were found to have adopted this practice (Fig. 8).

5.3.13 Weed control

According to Nel and Smit (1977), weeds in agricultural lands in South Africa can amount to a loss of R120 million. The same authors point out that research indicates that weed control can have a greater influence on yield than fertilizer, although obviously both practices should be applied for optimum production. Furthermore, if weeds are allowed to grow unchecked, they remove large quantities of nutrients during the first 6 weeks, which would otherwise be available to the maize crop (Nel and Smit, 1977).

Fig. 8 shows that lack of proper weed control is a major constraint to maize production. Weed control was poor in the first 40 - 60 days after planting, with only about 11 per cent of farmers controlling weeds adequately during this stage. A similar picture is apparent in the later stage of the crop, where even less (6%) achieved good weed control.

The low levels of weed control can be partly attributed to the heavy reliance on hand weeding. _Cynodon dactylon_, which can often be eradicated only by dry-ploughing in winter, goose grass (_Elusine indica_) and nut grass (_Cyperus spp._) were reported as the major weed species associated with a number of broad-leafed weeds such as Mexican marigold (_Tagetes minuta_), black jack (_Bidens pilasa_), goose foot (_Chenopodium album_), wild hibiscus (_Xanthium pungens_), pig weed (_Amaranthus spp._), thorn apple (_Datura stramonium_) and cocklebur (_Xanthium spp._).

5.3.14 Crop/

Plate 5 - Oxdrawn cultivation - many farmers do not have draught power for cultivation, Amatola Basin, 1982

Plate 6 - Labour for weed control is often a problem, Amatola Basin, 1982

5.3.14 Crop rotation

Although 20 per cent of farmers said they practised crop rotation (Fig. 8), only about 4 per cent rotated crops on a sound basis, with a legume crop following a maize crop.

5.3.15 *Inter-cropping*

'Inter-cropping' or 'multiple cropping' are terms which describe forms of cropping practice where total production from a unit area of land is achieved by growing crops simultaneously.

Despite the fact that this practice is not recommended by extension workers, inter-cropping maize with beans and pumpkins is widely practised throughout the Ciskei. Inter-cropping is practised by 81 per cent of Amatola Basin farmers. Spacing and patterns and methods of inter-planting were found to vary widely. Field observations showed that (in order of importance) beans (67%), pumpkins (30%), potatoes (10%) and peas (6%) were the most popular crops for inter-planting with maize.

The majority (67%) of farmers who practised inter-cropping maize with pumpkins and beans, reported that they were obtaining higher yields and the remainder (17%) considered that by inter-cropping there was less risk of crop failure. It was not possible to obtain accurate yields of production from inter-cropping, but observations indicate that yields of both pumpkins and beans were low. Competition may reduce potential yields of both the main crop and the inter-planted crops. Poor weed control is an added constraint.

Though inter-cropping in peasant agriculture has a long history, the concept has received only limited

attention/

attention from researchers, and then only in recent times (Papendick, Sanchez and Trimlett, 1977). While research shows that the extent of any extra contribution to production per unit area from mixtures of crops has been difficult to define, good responses at higher production levels have been demonstrated by a number of researchers (Willey and Osiru, 1972; Osiru and Willey, 1972; Andrews, 1974; Baker, 1974). Baker and Norman (1975) in West Africa found better weed control and use of labour in crop mixtures, and there is evidence that crop mixtures can make better use of Nitrogen (IRRI 1974). It is suggested by Ruthenberg (1971) that in the tropics the adoption of single-cropping practices for many crops offers less dependable returns.

Whatever the validity of farmers' perceptions of inter-cropping practices, there is enough evidence to suggest that local researchers should evaluate inter-cropping systems with a view to improving inter-cropping technology adapted to present farming systems. Details of production methods will be useful in the design of experiments.

5.3.16 <u>Rate of adoption of selected maize practices</u>

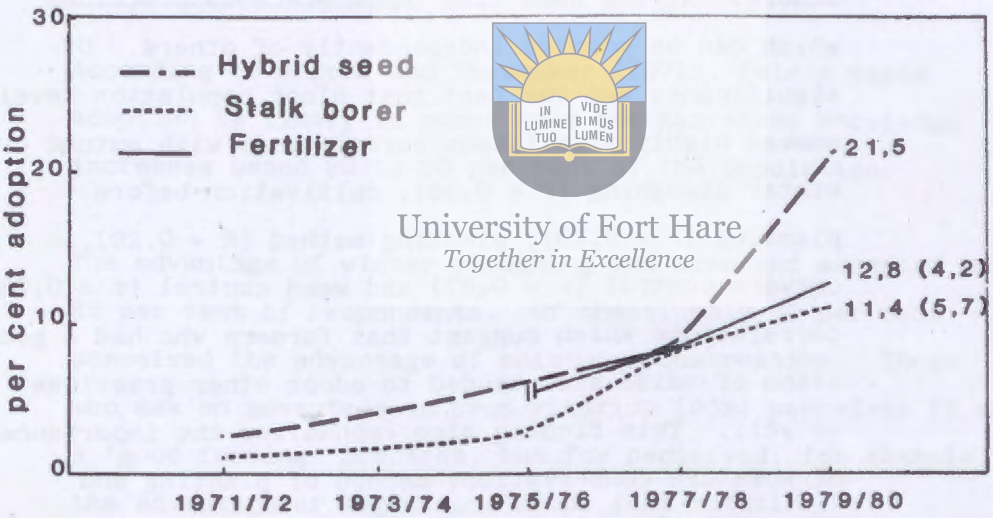
The stage in the adoption process of a practice can be assessed by obtaining the data with regard to the first adoption of that practice by the population. Fig. 9 shows the cumulative percentages of farmers adopting three important practices over the past decade.

Although the use of fertilizer has shown an increase over the past 10 years, with 13 per cent of respondents having adopted the practice at some stage or another, the present level of adoption is only 4,2 per cent (Fig. 9). Rejection of this practice by 67 per cent

of/

of adopters can be attributed to a lack of response caused by low fertilizer application rates (Fig. 8), and failure to adopt other important practices such as improved seed, plant populations and weed control (Fig. 8). Increased cost of fertilizer has probably also been a factor.

The trends for adoption of improved seed has been more stable, whereas stalk borer control has shown a similar trend of rejection as has fertilizer utilization (Fig. 9), with a 50 per cent rejection after initial adoption, probably for similar reasons.



<u>Fig. 9 : Rate of adoption of hybrid seed, fertilizer and stalk borer control by Amatola farmers, 1981 (N = 70)</u>

These findings suggest that adoption of a recommended practice or practices has not resulted in a positive economic yield response. Of greater importance than adoption <u>per se</u> is <u>how</u> the practices are applied - defects in applications were observed in all three practices. Results suggest that it is possible that farmers do not perceive the inter-relatedness of

practices/

practices in the farming system. In short, adoption curves in Fig. 9 hide the facts that a large percentage of respondents subsequently rejected practices after adoption, and that application of technology was unsatisfactory.

5.3.17 Intercorrelation of maize practices

Table 4.1 shows the intercorrelation of certain maize practices previously discussed. If optimum yields are to be achieved, then the adoption of succeeding practices is dependent on the prior adoption of others. At the same time there are some practices which can be adopted independently of others. Of significance was the fact that plant population levels showed highly significant correlations with autumn or winter ploughing (r = 0,36), cultivation before planting (r = 0,29), planting method (R = 0,29), cutworm control (r = 0,67) and weed control (r = 0,78), correlations which suggest that farmers who had a good stand of maize also tended to adopt other practices as well. This finding also emphasizes the importance of moisture conservation, method of planting and cutworm control in achieving a high plant population.

It has been postulated by a number of researchers (Crouch, 1981), that a scale of adoption of farming practices can be used as a predictive model in an attempt to understand the behavioural process in adoption of improved technology.

In a step-wise multiple regression in which adoption of maize practices was entered as a dependent variable against the 17 variables in Table 4.1, the total regression model was significant ($P<0,01$) with a coefficient of determination of 92,58 per cent. The most important variables explaining 71,45 per cent of the variance was the farmer's level of vocational

training,/

training, which in turn correlated significantly with education (r = 0,63), outside employment (r = 0,36) and managerial aptitude (r = 0,51). It can be concluded, therefore that the most progressive crop farmers in the Amatola Basin tended to be employed outside the area and thus probably had greater financial resources, were better educated, had some form of vocational training and a high level of managerial aptitude. This finding suggests the need for an intensive educational input to improve crop farming and management levels in the area.

5.4 Knowledge of practices

According to Rogers and Shoemaker (1971), fairly rapid adoption is likely to occur once the awareness knowledge increases beond 20 to 30 per cent of the population.

The advantage of winter ploughing was seen and accepted by 85 per cent of respondents. Of these, only 30 per cent perceived the advantage of moisture conservation. Those who saw an advantage in crop rotation (66%) perceived it as a 'good farming' practice, but few perceived, for example, the advantage of leguminous crops in a rotation.

Table 5.8 : Distribution of Amatola Basin farmers according to knowledge of certain maize practices, 1981 (N = 70)

Practice	No.	%
Planting date	28	40,0
Use of fertilizer	49	70,0
Autumn ploughing	61	87,0
Stalk borer control	50	71,0
Crop rotation	46	66,0

Although/

Although, according to Table 5.7, the vast majority of farmers were aware of fertilizer and maize stalk borer control practices, their knowledge of the scientific application and inter-relatedness of these with other practices was deficient. These findings suggest that the majority of respondents were aware of practices, but did not have full knowledge of the proper application of the innovation. This conclusion is in line with the communication theory, which suggests that knowledge will spread fastest when a recommendation is perceived as relevant to the situation (Galjart, 1971; Tully, 1968).

Robbertse (1972) states that at a 50 per cent rate of adoption (early majority) there is a likelihood that most opinion leaders will have adopted the practice and can influence the rest of the target audience; consequently extension workers should plan extension strategies to obtain at least a 50 per cent adoption. On the basis of this criterion, extension has been unsuccessful in providing the extension requirements of maize production, in terms of adequacy and intensity of adoption required to achieve even subsistence requirement yields.

5.5 *Information sources*

Forty-one per cent of farmers cited extension workers as sources of information on fertilizer and 26 per cent as sources of information on stalk borer control, while other farmers were cited as sources of information for these two practices by 21 and 29 per cent of farmers respectively. The latter finding may be a contributory cause of rejection of these practices, owing to distorted information "trickling down" from extension workers.

The finding that only 54 per cent of farmers said they had ever received any advice on their crop farming from the extension officer confirms the need for improved extension services. The majority of farmers (80%) were in favour of crop demonstrations on their own land to demonstrate the value of suitable technology.

5.6 Farmers perception of maize production problems

The phenomenon of droughts was cited as a major cause of low crop yields by 63 per cent of respondents. Nineteen per cent and nine per cent cited the valid reasons of lack of finance for inputs and lack of equipment respectively. Despite the overall low level of adoption of maize production practices, only 4 per cent regarded poor methods as a major reason. This finding has important implications for future crop production programmes.

On being questioned about their own personal needs for crop production, 87 per cent of respondents cited finance or inputs such as implements, seed and fertilizer which require finance, as their needs to achieve higher yields.

The fact that 37 per cent of farmers felt they could achieve higher yields, suggests that there is scope for extension programmes supported by the necessary inputs and infrastructure. At the same time the survey suggests three in five farmers are not motivated enough to improve their levels of production.

5.7 Maize yields

Due to lack of records it was not possible to establish past maize yields in the area with any degree of accuracy. Estimates were given as approximately 300 kg per ha.

In this study yields for 1980/81 were determined on a random sampling basis, by counts of plant population and by determining the average mass of samples of cobs. Allowance was made for whole plants or cobs which had been removed for 'green mealies'. Even this laborious method, it has been found, does not provide a high degree of accuracy (Marais, 1981). The alternative of questioning farmers or measuring maize actually harvested does not take cognizance of maize consumed during the season, and is considered to be less accurate then sampling in the field, a method which has the added advantage of giving the researcher the opportunity to make an intelligent estimate.

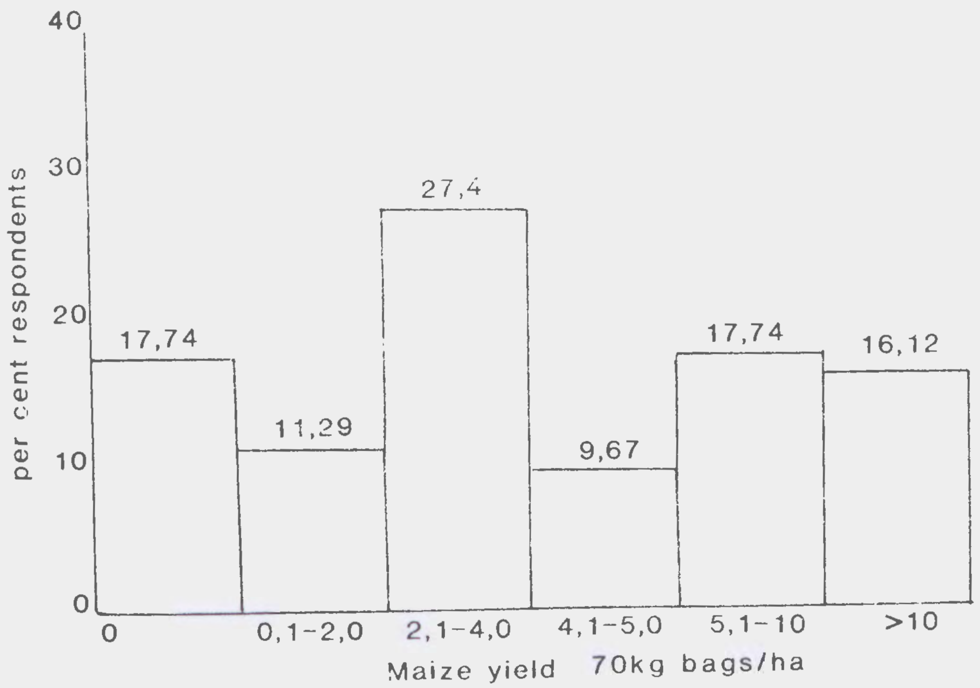


Fig. 10 : Distribution of respondents according to maize yield/ha, 1980/81

For practical purposes the yield distribution given in Fig. 10 can be regarded as a fair reflection of the appallingly low levels of maize productivity in the area. The fact that there was a high correlation between overall adoption of maize production practices and yield per hectare adds weight to the validity of the data obtained. The average yield of 261 kg per ha, compared to a potential of approximately 3500 kg (Table 3.3), confirms the existence of a tremendous scope for improving maize production in the area, with the assistance of inputs, advice and application of suitable technology.

5.8 Income from crop production

The gross value of crop, vegetables and fruit production was calculated by using standard producer prices for 1980 (Division of Agricultural Marketing Research, 1981). Gross margin was calculated by using actual expenditure on seed, fertilizer, insecticides and tractor hire. Since labour is usually provided by the family unit, and because there are

difficulties/

difficulties in evaluating labour inputs, this factor was not included in the analysis.

Table 5.9 : Mean gross value of crop production in Amatola Basin, 1980/81 (N = 70)

Crop	R	%
Maize	7,70	72,6
Sorghum	3,15	3,4
Beans	1,66	1,8
Winter cereals	2,30	2,5
SUB-TOTAL	74,81	80,3
Garden crops	12,18	13,0
Orchard	6,26	6,7
TOTAL	93,25	100,0

The extremely low levels of production shown in Table 5.9 are a direct reflection of the low rate of adoption of technology (Fig. 8). The average gross value of crop production in 1980/81 was R93,25 with maize making the major contribution (73%) of the total value (Table 5.9).

Maize and other field crops provide the calorie requirements for approximately half the average de facto household of 5,01 persons. Taking cognizance of the fact that 53 per cent of families in the Amatola Basin have no lands at all, it can be concluded that, overall, approximately 25 per cent of calorie requirements are produced from crops, against a potential of at least sixteen times the amount currently produced (Table 5.1).

In a step-wise multiple regression, yield per ha was entered as a dependent variable on the 7 practices given in Table 4.1, the total regression model was significant ($P<0,05$), with a coefficient of determination of 41,33 per cent.

The most important variables, which accounted for 39,15 per cent of the variation, are given with their regression coefficients in Table 5.10.

Table 5.10: Regression coefficients and standard errors of coefficients of maize yield per ha on most important maize practice variables (Total R^2 = 41,33%) 1981

Independent variable	b_{yx} ± S.E	Cumulative R^2 %
Weed control	0,638 ± 1,773	17,65
Method of planting	1,739 ± 9,019	21,53
Autumn/Winter ploughing	1,183 ± 1,785	27,36
Stalk borer control	4,327 ± 4,102	31,92
Cultivation before planting	1,375 ± 1,479	39,15

Table 5.10 confirms the importance of weed control, which was found to be inadequate in most cases (Fig. 8) and of autumn and winter ploughing to conserve moisture, for achieving high maize yields in the Amatola Basin.

Although input costs were extremely low, the return on labour expended of R68,81 per annum is a minimal return on efforts

expended./

expended. However, on the small scale farm there is the added value that 'on farm' prices are a good deal lower than retail prices, so that the real value to the family is considerably more than that indicated in Table 5.11.

Table 5.11 : Estimated gross margin from crop production in Amatola Basin, 1980/81 (N = 70)

Item	R
Gross value of crops, vegetables, fruit	93,25
Costs	
Ploughing	10,42
Seed	12,70
Fertilizer	1,00
Insecticide	0,32
	24,44
Gross margin	68,81

5.9 Labour

Fifty-six per cent expressed the opinion that labour was a problem in crop production. This is reflected in the lack of adequate weed control (Fig. 8).

The contributions to crop production made by various groups of the family is shown in Fig. 11. The contribution by wives amounted to 47%, husbands 41% and sons 37%. Field observation indicated that the greater part of labour input in weed control and harvesting is provided by the female

members/

members of the household. Fig. 11 shows that there was comparatively little sharing of labour between households.

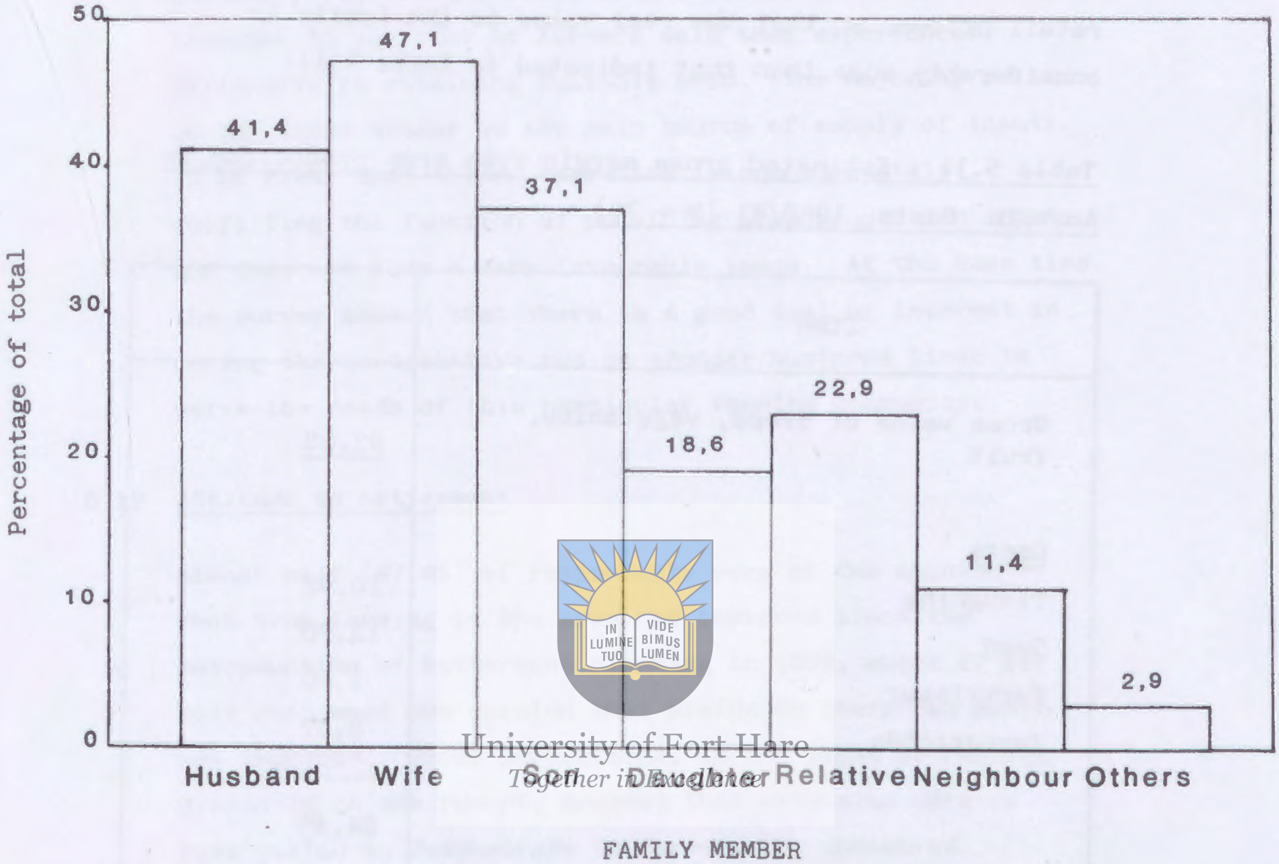


Fig. 11 : Distribution of members of Amatola households according to participation in crop growing operations, 1981 (N = 70)

5.10 Attitude to credit

While the majority (93%) of respondents were aware that money could be borrowed for crop production inputs, only 16 per cent had ever availed themselves of loan facilities, and only 57 per cent were aware of the loan scheme administered by the Department of Agriculture. The lack of interest in loan schemes is no doubt influenced by the risk factor in applying technology which has not been adequately proved to be profitable in the area.

5.11 Attitude to co-operatives

A primary agricultural co-operative based in the area supplies certain basic foodstuffs and some basic agricultural inputs

such/

such as seeds. Because of low levels of crop production, it was not surprising to find that only 57 per cent of farmers perceived any value in the co-operative. For example, 80 per cent of farmers said they experienced difficulty in obtaining suitable seed. The majority relied on the local trader as the main source of supply of inputs. It is clear that the co-operative is not adequately fulfilling the function of providing crop production inputs and does not have a very favourable image. At the same time the survey showed that there is a good deal of interest in seeing the co-operative run on sounder business lines to serve the needs of this particular farming community.

5.12 Attitude to betterment

Almost half (47,4%) of respondents were of the opinion that crop farming in the area had improved since the introduction of betterment planning in 1959, while 27 per cent expressed the opinion that yields on their own plots had improved. These perceptions, in the light of results presented in the report, suggest that extension workers have failed to demonstrate to farmers the undoubted potential of the area.

On being questioned about land allocations, surprisingly enough (94 per cent) of respondents were of the opinion that they had sufficient land. This finding suggests that in general farmers are entirely subsistence production orientated, a state of affairs which is no doubt influenced by factors such as available labour, institutional support, migration, local environment and culture. The majority of farmers (89%) had a somewhat fatalistic attitude towards land, in that they did not see any means of obtaining additional land for crop production.

Fifty-seven per cent of farmers expressed themselves in favour of participating in some form of co-operative scheme with a package approach to improve crop production, involving

assistance/

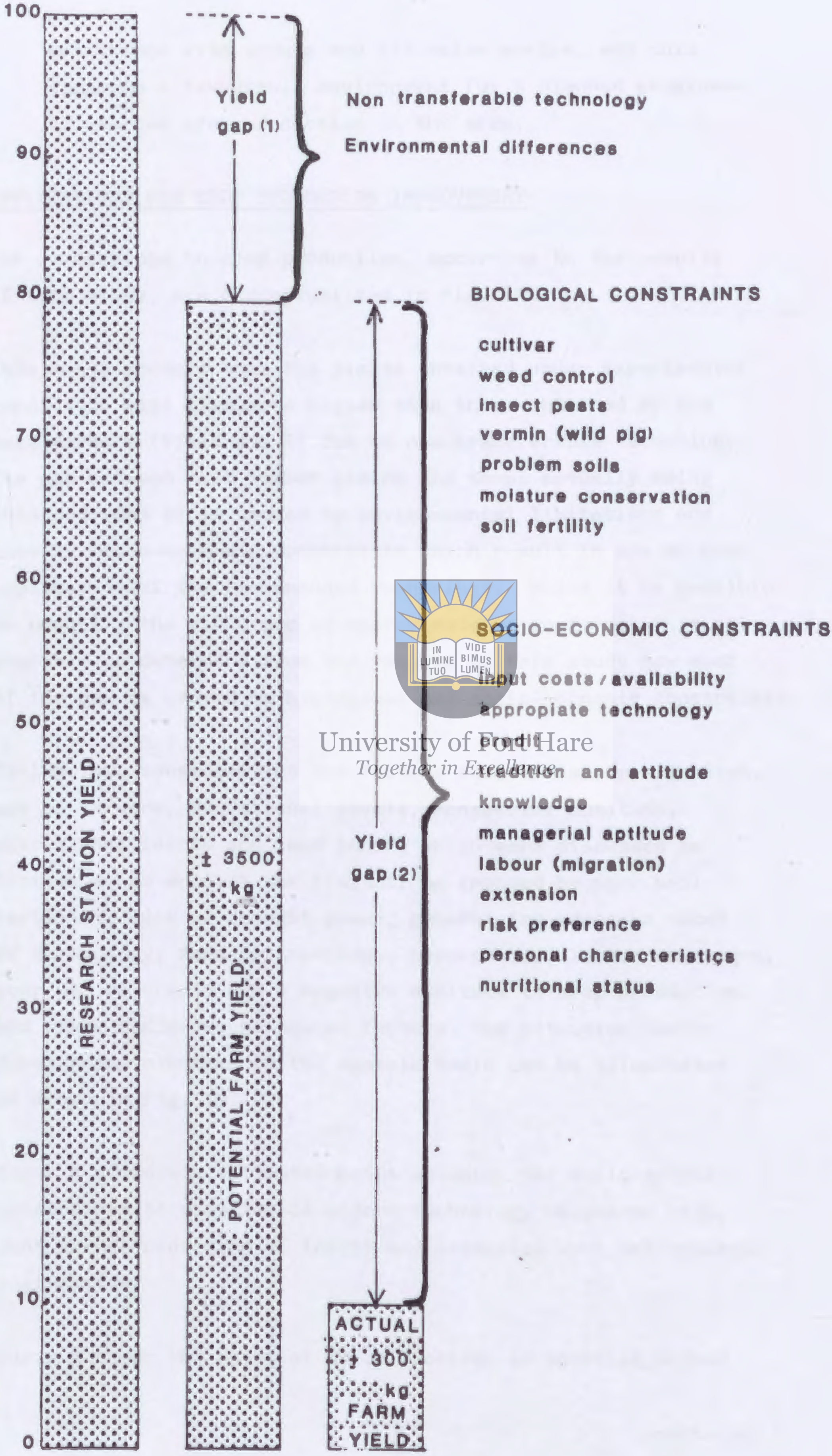


Fig.12 Conceptual model explaining the yield gap between potential and actual farm yield, Amatola Basin,1981.

assistance with inputs and extension advice, and this suggests a favourable environment for a planned programme to improve crop production in the area.

6. IMPLICATIONS FOR CROP PRODUCTION IMPROVEMENT

The constraints to crop production, according to the results of this study, are conceptualized in Fig. 12.

This model accepts that the yields obtained under experimental conditions will always be higher than those obtained by the best farmers (Yield gap 1) due to non-transferable technology. The gap between best former yields and those actually being obtained (Gap 2) is caused by environmental limitations and also by socio-economic constraints which result in non or poor application of the recommended technology. While it is possible to quantify the yield gap at approximately ten-fold, it is not possible to determine from the results of this study how much of the gap is caused by biological and socio-economic constraints.

Taking into consideration the factors such as labour migration, age of farmers, educational levels, managerial aptitude, nutritional levels and land tenure which were discussed in Section 4, as well as the limitations imposed by poor soil fertility, lack of draught power, general low adoption rates of technology, farming knowledge, perceptions, labour shortages, poor use of credit and a negative attitude to crop production, and other socio-psychological factors, the situation facing development planners in the Amatola Basin can be illustrated as shown in Fig. 13.

Curve A shows the estimated point at which the socio-economic constraints to adoption of modern technology become so high, that normal provision of inputs and extension work are rendered ineffective.

Curve B shows the point at which problems in adopting modern

practices/

practices are not very great and can be overcome. The group falling below this curve has received the most attention from extension and development organisations, despite the fact that they are the group needing least help because they have entrepreneurial and managerial ability. Extension and development efforts will have the highest potential effectiveness with people who fall between the two curves. It is difficult to quantify the percentage of a given population in any specific category, as this will obviously vary from area to area.

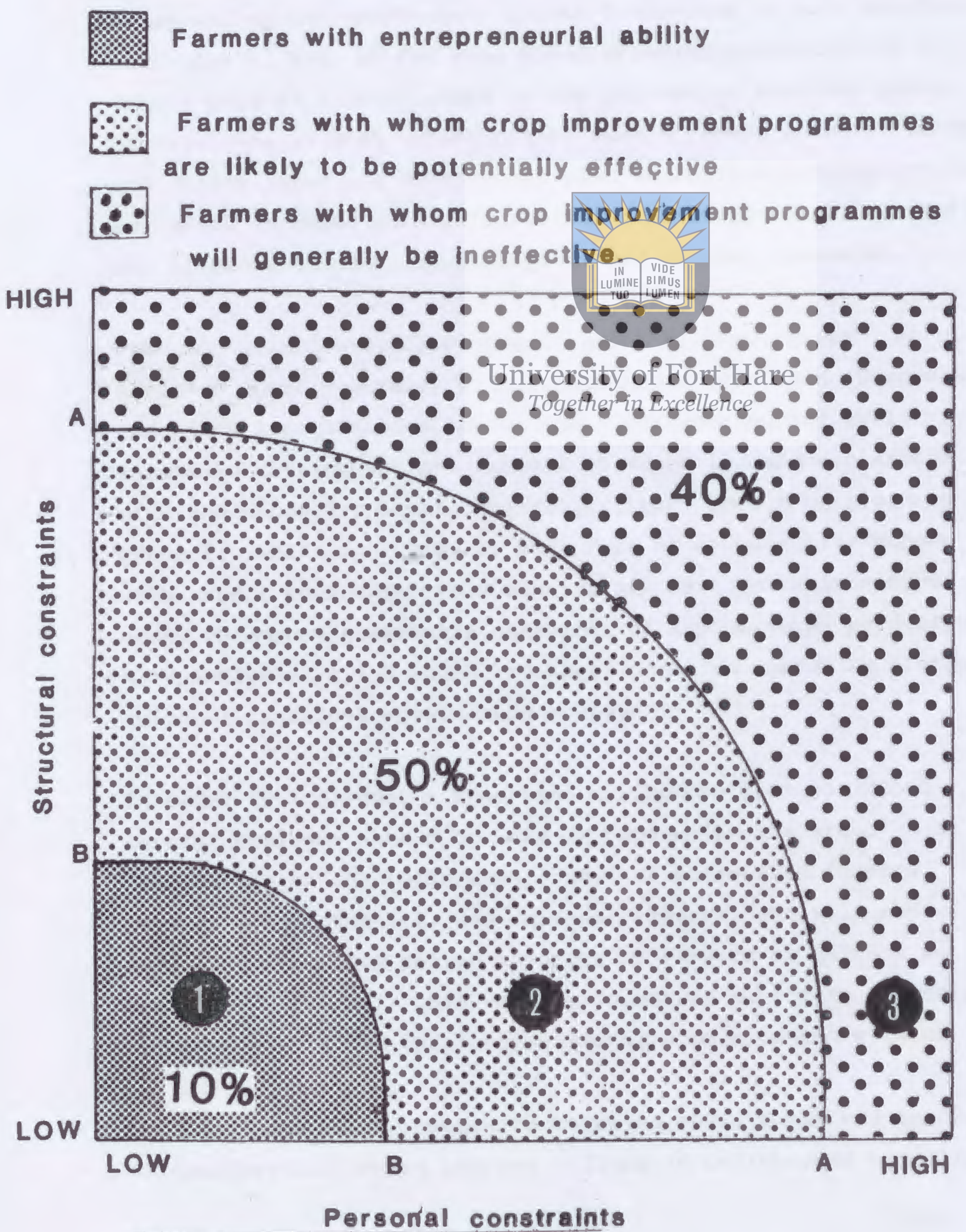


Fig. 13 Influence of personal and structural constraints on the potential impact of crop production improvement.

It is difficult to quantify the percentage of a given population in any specific category, as this will obviously vary from area to area.

It should be recognised that development in terms of economic growth is a process in which not everyone participates at the same time (Jaeger, 1981). Some individuals have the entrepreneurial ability to take timely advantage of new innovations, while others are very much slower. This suggests the need for a parallel policy of advancing the spontaneous growth tendencies of more progressive individuals, and, at the same time, offering opportunities to those taking part at a later stage in the process of economic growth. A prerequisite is that opportunities should remain open for those who follow later. A development plan which incorporates entire areas and which is based on a differentiated strategy offers the optimal use of present human, technological and natural resources.

From an agricultural development point of view, group 1 should be assisted where necessary with inputs and advice, and encouraged and given opportunities to use their entrepreneurial ability; an intensive development programme with education and assistance with the necessary inputs, marketing, etc. should be given to group 2; while for group 3, some form of co-operative scheme with expert management from outside may have to be introduced in order to ensure reasonable standards of agricultural production. Alternatively, a low input 'package' based on improving present cultural practices should be encouraged.

In order to implement a programme to improve crop yields, a careful analysis should be made of farmers in the area, so as to concentrate on the 'middle majority' of interested farmers, farmers with potential, and informal leaders, who will assist in spreading practices to the majority of farmers as quickly as possible. This will involve a socio-metric survey to determine opinion leaders and the inter-personal communication network.

Extension should be focused on selected individuals and groups of co-operator farmers who are willing to collaborate and allow

other/

other farmers to visit them. Farmers should be selected in consultation with the area development committee and the tribal authority. In such selection the importance of women farmers should not be lost sight of.

Intensive training will have to be given to extension workers in specific seasonal agricultural practices at given intervals throughout the season. Schedules of work must be clearly specified and supervised. The programme should initially be based on targets aiming at production/incomes to satisfy subsistence requirements, and thereafter aiming at producing a surplus for sale to provide adequate cash for inputs and services.

The approach should concentrate on making a clearly visible impact and focusing on removing those production constraints which have been specified in the survey. Priority must be given to practices which give best economic results, bearing in mind the circumstances of individual farmers. Trials on inter-cropping should be carried out in the area.

Special attention should be focused on small vegetable gardens near the homesteads in order to improve the nutritional status of farm families.

No programme can succeed without the necessary supporting services of crop production inputs, credit and marketing.

APPENDIX 1/

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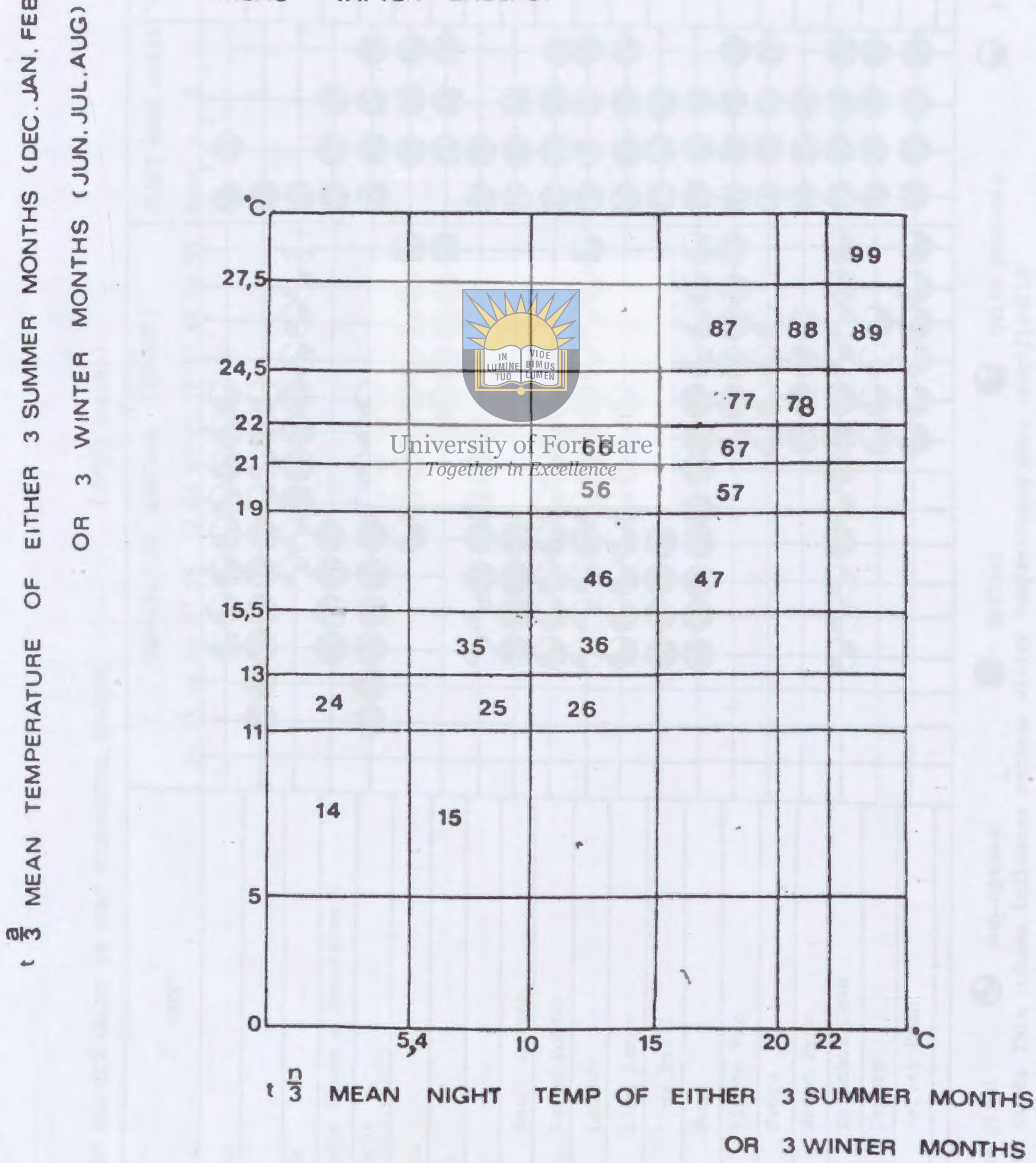
APPENDIX 1

KEY TO TEMPERATURE REGIME OF AGRO ECOLOGICAL AREAS (AFTER EHLERS)



LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP	25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	None	A	B	C	*WINTER CODE	**RE= MARKS
	TEMPERATURE REGIONS (SUMMER)															FROST FREE AREAS					
Almonds				Q	Q	Q	Q	Q	Q	Q	Q					O	O			46	
Apple		O	O	O	O	O	O	S	S	M	M					O				14	
Apricot						S	S	O	O	O	O	S	S	S	M	O				25	
Artichoke Globe + Jerusalem				O	O	O	O									O	O	O			FF
Asparagus		O	O	O	O	O	O	Q	Q	Q	Q					O	O	O	O	25	
Avocado							Q	[illegible]	[illegible]	O	O	Q	Q	Q	Q		O	O	O	35	
Banana								[illegible]	[illegible]	O	O	O	O	O	O		O	O	O		FF
Barley				S	S	O	O	O	O	O						O	O			35	
Beans Small Butter				O	O	O	O									O	O	O			FF
Large Butter				Q	Q	Q	Q	Q	Q	Q	Q					O	O	O	O		FF
Lablab				S	S	S	O	S	O	O	O	S	S	Q	Q	O	O	O	O		FF
Lima Large				Q	Q	Q	Q	Q	Q	Q	Q					O	O	O	O		FF
Lima Small				O	O	O	O									O	O	O			FF
Mung				O	O	O	O	O	O	O	O	Q	Q	Q	Q	O	O	O			FF
Pigeon Pea										Q	O	O	O	O	O	O	O	O	O		FF
Sword										Q	Q	Q	M			O	O	O	O		FF
Broad Bean										O	O	O	O			O	O	O			FF
Dolichos Bean				S	S	S	O	S	O	O	O	S	S	Q	Q	O	O	O	O		FF
Tepary										Q	Q	S	Q			O	O	O	O		FF
Velvet Bean										Q	Q	Q	Q	Q	Q	O	O	O	O		FF

(Symbols shown in the chart as circles: M = Marginal, S = Sub-optimal, O = Optimal, Q = Quite probable, P = Possible)

Marginal Sub-optimal Optimal Quite probable Possible Frost Free

* WINTER CODE: This column indicates optimal winter temperatures more specifically

** FF: indicates that Frost Free conditions are required during growth.

LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP	TEMPERATURE REGIONS (SUMMER) 25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	FROST FREE AREAS None	A	B	C	WINTER CODE	RE= MARKS
Beetroot				●	●	●	●	◐	◐							●	●	●			FF
Bixa Orellana										◐	◐	●	●	●	●	●	●	●	●	46	FF
Broccoli		●	●	◐	◐	◐	◐									●	●	●			FF
Brussel sprouts				●	●	●	●									●	●	●			FF
Buck wheat		◐	◐	●	●	◐	◐									●	●	●			FF
Cabbage				●	●	◐										●	●	●			FF
Carrots	◐	◐	◐	●	●	●	●	◕	◕							●	●	●			FF
Cassata										◕	◕	◕	◕	◕	◕		●	●	●	46	FF
Casteroil										◕	◕	●	●	●	●	●	●	●	●		FF
Cauliflower	◐	◐	◐	●	●	◐	◐									●	●	●			FF
Celery				●	●	●	●									●	●	●			FF
Cherry			●	●	◐	◐	◐									●				14	
Chicory				●	●	●	●	◕	◕							●	●	●			FF
Chinese Cabbage				●	●	●	●									●	●	●			FF
Citrus : Grapefruit													◕	◕	◕			●	●	46	FF
Mandarin												◕	◕	◕	◕		●	●	●	35	FF
Navalorange										◕	●	●				●	●			25-35	
Tangarine Orange										◕	◕	◕				●	●	●		25-35	
Satsuma									◕	◕						●	●			25-35	
Valencia												●	●	◕	◕	●	●			35-46	

LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP	TEMPERATURE REGIONS (SUMMER)															FROST FREE AREAS				WINTER CODE	RE= MARKS
	25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	None	A	B	C		
Coffee Arabia							●		●	◑	◑						●	●	●		FF
Robusta													◑	●	●			●	●	46	FF
Cole-rabe						◑	◑									●	●	●			FF
Colocasia antiquorum											◕	◕	◕	◕	◕			●	●		FF
Coriander								◑	◑							●	●	●			FF
Cowpeas				●	●	●	●	●	●	●	●	●	◕	◕	◕	●	●	●	●		FF
Cucumber						●	●	●	●	●	◕	◕				●	●	●	●		FF
Custard Apple												●	◕	◕	◕			●	●		FF
Dhal											●	●	●	●	●		●	●	●		FF
Eggplant								●	●	●	●	●	●	●	●	●	●	●	●		FF
Endive				●	●	◑	◑									●	●	●			FF
Figs							◕	◕	◕	◕	◕	◕	◕	◕	◕	●	●	●	●	35	
Flax				●	●	●	●									●	●	●			FF
Garlic		●	●	●	●	●	●	●	●	●	●					●	●				FF
Ginger											◕	◕	◕	◕	◕			●	●		FF
Grenadella Yellow											◕	◕	◕	◕	◕		●	●	●		FF
Purple							◕	◕	◕	◕	◕						●	●	●		FF
Grapes		◑	◑	◑	●	●	●	●	●	●	●	◑	◑	◑	◑	●	●			35	
Groundnut									◕	◕	●	●	●	●	◕	●	●	●	●		FF
Groundnut Bambara											◕	◕	◕	◕	◕		●	●	●		FF

LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP	TEMPERATURE REGIONS (SUMMER)															FROST FREE AREAS				WINTER CODE	RE= MARKS
	25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	None	A	B	C		
Guava										◕	◕	◕	◕	◕	◕		●	●	●		FF
Horseradish				●	●	●	●									●	●	●			FF
Hubbard Squash					◕	◕	◕	◕	◕	◕	◕					●	●	●	●		FF
Japanese Radish				◕	◕	◕	◕	◕	◕							●	●	●			FF
Kaffir watermelon								◕	◕	◕	◕	◕	◕	◕	◕	●	●	●	●		FF
Kale				●	●	●	●									●	●	●			
Kumquat										◕	◕	◕	◕			●	●	●		35-46	
Leek		●	●	●	●	●	●	●	●	●	●					●	●	●	●		FF
Lettuce	◐	◐	◐	●	●	◕	◕									●	●	●			FF
Lentil				◕	◕	◕	●	●	●							●	●	●			FF
Litchee										◐	◐	●	●	●	●		●	●	●	46	FF
Linseed				◐	◐	◐	●	●	●	●	●	●	●	●	◐	●	●	●	●		FF
Loquat						◐	●	◐	●	●	◐					●	●	●	●	35	
Lucerne		●	●	●	●	●	●	●	●	●	●	●	●			●	●	●			FF
Mocadamia Nut									●	●	●	●	●	◐	◐		●	●	●		FF
Maize				◐	◐	◐	●	◐	●	●	●	◐	◐	◐		●	●	●	●		FF
Mangle				◕	◕	◕	◕	◕	◕	◕	◕					●	●	●	●		FF
Manihot Spp.											◕	◕	◕	◕	◕			●	●	46	FF
Manga										◕	◕	◕	◕	◕	◕		●	●	●	46	FF
Muskmelon						●	●	●	●	●	●	●	◐	◐	◐	●	●	●	●		FF

LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP		TEMPERATURE REGIONS (SUMMER)															FROST FREE AREAS				WINTER CODE	RE=MARKS
		25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	None	A	B	C		
Mustard					●	●	●	●									●	●	●			FF
Oats			◐	◐	●	●	●	●	●	●	◐						●	●	●		35	
Okra									◐	◐	◐	◐	◐	◐	◐	◐	●	●	●	●		FF
Onions			●	●	●	●	●	●	●	●	●	●					●	●	●	●		FF
Parsley					●	●	●	●									●	●	●			FF
Parsnips					●	●	●	●									●	●	●			FF
Pawpaw										●	●	●						●	●	●		FF
Peach					◐	◐	◐	◐	◐	◐	◐	◐	●	●	●	◐	●	●			25	
Pear					◐	◐	◐	◐	◐	◐	◐	●	●	●	●	◐	●				24	
Peas			◐	◐	●	●	◐	◐									●	●	●	●		FF
Pecan nuts										◐	●	●	●	●	◐	◐	●	●			35	
Peppers	Sweet							●	●	●	●	●					●	●	●	●		FF
	Hot								●	●	●	●	●	●	●	●	●	●	●	●		FF
Persimmon								◐	●	●	●	●	◐	◐			●	●	●	●	25	
Phormium tenax							●	●	●	●							●	●	●		15	FF
Pimento											◐	◐	◐	●	●	●	●	●	●	●		FF
Pineapple										●	●	●	●	●	●	◐		●	●	●	36	FF
Plum	Europea		●	●	●	●											●	●			25	
	Japanese		●	●	●	●											●	●			25-35	
Potato				◐	●	●	●	●	◐	◐							●	●	●			FF

LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP	25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	None	A	B	C	WINTER CODE	RE= MARKS
	TEMPERATURE REGIONS (SUMMER)															FROST FREE AREAS					
Pumpkin						●	●	●	●	●	●	◕	◕			●	●	●	●		FF
Pyrethrum				●	●	●	●									●	●	●		35	
Quince								◕	◕	◕	◕	◕	◕	◕	◕	●	●	●	●	35-46	
Radish				●	●	●	●									●	●	●			FF
Radish Japanese				◕	◕	◕	◕	◕	◕							●	●	●			FF
Rhubarb				●	●	●	●									●	●	●		14	
Rice												◑	●	●	●	●	●	●	●		FF
Ricebean											●	●	●	◕	◕	●	●	●	●		FF
Rye		◑	◑	●	●	●	●	●	◕	◕						●	●	●	●	35	
Shallot		●	●	●	●	●	●	●	●	●	●					●	●	●	●		FF
Sisal											◕	◕	◕	◕	◕		●	●	●		FF
Sorghum										◕	◕	◕	●	●	●	●	●	●	●		FF
Soyabeans							●	●	●	●	●	◑	◑			●	●	●	●		FF
Spinach		◑	◑	●	●	◑	◑									●	●	●			FF
Squash						◕	◕	◕	◕	◕	◕					●	●	●	●		FF
Sugarbeat				●	●	●	●	◑	◑							●					FF
Sugarcane										◑	◑	●	●	●	●		●	●	●		FF
Sunflower						◑	◑	◑	●	●	●	●	●			●	●	●	●		FF
Tea							●	◑	◑								●	●	●		FF
Tobacco									◕	●	●	●	●	◑	◑	●	●	●	●		FF

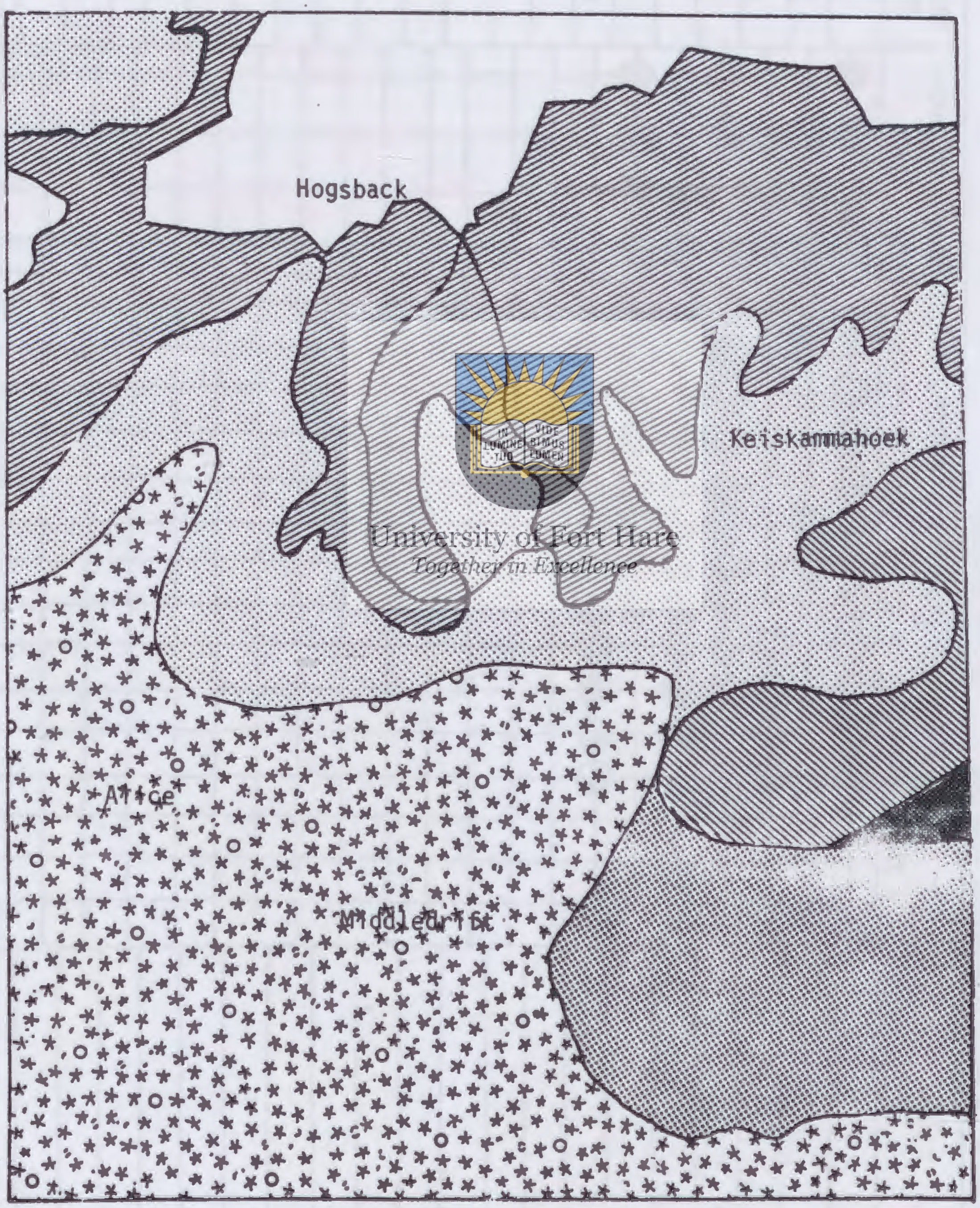
LIST OF ADAPTED CROPS IN AGRO ECOLOGICAL REGIONS (AFTER EHLERS)

CROP	TEMPERATURE REGIONS (SUMMER) 25	35	36	46	47	56	57	66	67	77	78	87	88	89	99	FROST FREE AREA				WINTER CODE	RE= MARKS
Tomatoe				◑	◑	◑	◑	◑	●	●	●	◑	◑			●	●	●	●		FF
Tung-oil									●	●						●	●	●		35	
Turnip				●	●	●	●									●	●	●			FF
Vegetable marrow						◕	◕	◕	◕	◕	◕	◕	◕	◕		●	●	●	●		FF
Walnut					◕	◕	◕	◕	◕	◕	◕	◕				●	●			35	
Watermelon								●	●	●	●	●	●	●	◕	●	●	●	●		FF
Wheat				◑	◑	●	●	●	●	●		◑	◑	◑						25	

Appendix 3

Humid Mountains and Highlands

Dry-Subhumid Mountain Basin



Scale: 1 : 250 000

DERIVED CLIMATIC ZONES AMATOLA BASIN