DISTORTION OF INCENTIVES FOR FARM HOUSEHOLDS IN KWAZULU

By

MICHAEL CHARLES LYNE

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I hereby certify that, unless specifically indicated to the contrary in the text, this dissertation is the result of my own original work.

M. C. Lyne

Abstract

KwaZulu is a less developed region of South Africa. Low agricultural incomes have contributed to widespread poverty in the region. Despite intense population pressure on the land, arable resources are underutilized. Conversely, grazing resources are overutilized.

Tribal tenure prevents the sale of land and has also precluded an active land rental market. Population growth has reduced farm sizes because households have an incentive to retain their rural land rights. At the same time, the opportunity cost of household farm labour has increased. As a result, the average cost of producing crops has risen relative to product prices. Households are generally able to procure food and income at lower cost by allocating better educated workers to urban wage employment. Consequently, many households have little incentive to produce crops and are deficit food producers. Arable land is underutilized because these households cannot rent land to others who would farm it.

A mathematical programming model constructed from models of representative households demonstrates that output responses to higher food prices and reduced input costs are small. Furthermore, an increase in food prices harms most rural households and lower input costs do little to improve household welfare. However, the model predicts that a land rental market will have a substantial impact on crop

production and could generate significant income opportunities in agriculture and its service industries. A rental market for arable land would require minor institutional changes and has equity as well as efficiency advantages.

The uncultivated portion of a household's tribal land allotment is regarded as common property for grazing purposes. Access to these grazing resources is not restricted and an empirical analysis of herd data indicates that stocking rates decline when the private cost of keeping cattle increases relative to their perceived benefits. Unlike most 'solutions' to the common property problem, privatization of grazing land would not only reduce overstocking and its associated social cost, but would also improve incentives to upgrade herd and pasture quality. It is recommended that privatization of grazing land (even in the limited sense that arable land is privately controlled) should be encouraged.

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Introduction

KwaZulu is a tribal homeland in South Africa. The homeland displays many features typical of a developing country. Low farm incomes and rapid population growth have contributed to widespread poverty. This study explores the anomaly that arable resources are underutilized despite intense population pressure on the land and sincere efforts to assist farmers. Attention is also focused on the overutilization of grazing resources. It is contended that these inefficiencies reflect distorted agricultural incentives. The object of this study is to identify the distortions, to predict the effects of changing economic incentives on resource allocation, and to make recommendations aimed at improving agricultural efficiency and household welfare in rural KwaZulu.

It is argued that many of KwaZulu's rural households have little incentive to produce crops, and that arable land is underutilized because the rental market for agricultural land is incomplete. Overutilization of grazing resources is attributed largely to institutional arrangements that reduce the private cost of keeping cattle relative to their perceived benefits. In particular, stockowners enjoy free access to land that is allocated to, but not cultivated by, other households. Policy recommendations emphasise efficiency and equity aspects of privatizing grazing land and of removing institutional barriers to land rental.

Chapter 1 describes important characteristics of rural

KwaZulu and its households. Most striking is that farms are uniformly small, arable land is generally underutilized, farm incomes are low relative to off-farm incomes, and the vast majority of households are deficit food producers. Evidence of an incomplete land rental market is reported. Overall, the data indicate widespread poverty.

Chapter 2 reviews models of household resource allocation. It is concluded that economic and institutional factors are responsible for inefficient use of agricultural land in KwaZulu. Given prevailing circumstances, it is predicted that an increase in food prices will stimulate crop production but render most rural households worse off. Reduced prices for market inputs are expected to increase crop output and household welfare. However, it is contended that supply responses to changes in product and input prices will be small. Changes in off-farm earnings are expected to have a large influence on household welfare but the effects on crop production are ambiguous. A rental market for arable land is expected to raise the welfare of all households participating in the market and to impact significantly on crop production. Cattle statistics are analysed and it is demonstrated that stocking rates in KwaZulu decline when the private cost of keeping cattle increases relative to their perceived value.

Chapter 3 describes an attempt to quantify the effects of price and institutional changes on aggregate crop production using a mathematical programming model. The model is constructed from programming models of representative

households. Predicted results confirm expectations and draw attention to other issues such as complementarity between cash and food crops and the creation of income opportunities in local agri-business.

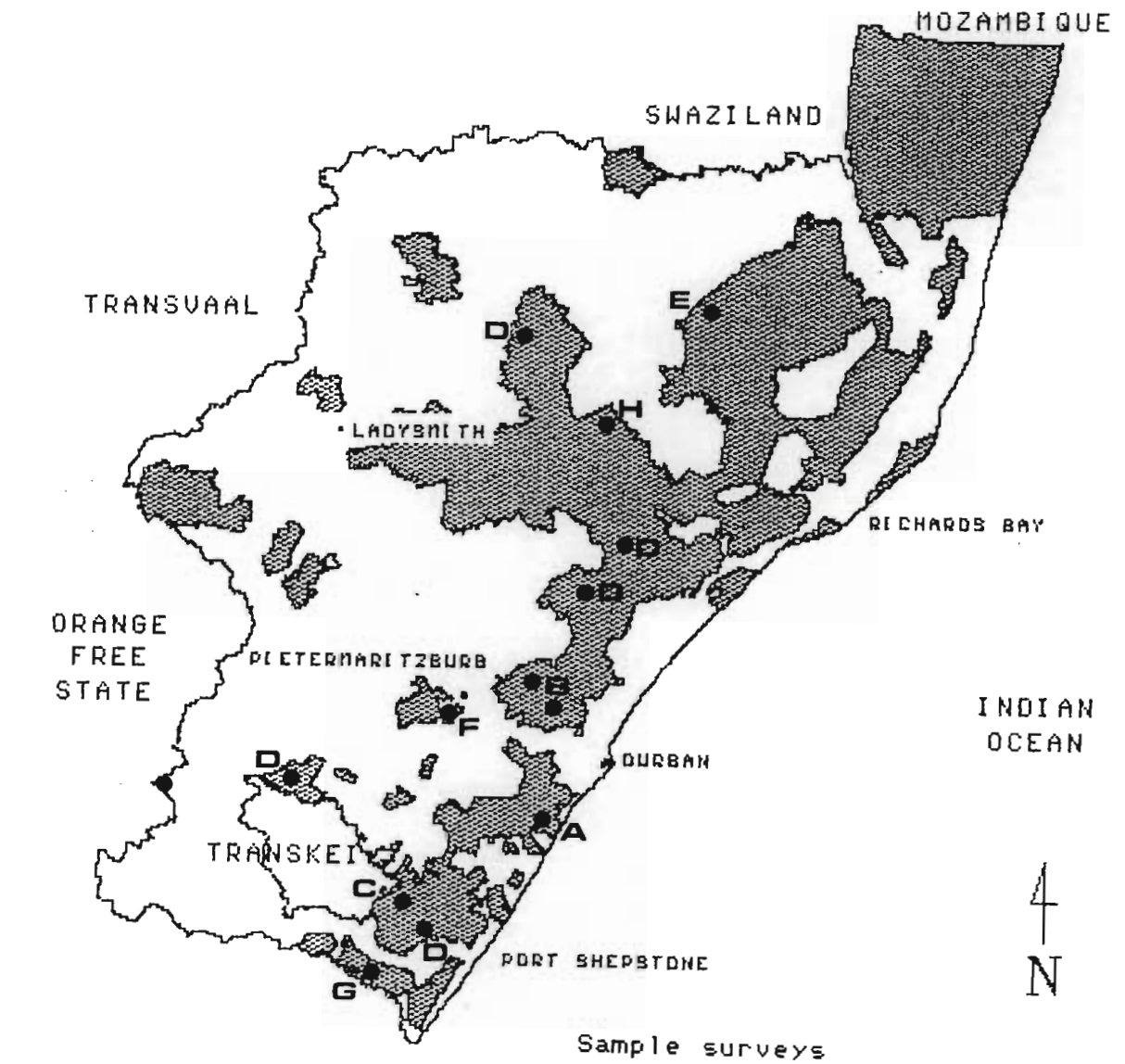
Policy implications are analysed in Chapter 4. Although emphasis is placed on the efficiency and equity advantages of a rental market for arable land, discussion is also directed at the effects of privatizing grazing land and the future prospects of consolidating farms under freehold tenure. It is concluded that minor institutional changes are required to facilitate a rental market for arable land and that (partial) privatization of grazing land should be encouraged in areas where it is more acceptable.

Chapter 1

A profile of rural KwaZulu and its households

This chapter briefly describes key features of the study area at both aggregate and household levels. The household data are essentially a by-product of sample surveys conducted by various researchers for specific but mostly different purposes. The first of these surveys was undertaken in 1980 to test a multi-stage sampling design proposed and documented by the author (Lyne, 1981:3-13). This technique was employed in subsequent sample surveys conducted by Carr (1981), Rogers (1982), and Stewart (1986) in conjunction with the author. A common feature of these surveys was the accurate measurement of individual crop areas and fallow land. Unbiased estimates of the population means and proportions presented in this chapter were computed using formulae appropriate to the multi-stage sampling design (Lyne, 1981:13-39). Sample estimates provided by Lyster (1987), Cairns (1988) and the Development Studies Unit (DSU) are also reported. These estimates might contain bias as the data were analysed as if sampling units were drawn randomly even though the selection process was not strictly random. The results of five rural sample surveys undertaken by DSU staff (Perkins and May, 1988) are reported in aggregate as the individual sample estimates relate to fairly heterogeneous study populations. The approximate spatial location of each sample survey is depicted in Map 1.

Map 1 KwaZulu in the context of Natal.



KWAZULU

Sample surveys

A Lyne (1981)
B Stewart (1986)
C Carr (1981)
D DSU (Perkins and May, 1988)
E Lyster (1987)
F Lyster (1987)
G Rogers (1982)
H Cairns (1988)

Source INR (1989)

1.1 Location, finance and constitutional status.

KwaZulu, homeland of the Zulu tribes, is located in the province of Natal on the eastern seaboard of South Africa (Map 1). A Legislative Assembly was established in KwaZulu during 1972 and in 1977 the territory became 'self-governing' in terms of South Africa's National States Constitution Act, No. 21 of 1971 (Lyster, 1987:30). In 1983 membership of the Legislative Assembly was increased to 141 including 72 tribal chiefs elected by 24 Regional Authorities representing 208 tribes and 8 communities, and 65 members elected in 26 constituencies (SAIRR, 1984:347 ; DBSA, 1987). Executive power is vested in a Cabinet comprising the Chief Minister (M.G. Buthelezi) and eight ministers. Executive functions are performed by 11 departments and two public corporations. Given the nature of this study the KwaZulu Department of Agriculture and Forestry (KDA) and the KwaZulu Finance and Investment Corporation (KFC) warrant specific mention. In 1985/86 KwaZulu government expenditure amounted to R959,0 million while non-loan revenue amounted to R921,9 million (DBSA, 1987). Estimates for 1985/86 (SAIRR, 1987:266) indicate that only 24 per cent of non-loan revenue was raised within the territory (mainly through taxation), the balance representing transfers from central (i.e. South African) government. The KDA's 1985/86 budget allocation amounted to R43,4 million of which one third was targetted for staff remuneration and one third for machinery, equipment and engineering services (KDA, 1986). During the same period,

budget allocations for KwaZulu's departments of Health (and welfare), Education (and culture) and Works are listed by SAIRR (1987:270) as R303,9, R233,3 and R167,0 million respectively.

Amongst those matters over which the Assembly has power to legislate are taxation and education of citizens, agriculture and forestry, conservation of flora and fauna, land settlement, public works and welfare services. Matters over which the Legislative Assembly has no power include customs and excise, foreign exchange and banking (Thorrington-Smith et al., 1978:59-60). KwaZulu does not have its own currency and is a price-taker on much larger South African markets. Consequently, policies which influence relative prices in South Africa bear directly on KwaZulu.

1.2 Rural characteristics.

1.2.1 Land use.

Whereas farms in KwaZulu are operated by small-scale subsistence (Black) farmers, farms in Natal are operated by large-scale commercial (White) farmers. The cropping potential of land in KwaZulu is tabulated in Table 1.1. Important features of the bioclimatic groups (Phillips, 1973) referred to in Table 1 are listed in Appendix A, Table A1. KwaZulu has relatively less arable land than Natal (12,4 versus 18,4 per cent) but a similar distribution of cropping potential (Lyster, 1987:26-28).

Table 1.1 Estimated land potential in KwaZulu.

Bioclimatic group	Crop potential	Area (Ha)	Arable (Ha)	Arable (%)
1,2,3 and 4	High	1333073	263112	7,9
6 and 8	Medium	580317	54599	1,6
7,9,10 and 11	Low	1402710	93910	2,8
Total		3316100	411621	12,4

Source KDA (1980).

Land used by households in KwaZulu for cropping purposes is not necessarily part of the region's potential arable land. This is primarily a result of high population pressure on rural land and the tribal system of land tenure (section 1.2.2). Households may find it expedient or necessary to cultivate at least part of their allocated land even though the allotment may be classifed as non-arable by agricultural planners. Table 1.2 summarizes global estimates of 'arable' land utilization and rural household numbers in KwaZulu during 1985.

Table 1.2 Estimated areas of potential arable, land used as arable and rural household distribution in KwaZulu during 1985[1].

Crop potential	Potential arable (Ha)	Ha land used as arable (cultivated & fallow)	Rural households
High	263112	239567	225475
Medium/low	148509	153396	187069
Total	411621	392963	412544

Note 1 1985 population census estimates adjusted to exclude residents of urban areas within KwaZulu that have no local government body and for undercount.

Source KDEA (1986) and Tables 1.4 and 1.9.

Tables 1.3 - 1.5 provide information at aggregate and household level concerning areas cultivated and yields of major crops produced in KwaZulu. Staple food crops, maize in particular, account for more than 80 per cent of the areas cultivated by households. This proportion reduces to approximately 60 per cent in areas of high cropping potential closer to Natal's sugar mills.

Table 1.3 Estimated average annual crop production in KwaZulu during the period 1982/83-1984/85.

Crop type[1]	Area (Ha)	Area (%)	Yield (t)	Value (R 000) at local farm gate price (1985 = 100)	Yield/Ha in KwaZulu (t/Ha)	Yield/Ha in Natal (t/Ha)
Cereals	180053	45,8	148708	49974	0,826[2]	2,088[4] (maize)
Legumes	50115	12,8	16905	31279	0,337[3]	1,011[5] (dry beans)
Roots	17164	4,4	85930	17274	5,006	24,015 (potatoes)
Sugar-cane	45000	11,4	1295765	47950	28,795	53,814[6]
Other	13525	3,4				
Approx. fallow	87106	22,2				
Utilized (1985)	392963	100,0				

Notes
1 Cereals = mainly maize ; Legumes = mainly dry bean ; Roots = potato, sweetpotato and madumbi.
2 Rogers (1982) measured a mean maize yield of 0,813 t/Ha (n=76) and Cairns (1988) measured a mean maize yield of 1,158 t/Ha (n=59), both in areas of KwaZulu with high cropping potential.
3 Melis and Garman (1981/82-1986/87) measured a mean yield of 0,359 t/Ha for Sugar Beans grown in a region of high cropping potential using management practices typical of those employed in KwaZulu.
4 This is an underestimate of mean maize yield in Natal during 1982/83-1984/85 as a large part of the crop is fed to cattle and therefore excluded from recorded grain yields.
5 Computed from yields for Sugar Beans recorded at four sites in Natal during 1986/87.
6 Computed from dryland sugar-cane production estimates in Natal during 1976/77-1979/80.

Source Appendix B, Table B.12; Chapter 3, Tables 3.11 - 3.13; Liebenberg and Joubert (1986/87); Maize Board (1985); Ortmann (1985); Potato Board (1985); .

Farm sizes are extremely small in KwaZulu. Although the allotment size distributions presented in Table 1.5 are

positively skewed, there is no evidence of very large farms. More than 80 per cent of the sample households have 'arable' allotments smaller than 2,0 hectares and the largest allotment measured only 9,9 hectares. In Natal, average farm size is 670 hectares (Directorate Agricultural Economic Trends, 1989).

Table 1.4 Mean crop areas for sample households in rural KwaZulu.

	High crop potential in sugar-cane area		High crop potential out of sugar-cane area			Low/med crop potential
	Lyne 1980 n = 140	Stewart 1985 n = 132	Carr 1981 n = 200	Cairns 1986 n = 61	Rogers 1982 n = 80	Stewart 1985 n = 61
Crop	(Ha) (%)	(Ha) (%)	(Ha) (%)	(Ha) (%)	(Ha) (%)	(Ha) (%)
Maize	0,41 28,3	0,24 22,7	0,47 53,1	0,64 48,7	0,53 60,4	0,26 31,7
Maize & dry beans	0,06 4,4	0,09 8,6	0,05 5,6	0,08 5,8	0,04 4,7	0,30 36,2
Maize & other	0,08 5,8	0,00 0,1	0,09 10,8	0,06 4,7	0,14 16,4	0,00 0,2
Dry beans	0,10 7,0	0,08 7,2	0,08 8,8	0,03 2,6	0,01 1,6	0,05 5,5
Sugar-cane	0,39 27,5	0,33 31,0				
Roots	0,06 4,1	0,09 8,3	0,04 4,0	0,07 5,0	0,02 1,9	0,02 1,8
Vegetables	0,02 1,5	0,01 0,6	0,00 0,3	0,01 0,8	0,03 3,7	0,03 3,8
Other crops	0,02 1,6	0,06 6,0	0,09 10,2	0,00 0,0	0,04 4,5	0,00 0,0
Cultivated	1,15 80,2	0,90 84,4	0,81 92,7	0,88 67,5	0,82 93,2	0,65 79,3
Fallow	0,28 19,8	0,17 15,6	0,06 7,3	0,42 32,5	0,06 6,8	0,17 20,7
Total	1,43 100	1,06 100	0,88 100	1,30 100	0,88 100	0,82 100

Source Cairns (1988); Carr (1981); Lyne (1981); Rogers (1982); Stewart (1986).

Approximately 22 per cent of the arable land in KwaZulu is left fallow (Knight and Lenta, 1980, report a comparable estimate of 27 per cent for 1972) and per hectare yields of staple food crops are extremely low relative to those recorded in Natal. Underutilized arable land is a prominent feature of less developed rural areas in Southern Africa and

calls into question the appropriateness of economic models that assume crop land to be used intensively (Low, 1986:119-123). It is not contended that land is not scarce but rather that there is little incentive to use arable land intensively and that constraints on the land (rental) market are partly responsible for this situation (section 4.1.2).

Table 1.5 Size distributions of sample household 'arable' land allotments in rural KwaZulu.

	Relative fequency (%)			
	High crop potential in sugar-cane area		High crop potential out of sugar-cane area	Low/med crop potential
Size (Ha)	Lyne 1980 n = 140	Stewart 1985 n = 132	Carr 1981 n = 200	Stewart 1986 n = 61
0	0,0	0,0	0,0	1,6
0,01 - 0,50	22,9	29,5	26,5	37,7
0,51 - 1,00	27,1	34,1	37,5	39,3
1,01 - 1,50	21,4	18,9	22,0	4,9
1,51 - 2,00	7,1	6,8	8,0	9,8
2,01 - 2,50	5,0	3,8	3,5	3,3
2,51 - 3,50	9,3	3,8	2,0	1,6
3,51 - 5,50	5,0	3,0	0,5	1,6
5,51 - 10,0	2,1	0,0	0,0	0,0

Source Carr (1981); Lyne (1980); Stewart (1985).

1.2.2 Rural land rights.

Under the tribal tenure system operating in KwaZulu, land is not owned by individuals but is held in trust by the King who distributes it to district chiefs (Thorrington-Smith et al., 1978:89). In rural areas, it is usually the district chiefs and their headmen (indunas) who allocate land to household

heads and who settle boundary disputes. In return, the household is expected to pay allegiance to the district chief. The chief therefore has an incentive to consider requests for land from households seeking to establish in his area of jurisdiction.

Land allocations provide households with usufruct rights (eg. to reside, crop, graze livestock and gather natural resources) which produce a stream of valuable benefits including (a) security during times of unemployment, ill health and old age and (b) access to building materials, grazing, fuel and water for which the private costs are low. However, households are not entitled to sell land. These features of tribal tenure have been well documented (see Low, 1986:108-110).

Another important aspect of tribal land tenure in KwaZulu is that land allocated to a household which is not used for dwellings or crop production serves as grazing and is available to other households for this purpose only (Stewart, 1989). In some districts even the cultivated lands are opened to stockowners for grazing during the winter months (Naledzani, 1987:82). With few exceptions, grazing is a common resource to which households within a tribal ward have unrestricted access (Lyne and Nieuwoudt, 1989). This issue and its impact on farmer incentives is discussed in section 2.2.

To maintain land rights and their associated benefits, a

household must demonstrate some use of its allotment and must continue to be accepted as a full member of the community. Land rights may be lost through prolonged failure to use the land (Low, 1986:108 ; Lenta, 1982). Lyster (1987) found that 84 per cent of 326 households sampled in the Usuthu tribal ward viewed their land allotments as belonging to the chief or tribal authority and that 75 percent believed their land would be reallocated to other households if they appeared not to use it.

Households have an incentive to retain their rural land rights, even if they derive virtually all of their income from urban wage employment, because the benefits (a) can be procured by members whose opportunity cost of time in cultivation is low and (b) are elsewhere unobtainable or expensive (Low, 1986:109-110 and 163). As a result, population pressure on rural land has worsened over time and wage employed household members have become migrant workers or commuters. This situation contrasts with the more permanent urbanization of nineteenth century England where towns drew their populations from rural families that had no land rights (Elkan, 1960:138).

Although some observers have attributed 'circulating labour migration' to legislation that prevented black wage workers from relocating with their families to urban job centres in South Africa (see Nattrass and May, 1986) the validity of this claim is not clear in KwaZulu which borders the major metropolitan areas of Natal.

The incentive to retain land rights has virtually precluded a rental market for agricultural land owing to the perception that, by openly demonstrating what tribal authorities may interpret as an indifferent attitude toward land use, lessors' may jeopardize their right to land and its economic benefits (Lenta, 1982). In addition, rental arrangements tend to be resisted by stockowners whose access to communal grazing is reduced when uncultivated land is hired and either cultivated or used as a private grazing resource by the lessee (Khumalo, 1989). Consequently, underutilization of arable land does not involve high opportunity costs as the land market is incomplete. The sample data presented in Table 1.10 give some indication of rental market inactivity. Only two of 79 households sampled by Lyster (1987:59) rented land although 50 indicated a land shortage.

1.2.3 Demography.

Important population characterisitcs, including the extent of off-farm employment and its contribution to rural household incomes, are demonstrated in this and the following section. Tables 1.6 and 1.7 present aggregate data whilst Tables 1.8 and 1.9 emphasise the household situation.

In 1985 the urban population of KwaZulu (including rural migrants) was 1,04 million or less than 25 per cent of the region's total population (DBSA, 1987). An average annual population growth rate of 3,8 per cent is projected for KwaZulu during the period 1985-1995 (DBSA, 1988) and de Graaf

(1987) predicts that, after accounting for urbanization, the rural population will grow at an average annual rate of nearly 2,5 per cent between 1980 and the year 2000.

Table 1.6 Kwazulu rural population (million).

	1980	1985[1]
De facto rural population		3,116
plus closer settlements with no local government		0,307
De facto population in rural area	2,723	3,423

Note 1 1985 census estimates adjusted to correct for undercount.

Source DBSA (1987); KDEA (1986).

The estimates presented in Table 1.7 suggest an inverse relationship between real off-farm remittance earnings and per capita food production in rural KwaZulu.

Table 1.7 Estimated migrant remittances in rural KwaZulu (1985 = 100).

	1960	1970	1976	% Annual growth
Migrants and commuters absent on census day (000)	166	370	460	6,6
Remittance earnings/annum (R000)[1]	44239	133895	361015	14,0
Share of KwaZulu GDP attributed to labour exports (%)	54	70	78	2,3
Share of KwaZulu cereal requirements produced in KwaZulu (%)[2]	38	30	27	-1,7
Per capita grain production in all homelands (kg)	60	31	29[3]	-3,7

Notes 1 Mean cash remittances account for roughly one third of mean wages (Stewart and Lyne, 1988).
2 Estimates centred on 1958, 1972 and 1978 respectively.
3 Estimate relates to the period 1980-84.

Source Bembridge (1986); Buthelezi Commission (1982); Lenta (1982b).

It would appear that during the period 1960-1976 (a) real per capita wage remittances increased (at a decreasing rate) despite high rates of population growth and (b) households substituted (at a decreasing rate) imported food for farm produced staples. The mechanics of this relationship, which has been observed in less developed countries throughout Southern Africa (Low, 1986:24-27 and 48-53), are the subject of section 2.1.4.

The household sample data presented in Tables 1.8 and 1.9 provide very similar estimates of population composition in rural KwaZulu.

Table 1.8 Mean composition of sample households in rural KwaZulu.

	High crop potential		Cross-section	Low/med crop potential	
	Stewart 1985 n = 132	Lyster 1983 n = 79	DSU 1983-86 n = 1114	Stewart 1985 n = 61	Very rural Lyster 1984/85 n = 326
Children	3,5	3,5	3,1	4,0	4,6
Adults:					
Pensionable	0,5	0,4	0,5	0,7	0,5
On-farm	2,6	3,0	2,4	3,2	3,3
Off-farm workers	2,2	1,8	1,6	2,2	1,8
De jure Household	8,8	8,7	7,6	10,1	10,2
Off-farm workers (%)	25,1	20,7	21,1	22,0	17,4
LFPs[1] (%)	32,0	n/a	27,4	27,0	n/a
Unemployed (%)	21,6	n/a	22,4	18,5	n/a

Note 1 LFPs = labour force participants = unemployed plus wage emloyed and self employed, including full-time farmers.

Source Lyster (1987); Perkins and May (1988); Stewart (1986).

Approximately 40 per cent of household members are under the

age of 16 and slightly more than five per cent are of pensionable age. Of the remaining members (adults), nearly 40 per cent are wage employed (migrants and commuters) although this figure appears to be lower in (very rural) areas more distant from job centres. Even so, neither distance from job centres nor cropping potential appear to have a major influence on the proportion of household members engaging in off-farm employment.

The unemployment rates estimated by Stewart (Table 1.8) are almost double the official estimate for KwaZulu at that time (DBSA, 1987). Although the official statistic is an aggregate estimate for rural and urban KwaZulu, the discrepancy more likely stems from differences in definition. Stewart (1986:25) defined as unemployed any economically active person (healthy individuals, 16 - 59 years of age) who claimed to be seeking wage employment whereas the official definition requires the same person to have actively sought work during the previous month and to have either worked less than five hours during the previous week or to be able to accept a job within a week. The estimate of 22,4 per cent (Table 1.8), an average computed from sample data gathered in five rural surveys by the DSU during 1983-1986, compares favourably with Stewart's estimates and is also based on a definition less stringent than the official one (Perkins and May, 1988:35). Bromberger (1981) estimated an unemployment rate of 32 per cent in Vulindlela, a peri-urban district, using a definition of unemployment similar to Stewart's.

Migrant adults (Table 1.9) account for approximately 19 per cent of de jure household members and more than 73 per cent of wage workers, the latter estimate increasing with distance from job centres.

Table 1.9 Mean household migrants (excluding daily commuters) and de facto composition of sample households in rural KwaZulu.

	High crop potential				Cross-section	Low/med crop potential	
	Lyne 1980 n = 140	Stewart 1985 n = 132	Very rural Carr 1981 n = 200	Rogers 1982 n = 80	DSU 1983-86 n = 1114	Stewart 1985 n = 61	Very rural Lyster 1984/85 n = 326
Adult residents:		3,7				4,3	3,8
Males	1,1		0,6	0,5	1,1		
Females	2,3		2,0	2,0	2,2		
Adult migrants:		1,6				1,8	1,8
Males	1,3		1,6	1,2	1,0		
Females	0,3		0,7	0,4	0,3		
Children:							
Residents	4,5	3,5	3,9	3,1	2,9	4,0	4,6
Migrants	0,3	0,0	0,4	0,5	0,1	0,0	0,0
De facto household	7,9	7,2	6,5	5,6	6,2	8,3	8,4
De jure household	9,8	8,8	9,2	7,7	7,6	10,1	10,2
Female/male adult residents (%)	2,0	n/a	3,2	4,0	2,0	n/a	n/a
Migrant adults/household (%)	16,3	17,8	25,0	20,8	17,1	18,0	17,4
Migrant adults/wage workers (%)	n/a	72,7	n/a	n/a	81,3	81,8	100,0
Hhlds with resident head (%)	45,0	n/a	24,6	44,8	n/a	n/a	n/a

Source Carr (1981); Lyne (1981); Lyster (1987); Perkins and May (1988); Rogers (1982); Stewart and Lyne (1988).

The sample masculinity ratios reported in Table 1.9 suggest that adult female residents outnumber adult male residents 2:1 in most rural areas and by as much as 4:1 in more remote places. In Stewart's (1986:44) combined samples, some 43 per cent of the economically active population (752 individuals) were regular off-farm wage workers with an average of 6,2

years of formal schooling. Of those remaining, approximately 80 per cent were female with an average of only 3,6 years of formal schooling. An econometric analysis of these data reported in section 3.1.3 supports the observation that "...the propensity to migrate is higher among young adult males with above average levels of education" (Nattrass, 1976:69).

The implication is that high rates of out migration have reduced the quality and quantity of farm labour. Farming activities require considerable effort and compete with leisure and household work (eg. gathering water and firewood) for time. If leisure is a superior or normal good, rising remittance income may result in a substitution of leisure for farm work. It has also been suggested that out migration reduces the efficiency of farm labour owing to declining 'complex cooperation'[1] (Low, 1986:127) and that timely management decisions are constrained by the absence of household heads (Table 1.9) who usually assume the role of decision-maker (Nattrass and May, 1986; Lenta, 1982).

1.2.4 Household income, wealth and expenditure.

Tables 1.10 and 1.11 present information about income (poverty) and its distribution in rural KwaZulu. The annual household income estimates reported in Table 1.10 provide

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1 The principle of complex cooperation implies that, over a limited range, productivity per worker increases as more hands become available.

Table 1.10 Mean annual cash income and farm expenditure for sample households in rural KwaZulu (1985 = 100).

	High crop potential in sugar-cane area		High crop potential out of sugar-cane area			Cross-section	Low/med crop potential	
			Very rural		Peri-urban			Very rural
	Lyne 1980 n = 140	Stewart 1985 n = 132	Carr 1981 n = 200	Rogers 1982 n = 80	Lyster 1983 n = 79	DSU 1983-86 n = 1109	Stewart 1985 n = 61	Lyster 1984/5 n = 326
Land planted (Ha)	1,15	0,90	0,81	0,82	n/a	n/a	0,65	n/a
Farm inputs: (R)								
Labour hire	76,1	83,0	7,4	3,3	3,5	n/a	2,1	n/a
Fertilizer	42,6	101,1	35,5	38,0	14,6	n/a	4,2	9,3
Seed	38,2	13,1	15,1	7,2	18,6	n/a	16,1	19,5
Land preparation								
Services	21,1	48,9	25,0	28,2	n/a	n/a	20,5	n/a
Land hire	0,0	0,0	1,5	0,0	n/a	n/a	0,0	n/a
Other	7,0	0,0	5,5	1,2	n/a	n/a	0,0	n/a
Total	185,0	246,1	90,0	77,9	n/a	107,6[1]	42,9	n/a
Farm cash income: (R)						72,3		
Crop sales	352,3	238,9	23,9	2,2	3,0	n/a	15,7	8,1
Livestock	63,9	7,9	9,1	0,2	9,9	n/a	10,4	31,9
Labour	7,4	9,1	0,1	0,5	34,2	n/a	10,0	n/a
Equipment hire	30,4	43,2	0,0	0,7	n/a	n/a	19,6	n/a
Land rent	0,1	0,0	0,0	0,0	n/a	n/a	0,0	n/a
Handicraft	n/a	23,1	n/a	n/a	n/a	76,5	22,7	n/a
Off-farm income: (R)								
Wages					4960,6			3457,2
Remittances[2]	n/a	1565,0	821,7	605,3		1847,6	1676,0	
Welfare payments[3]	n/a	596,1	n/a	n/a	184,7	717,6	990,8	482,2
De facto household	7,9	7,2	6,5	5,6	8,7[4]	6,2	8,3	10,2[4]

Notes 1 Estimate computed from a subset of the sample (see Table 1.12).
2 Remittance = migrant worker cash remittances plus commuter wages.
3 The minimum age to qualify for a state pension has been relaxed and real welfare payments have increased significantly during the period 1981-1986.
4 Estimate relates to de jure household size as wages were recorded in place of remittances.

Source Carr (1981); Lyne (1981); Lyster (1987); Perkins and May (1988); Rogers (1982); Stewart (1986).

some indication of the sources of cash income and expenditure on market inputs used in farming. Although the definitions of

off-farm income vary between studies, it is apparent that remittances and welfare benefits (public and private sector pensions and welfare grants) account for more than 90 per cent of gross cash income accruing to de facto households - even in years of good rainfall (1980 and 1982 being drought years). The overriding importance of off-farm employment as a source of income is not unique to peri-urban areas or to regions of low cropping potential and has also been observed in a sub-sample of 'top' farmers selected from the Vulindlela district (Lyster, 1987:88).

Perkins and May (1988:92-93) computed a Gini coefficient of 0,51 for household incomes recorded in the DSU sample (Table 1.10) and concluded that incomes may be more unequally distributed amongst Blacks in KwaZulu than amongst other population groups in South Africa. An analysis of Stewart's (1986) combined samples, drawn from a region within commuting distance of wage employment markets and covering areas of very high and low cropping potential, revealed similar inequities; households in the lowest decile of the income distribution accounted for only 2,4 per cent of total cash income (on-farm cash income plus remittances, pensions and grants) whereas the share accruing to the top ten per cent amounted to 21,9 per cent. However, it should be noted (a) that these statistics portray a biased picture of income inequality as household income varies with household size and (b) that within the White population of South Africa, the top five percent of wealth owners account for 50,7 per cent

of total wealth (McGrath, 1987).

No matter what income inequalities exist in rural KwaZulu, it cannot be disputed that even those people with relatively high incomes are poor. The average per capita cash income of the top ten per cent of all individuals sampled by Stewart (1986:41) during 1985 amounted to R1389 per annum (1985=100). In 1980, the per capita income for all White South Africans was R9881, valued at constant 1985 prices (McGrath, 1985).

The income estimates in Table 1.10 exclude remittances paid in kind and the opportunity cost of non-market products and services. Average remittances paid in kind amounted to R248 per annum (1985=100) for the households sampled by DSU (Perkins and May, 1988:82). Rogers (1984) used local retail price and yield estimates to compute a value of R230 (1985=100) for food produced and consumed by households in Carr's (1981) sample. Perkins and May (1988:69) provide a comparable estimate of R205 per annum (1985=100). It would seem reasonable to conclude that gross income from farming activities is much higher than the sales estimates tabulated in Table 1.10 suggest. Nevertheless, the share of household income generated by agriculture remains small (after adding a subsistence value of R230 for farm produced food to average crop and livestock sales recorded in the fertile sugar-cane producing region surveyed by Stewart, agriculture's gross contribution to household income is less than 18 per cent).

Nattrass's (1986) analysis of the DSU sample data revealed that most households in the four lowest income deciles were more than 15 minutes walk from the nearest school or store and that almost one half of these households were more than 15 minutes walk from water. In addition, nearly 70 per cent of this group could not access a hospital in less than an hour. In 1985 there were 490 people per hospital bed in KwaZulu whereas the corresponding estimate for South Africa was 193 (DBSA, 1987; DBSA, 1987b). Krige (1989) presents 1985 census data showing that only 20 per cent of KwaZulu's population had more than primary school training and that 40 per cent had never attended school. The corresponding estimates for the White population of Natal are 74 and 13 per cent respectively. By 1985 a total of 12 technical, vocational and industrial skills training institutions had been established in KwaZulu with a combined enrolment of only 3013 (DBSA, 1987).

Cattle are generally regarded as a store of wealth in the less developed rural areas of Southern Africa (Low, 1986:111). An analysis of raw sample data gathered by Stewart (1985) and Carr (1981) revealed large and highly significant positive correlations between household cattle numbers and income.

Table 1.11 shows that some 40 per cent of the households sampled outside of areas where sugar-cane is produced do not own cattle. Cairns (1988) and Rogers (1982) provide comparable estimates of 25 and 48 per cent respectively.

Although herd size distributions tend to be positively skewed, even the largest herd observed comprised only 32 cattle. Average herd size on beef farms in South Africa was 443 during 1985 (Elliot (1986:47). Aggregate herd data and evidence of high stocking rates are presented in section 2.2.

Table 1.11 Cattle ownership and herd size distributions amongst sample households in rural KwaZulu.

	High crop potential in sugar-cane area		High crop potential out of sugar-cane area	Low/med crop potential
	Lyne 1980 n = 140	Stewart 1985 n = 132	Carr 1981 n = 200	Stewart 1985 n = 61
Households with 0 cattle (%)	29,3	38,6	39,8	39,3
Households with 1 - 3 cattle (%)	27,1	34,1	22,0	18,0
Households with 4 - 6 cattle (%)	27,1	24,2	25,0	9,8
Households with) 6 cattle (%)	16,4	3,1	14,0	32,8
Largest herd observed	14,0	15,0	32,0	24,0
Cattle per household with cattle	4,8	3,6	5,0	7,6

Source Carr (1981); Lyne (1981); Stewart (1985).

According to the estimates in Table 1.10, average expenditure on market inputs applied to farming activities by households in sugar-cane producing regions is more than double that recorded for households in other regions of high cropping potential and five times the level observed amongst households in the area of low cropping potential surveyed by Stewart. More importantly, the data indicate that expenditure on market inputs constitutes a small fraction of household income. The major components of household expenditure are recorded in Table 1.12. These estimates reflect mean annual expenditure by sample households in three of the five rural

areas surveyed by DSU and analysed by Perkins and May (1988). Overall mean expenditure (R2691) compares favourably with mean cash income (R2714) attributed to households in the larger DSU sample (Table 1.10).

Table 1.12 Mean annual expenditure by sample households in rural KwaZulu (1985=100).

Study area	Sample size	annual expenditure (R)	Expenditure category: Staple foods (%)	Other foods (%)	Household (%)	Clothing (%)	Education (%)	Savings (%)	Farm inputs (%)
Mapumulo	211	2290	24,8	23,6	11,7	9,9	3,5	3,6	5,2
Mbongalwane	210	2535	24,3	21,3	11,1	10,0	6,5	5,7	4,9
Nqutu	202	3272	21,3	19,8	16,2	12,3	4,4	7,5	1,9
Mean		2691	23,5	21,6	13,0	10,7	4,8	5,6	4,0

Note 1 Household = fuel, light, toiletry, laundry and cleaning materials and household durables.

Source May and Peters (1984 and 1984b); Peters and May (1984).

On average, food products account for more than 40 per cent of total expenditure by sample households. This finding is consistent with the conclusion reached in section 1.2.3 that most households in rural KwaZulu are deficit food producers, even in terms of staple food requirements. Some evidence of the fact that the proportion of surplus food producers is very small is provided in Table 1.13. Nieuwoudt and Vink (1988) report claims that only 17 per cent of KwaZulu's rural households are self sufficient in grains and that the average household produces only 50 per cent of the grain it consumes. Gandar and Bromberger (1984) estimated that rural households sampled in the (remote) Mahlabatini district produced 41 per cent of the total value of food consumed.

The sample data presented in Table 1.12 suggest that rural households might spend more on education than on farm inputs. This was certainly the case for households sampled by Stewart (1985) in areas of low cropping potential where mean expenditure on education exceeded expenditure on farm inputs by 490 per cent (Lyne, 1988). Berry (1970) argued that (relatively) high off-farm wages provide both the incentive and the means for investment in education and that the resulting pattern of investment in education rather than farming would, in itself, lead to increasing rural-urban migration.

Table 1.13 Proportion of sample households selling crops in rural KwaZulu.

	High crop potential in sugar-cane area		High crop potential out of sugar-cane area	Low/med crop potential
Crop	Lyne 1980 n = 140	Stewart 1985 n = 132	Carr 1981 n = 200	Stewart 1985 n = 61
Maize sellers (%)	19,3	6,1	2,5	0,0
Dry bean sellers (%)	25,7	12,9	3,0	3,3
Root crop sellers (%)	36,4	3,8	7,5	1,6

Source Carr (1981); Lyne (1981); Stewart (1985).

In closing, it is worth noting that the proportion of sample households selling food crops is not smaller in areas where sugar-cane has been introduced (Table 1.13). Weber et al. (1988) refer to several studies in Africa where the production of non-food crops has resulted in increased food production and conclude that cash cropping is not necessarily detrimental to food security.

Chapter 2

Resource allocation by rural households in KwaZulu

This chapter focuses on variables influencing household resource allocation. Household economics theories are reviewed in section 2.1 and factors influencing the utilization of grazing resources are discussed in section 2.2. Key economic variables influencing household decisions relating to crop and livestock production are summarized in section 2.3.

2.1 A household economics approach to resource allocation.

Households in rural KwaZulu are both producers and consumers (Tables 1.4 and 1.12). Household economics theory recognises that production and consumption decisions are interdependent and raises issues relevant in a study of resource allocation on small farms.

Household economics literature can be traced back to original contributions by Chayanov (1966) and Becker (1965). These, and contributions by Mellor (1963), Sen (1966), Hymer and Resnick (1969), Krishna (1970) and Nakajima (1970), provided a basis for the more recent models described by Barnum and Squire (1979) and Low (1986:35-44). This section emphasises the policy implications and applicability of the Barnum-Squire and Low models in KwaZulu but begins with a brief

exposition of the original contributions to household economic theory.

2.1.1 Chayanov: Resource allocation in a peasant household.

The Chayanov approach assumes (a) that households strive to maximize an internally consistent (family) utility function, (b) that farm output may be consumed or sold in the market and is valued at the market price (Py), and (c) that there is no labour market. The absence of a labour market implies that the value of household labour is a subjective matter. Although the farm labour market is not very active in KwaZulu (section 2.1.4), rural households do have access to other wage markets. Chayanov's model ignores off-farm income opportunities which are very important in KwaZulu (section 1.2.4).

The analysis is framed in terms of the amount of labour (L) a household will commit to the production of farm output (Y) in order to satisfy its consumption needs. On the one hand the household wishes to increase income (m) by allocating more labour to farm production (m=YPy where Y=f(L)) and on the other hand it wishes to avoid the drudgery of farm work. Utility is therefore a function of income and leisure (á) and is maximized subject to the household's production function, its maximum number of working days and a minimum acceptable income level. Assuming that it is the production function which is binding and not one of the other constraints, the

solution to this problem occurs where the marginal rate of substitution of leisure for income equals the marginal value product of labour (i.e. where $dm/dá=VMP_L$).

A graphical explanation of the subjective equilibrium is presented in Figure 2.1 where gross farm output is measured in money terms on the vertical axes, and total household labour time is measured on the horizontal axis. Time allocated to farm work increases from left to right on the horizontal axis (OL). Conversely, time allocated to other activities (leisure in this instance) increases from right to left (LO). Farm production is described by the production function, or TVP curve when all output is valued at its market price, and displays diminishing marginal returns to labour. Strictly speaking, Chayanov assumed that households enjoyed flexible access to land so that the onset of diminishing returns could be deferred. Household consumption is represented by indifference curves such as I1 and I2, each depicting combinations of leisure and income that provide a given level of utility ($U=f(m,á)$). These indifference curves are convex toward the origin at L as leisure is measured from right to left on the horizontal axis. Income and leisure combinations on I2 provide less utility than those on I1. The slope measured at any point on an indifference curve ($dm/dá$) describes the amount of income required by the household to compensate it for the loss of a unit of leisure and therefore represents the subjective wage rate which the household attaches to its labour time. Provided that the production

function is the only limiting constraint, equilibrium occurs at point X where the slope of the indifference curve (dm/dá) giving the highest level of utility attainable is equal to the slope of the TVP curve (VMP_L). In other words, the household maximizes its utility by allocating OLe labour days to farm work and LLe days to other activities (leisure).

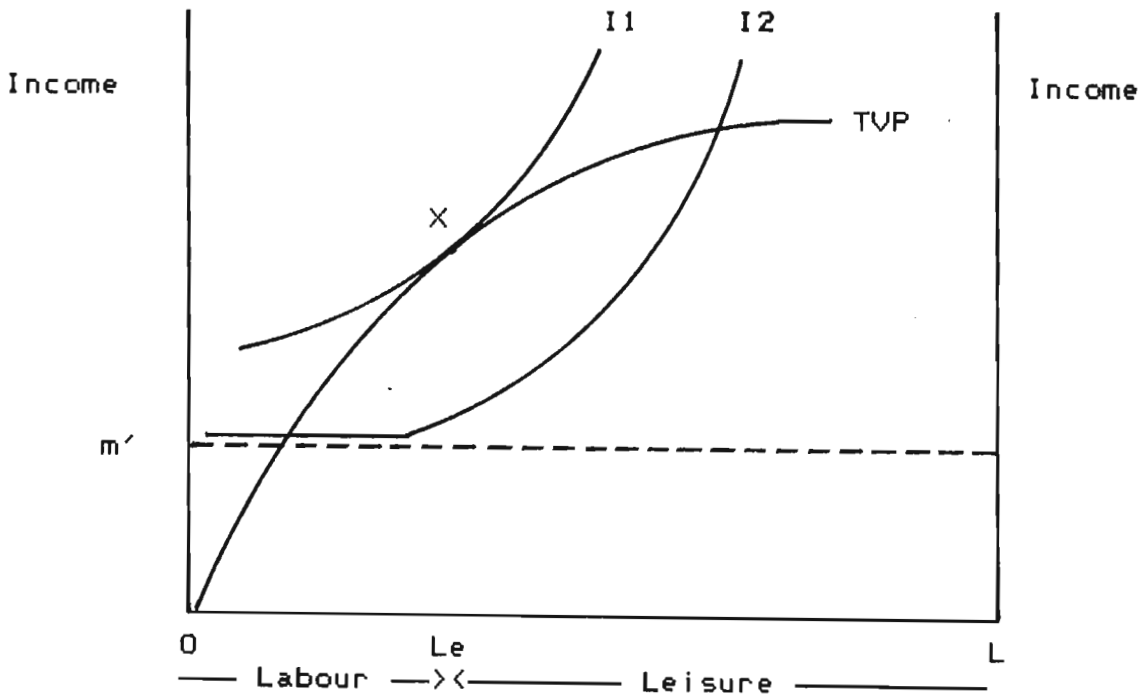

Figure 2.1 The Chayanov model of a small farm household.
Source Ellis (1988:107).

Ellis (1988:110) outlines the following policy implications of Chayanov's model:

(a) The subjective equilibrium is influenced by the size and composition of the household. These demographic variables determine minimum and maximum levels of output for the

household as well as the slope and position of its indifference curves. For example, an increase in children relative to workers might raise m′ in Figure 2.1 (minimum acceptable income) to a level where it becomes the most limiting constraint on utility maximization and could also flatten the indifference curves as workers may be prepared to accept a smaller increase in income for the loss of a unit of leisure in order to meet increased household consumption requirements. The implication is that households of different size and composition will attach different subjective values to their labour time and will therefore use labour at different levels of intensity.

(b) The subjective equilibrium is influenced by changes in TVP caused by changes in farm technology or output price provided that minimum acceptable income requirements are satisfied. In this case, a price or tecnology change that increases TVP will improve household welfare but its effect on household labour allocation is indeterminate unless leisure is regarded as an inferior good. Assuming that leisure is a normal or superior good and that the minimum acceptable income level is satisfied, an increase in income not only provides an incentive to substitute work for leisure (substitution effect) but also increases the demand for leisure (income effect). When the income effect of increased earnings exceeds the substitution effect, household labour supply declines. A backward

sloping supply curve for labour is therefore a possible outcome in terms of Chayanov's model.

(c) The subjective equilibrium is not influenced by the proportion of farm output retained for household consumption because the utility function excludes non-farm consumption goods purchased from farm income. It is also implicitly assumed that old, young, male and female workers are perfect substitutes in production.

Owing to the ambiguity of household responses to changes in TVP, strategies that raise minimum income requirements (eg. taxation) or which increase the marginal utility of income relative to the marginal utility of leisure (eg. by providing a wider range of consumer goods in rural areas) may seem appropriate. However, such policies do not imply improvements in the welfare of rural households and, as Ellis (1988:114) points out "pander to the purported leisure preference of the household rather than creating active conditions in favour of ouput growth".

The subjective equilbrium in Chayanov's model exists only in the absence of a labour market. When a competitive labour market is introduced, household production levels are determined by profit maximization with respect to the market wage. In this case demographic variables do not influence the level of farm output and responses to changes in TVP are predictable (an upward shift in TVP will increase total labour input and farm output).

2.1.2 Becker: Allocation of time by households.

Contemporary farm household models which permit labour hiring and selling utilize elements of Chayanov's analysis and Becker's (1965) theory of time allocation - the basis of 'new home economics'. New home economics views households as 'small factories' that convert market inputs (X) and household resources (member's time, T) into a set of ultimate non-market uses. Utility is derived from these ultimate uses (called Z goods) rather than from the range of goods and services. One such Z good is "the seeing of a play, which depends on the input of actors, script, theatre and the playgoer's time" (Becker, 1965:495).

The home production function therefore takes the form $Z=f(X,T)$ and the utility function, $U=f(Z)$ where $Z=(Z1,Z2,...,Zn)$. The household maximizes utility subject to its production function, a total time constraint and a money income constraint. Total time (T) is the sum of time spent at (wage) work (Tw) and time spent producing Z goods for consumption (Tc), i.e. $T=Tw+Tc$. The money income constraint (M) is the product of time spent in wage work and the market wage (W), i.e. $M=WTw$. In equilibrium, money income equals expenditure on market inputs used to produce Z goods, i.e. $WTw=M=XPx$ where Px represents prices of the purchased inputs.

The time and money constraints are not independent. They can be collapsed into a single 'full income' constraint (S, where

S=WT=WTc+XPx) by valuing all household time at the market wage. The expression WTc+XPx can be rewritten as (Pxb+Wt)Z where b and t are the inputs of X and Tc per unit of Z respectively. Assuming a linear production function, the equilibrium condition obtained by maximizing U=f(Z) subject to (Pxb+Wt)Z and the production function is $dU/dZ=\gamma(Pxb+Wt)$ where γ measures the marginal utility of money income and (Pxb+Wt) represents the full price or marginal cost of producing a unit of Z. If the production function is not linear the marginal cost of producing a unit of Z is $(W/MP_L)+(Px/MP_{x_i})$ where MP=marginal product.

2.1.3 The Barnum-Squire model of a farm household.

Barnum and Squire's (1979) model of a farm household follows the new home economics approach and has provided a basis for numerous empirical studies and more elaborate models (see Ahn et al., 1981; Hardaker et al., 1985; Singh et al., 1986). Ellis (1988:128) summarizes the assumptions of the Barnum-Squire model as (a) farm size is fixed in the short-term, (b) a competitive labour market exists and households may hire and sell labour at a given market wage, (c) leisure and time used in the production of non-market Z goods constitute a single consumption item in the household utility function, (d) there is no uncertainty or risk aversion, and (e) households consume part of their farm output, the balance being sold on competitive markets to finance purchases of market goods consumed. The latter assumption is not

appropriate in KwaZulu where the majority of rural households are deficit producers (section 1.2.4). Nevertheless, the Barnum-Squire model raises issues that could become relevant in KwaZulu.

Since the model relates to a farm household, the production function comprises farm output (Y), a marketed Z good. The household utility function is written as $U=f(Tc,C,N|D)$ where Tc is leisure plus time spent producing non-market Z goods, C is the share of farm output consumed, N represents non-farm goods purchased for consumption and D reflects fixed household demographics. The production function is written as $Y=f(L,X|A)$ where L is total farm labour (household plus hired), X represents purchased variable inputs and A is the fixed land area.

Following Becker's approach, household utility is maximized subject to the production function and time and income constraints. The time constraint is given by $T=Tc+L-Tw$ where Tw is time sold. For convenience, the household's own farm labour time is defined as Tf and hired labour as Th, i.e. $L=Tf+Th$. The income constraint requires that net money income should equal expenditure on purchased consumption goods and is written as $Py(Y-C)+WTw-WTh-XPx=NPn$ where Py is the market output price, (Y-C) the share of ouput sold, W the market wage, Px the prices of purchased variable inputs and Pn the prices of purchased consumption goods.

Again, the time and income constraints may be collapsed into

a single full income constraint, $S=WTc+PyC+NPn=\pi+W(Tc+Tf)$ where WTc is the opportunity cost of leisure and time spent producing non-market Z goods, PyC the market value of own farm output consumed, NPn the value of purchased consumption goods, π the net farm income and $W(Tc+Tf)$ is the value of total household time. An important feature of the Barnum-Squire model is that full income comprises the value of total household time (Becker's concept of full income) and net farm income ($\pi=PyY-WL-XPx$).

If there is perfect substitution between household and hired labour in production and between farm produced and market purchased goods in consumption, factor demand equations derived from the profit function can be expressed in terms of input and product prices, i.e.,

$$d\pi/dL = Py(dY/dL)-W = 0 \text{ at maximum} \Rightarrow L = f(W,Py|A) \quad (1)$$

$$d\pi/dX = Py(dY/dX)-Px = 0 \text{ at maximum} \Rightarrow X = f(Px,Py|A), \quad (2)$$

implying that production decisions are independent of consumption decisions. For this reason the model is said to be separable or recursive. However, consumption choices are not independent of production decisions because net farm income is part of full income.

Equations 1 and 2 are the profit maximizing conditions for the allocation of labour ($VMP_L=W$) and other variable inputs $VMP_X=Px$). Assuming that households strive to maximize farm profits, full income becomes $S*=\pi*+W(Tc+Tf)$ where $\pi*$ denotes maximized profits ($\pi*=PyY*-WL*-X*Px$ where $Y*$, $L*$ and $X*$ represent profit maximizing levels of output, labour and

market inputs respectively). At the second stage of decision making, households are assumed to maximize utility subject to their production function and the modified full income constraint $WTc+PyC+NPn=\pi^*+W(Tc+Tf)$. This yields the following equilibrium conditions:

$$dN/dC = Py/Pn \quad (3)$$

$$dN/dTc = W/Pn. \quad (4)$$

Equations 3 and 4 are the traditional first-order conditions of welfare economics. That is, the marginal rate of substitution in consumption must equal the marginal rate of transformation in production.

Empirical estimation of the Barnum-Squire model from farm household sample data is facilitated by its recursive nature. First, the production or profit function is estimated. Equations 1 and 2 are used to determine the profit maximizing levels of labour and other inputs and, since land is fixed, the economic optimum level of output. From this information an estimate of π^* is computed. In some studies linear programming (LP) has been used to estimate π^* (for example, Ahn et al., 1981).

Second, demand equations expressing the consumption choices (Tc,C and N) as functions of wage rate, price and household demographic variables are estimated using a demand system that includes the modified full income constraint. This procedure allows profits generated in farm production to influence consumption. Delforce (1987) provides a concise summary of systems approaches (eg the linear expenditure

system) commonly used in estimating the demand equations.

Policy implications of the Barnum-Squire model are analysed in two stages. To begin with, total response elasticities, measuring the percentage change in an endogenous variable (eg. food consumption=Y) resulting from a one per cent change in an exogenous variable (eg. food price=P) when all other exogenous variables are held constant, can be computed for the average sample household using the estimated demand parameters. These household response elasticities (Π^*) will differ from conventional response elasticities (Π) owing to the inclusion of farm profits in the household budget constraint. For example:

$$\Pi^*_{YP} = \Pi_{YP} + \Pi_{YE}.\Pi_{E\pi}.\Pi_{\pi P}; \qquad (5)$$

where Π_{YP} represents the own price elasticity of food consumption obtained when farm profits are held constant and comprises the usual income and substitution effects of a price change, Π^*_{YP} is the own price elasticity of food consumption when farm profits are allowed to vary, Π_{YE} the elasticity of household food consumption with respect to household expenditure (E), $\Pi_{E\pi}$ the elasticity of household expenditure w.r.t. farm profit (π), and $\Pi_{\pi P}$ the elasticity of farm profit w.r.t. food price (Barnum and Squire, 1979).

It is clear from equation 5 that $|\Pi^*_{YP}|$ is likely to be smaller than $|\Pi_{YP}|$. In fact, estimates of Π^*_{YP} computed for paddy rice (Y) farmers sampled in Malaysia (Barnum and Squire, 1979) and in Korea (Ahn et al., 1981) were positive. The implication is that, in these households, an increase in

paddy price bolsters farm profit and hence the real budget constraint by an amount sufficient to raise rice consumption. This phenomenon has been termed the 'profit effect' (Singh et al., 1986:7). In Barnum and Squire's (1979) study, the profit effect caused a decline in household labour supply (leisure being a normal good) and dramatically increased the demand for hired labour. Similar studies conducted in other Asian countries have also predicted negative household labour supply responses with respect to product price (Singh, et al., 1986:25). Such an outcome is unlikely in KwaZulu where many household workers are employed in urban jobs. If farm earnings increase in KwaZulu, more household workers will stay in agriculture. The total household labour input in agriculture may therefore increase even if individual effort decreases. In short, the Barnum-Squire model does not draw a distinction between individual effort and the combined effort of all members of the household (Nieuwoudt and Vink, 1988).

A second stage of the Barnum-Squire policy analysis involves extrapolation of the estimated household response elasticities to market level. In their Malaysian study, Barnum and Squire (1979) estimated that a ten per cent increase in paddy price would raise wages by 13,4 per cent and that this would convert the positive paddy output response predicted at household level to a negative supply response at market level. However, Timmer and Falcon (1975) found close rank correlation between paddy prices and yields among Asian countries. This observation lends support to

Nieuwoudt and Vink's (1988) contention that Barnum and Squire do not consider the effects of rising wages on the opportunity cost of leisure, and might also reflect a tendency of the Barnum-Squire model to overstate the effect of product price increases on demand for hired farm labour. In KwaZulu, it is not anticipated that farm wages will respond significantly to changes in product prices as labour inputs in agriculture have close substitutes and the market supply of farm labour is expected to be price elastic owing to high rates of unemployment (section 1.2.3) and the high proportion of migrant wage workers. As a result, rents arising from increased crop income are more likely to be captured in the fixed resource, crop land.

Although the predictive powers of Barnum and Squire's model exceed that of Chayanov's model, the improvement stems largely from the different assumptions which they employ. Whereas Chayanov assumes away the existence of a labour market, the Barnum-Squire model requires a competitve labour market. If hired labour is not a perfect substitute for household labour (which embodies a management input) the recursive property of Barnum and Squire's model falls away. A similar situation arises if there are differences between market buying and selling prices or if uncertainty and risk aversion prevail (Delforce, 1987). In this case estimation of the model is complex and has been attempted by few researchers. Roe et al. (1986) incorporated the effects of risk aversion and Lopez (1986) the effects of labour market

imperfections in separate applications of non-separable Barnum-Squire type models.

The Barnum-Squire model is not generally applicable in KwaZulu as very few rural households produce marketable surpluses. Consumption responses measured using the recursive approach (Π*) would most likely be very similar to conventional response estimates (Π). For example, Nieuwoudt and Vink (1988) estimate the own price elasticity of demand for food staples in KwaZulu as -0,53 for deficit producers and as -0,43 (Π) for all producers. This indicates that the impact of profit effects in surplus producing households on Π is small.

On the production side, Barnum and Squire's model maximizes farm profit in the usual way but omits the effects of minimum consumption requirements, risk and leisure preferences on household profit maximizing behaviour. In effect, the production side of their model is only relevant in that it generates a profit effect to be included in the full income available for household consumption (Delforce et al., 1987). Details of how this profit is obtained are of little concern in a model intended primarily for use in studies of household consumption. Consequently, the Barnum-Squire approach is not suitable for a study (such as this one) aimed at investigating farm production because "it is probably unreasonable to assume that production decisions are not influenced by consumption requirements and other non-profit considerations" (Delforce, 1987:27).

2.1.4 The Low model of a rural household in Southern Africa.

The assumptions underpinning Low's (1986:32-44) model of a 'traditional' rural household in Southern Africa can be summarized as follows; (a) household members strive to maximize a family utility function, (b) farm-gate and retail prices of farm products are not equal, and (c) labour can be sold and household members have different wage earning potentials. The latter assumption and its implication that households may be deficit food producers is consistent with circumstances in KwaZulu. The assumption that buying and selling prices differ is perhaps less applicable as farm-gate and retail prices of surplus produce do not differ markedly in KwaZulu. However, purchase prices of commodities produced by commercial farmers in South Africa are usually higher than local farm-gate prices owing largely to transport costs and physical differences between the imported and local products. This is certainly true of maize as imported grain is highly refined (Appendix B, Table B.12).

In Low's model, household utility is expressed as a function of Becker's (1965) Z goods defined to include farm output produced for home consumption. Maximizing utility subject to a full income constraint implies cost minimization in the production of Z goods. Assuming, for convenience sake, that the production function is linear, the full price or marginal cost of producing a unit of Z is written as

$$Cz = Pxbi + Witi$$

where Cz is the marginal cost, Px represents prices of purchased variable inputs X, bi the amount of X required by household worker i to produce a unit of Z, Wi the wage rate of household worker i and ti is the amount of time required by worker i to produce a unit of Z.

A cost minimizing household will turn to the cheapest of its workers for its supply of Z goods. This will depend upon each workers wage rate and his or her marginal productivity (1/bi and 1/ti when the production function is linear). In addition, Z goods like subsistence crops can be purchased at retail prices. Assuming that the time required to buy such a Z good is negligible relative to growing it, the purchase option involves retail market prices (Pz) and savings incurred by not growing it. Hence, when

$$Pz < Pxbi + Witi$$

the subsistence requirement will be purchased rather than grown by household worker i. Rearranging the terms in this inequality yields

$$(Pz - [Pxbi])/ti < Wi \ . \qquad (6)$$

The left-hand-side of inequality 6, which Low (1986:37) refers to as the 'opportunity cost of purchase' for worker i, reflects the net money cost of not applying a unit of worker i's time to own food production. Inequality 6 states that if the i'th worker can, with a unit of his time, earn wages in excess of his or her opportunity cost of purchase, he or she will acquire the subsistence Z good more cheaply by engaging in wage employment and purchasing it than by growing it.

Low (1986:40-44) extends his analysis to include market crop production in a simplified geometric version of the model. In addition to the facilitative assumption of a linear production function and the implicit assumption of no uncertainty or risk aversion, Low assumes that household workers with different wage earning potentials are equally efficient in the production of Z goods and that input proportions are constant.

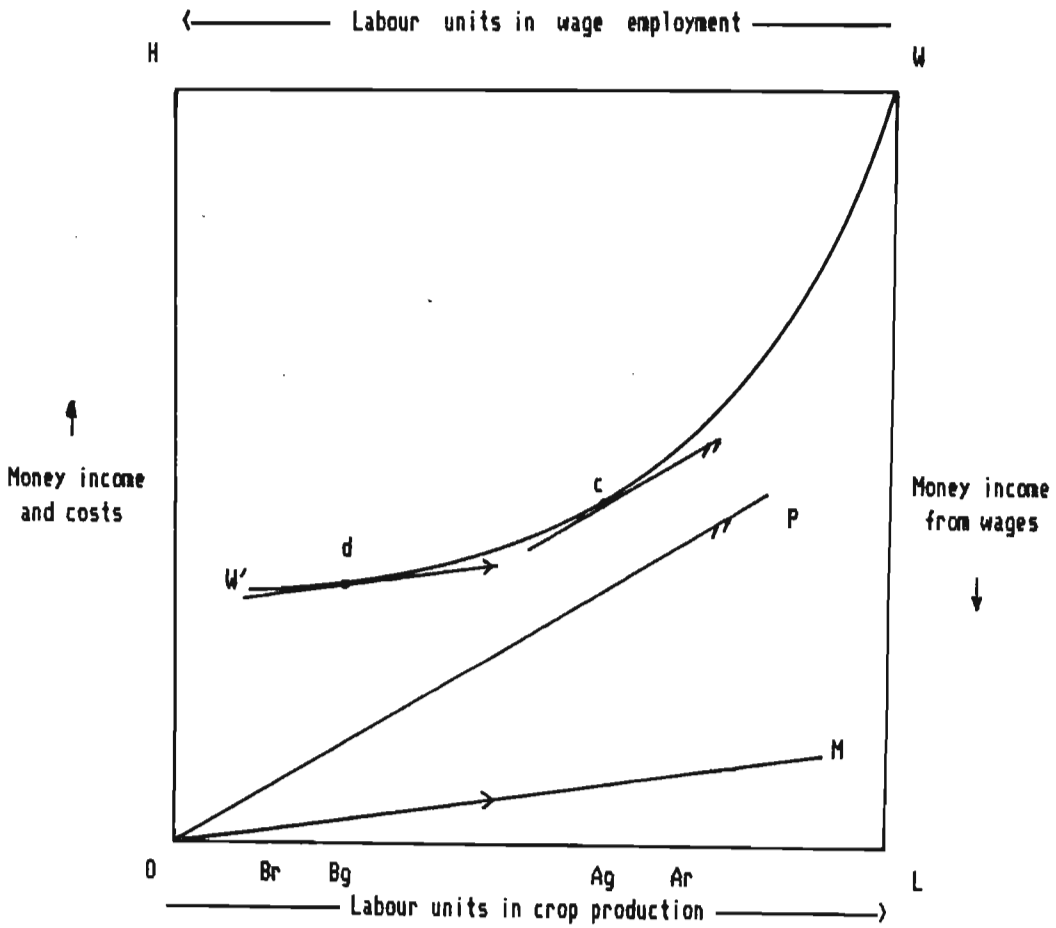

Figure 2.2 Deficit and surplus producers in the Low model.

Source Low (1986:43)

In Figure 2.2, OL measures the total amount of household

labour. Labour units (workers) are arranged in increasing order of comparative advantage in wage employment along the OL axis. WH is the corollary of OL. Workers' potential wage rates are given by the slope of the wage line W'W. Labour units on the left of OL have low wage earning potential whereas those on the right have high earning potential. OM represents commercial returns (at farm-gate prices) to crop production net of purchased input costs and OP the opportunity cost of purhase (inequality 6).

The assumption of a linear production function with constant input proportions implies that household subsistence requirements can be measured in terms of the labour units needed to grow it. A family with OL labour units and a high consumer:worker ratio may have subsistence needs equal to OAr in Figure 2.2. For the labour unit at Ar, wage rate exceeds opportunity cost of purchase (i.e. slope of W'W > slope of OP) and this labour unit will be allocated to wage employment rather than to subsistence production. In fact, only labour units to the left of Ag will be allocated to subsistence production (slope of W'W > slope of OP right of point c) making this household a deficit producer purchasing OAr-OAg of its subsistence requirement.

A second household with fewer consumers per worker may have subsistence requirements equal to OBr in Figure 2.2. This household will produce a surplus of OBg-OBr. Beyond Bg, wage employment offers higher returns than selling farm output (as slope of W'W > slope OM to the right of point d). Although it

is a surplus producer, this household might allocate more labour to wage employment than a deficit producer (if $L_B - B_g > L_A - A_g$) which is consistent with Low's (1986:35) observation that larger households tend to produce greater surpluses. This observation contradicts the Barnum-Squire model which predicts that an increase in household size will necessarily reduce marketable surpluses as consumption requirements vary with household size but quantities of labour allocated to farm activities do not (labour allocation is determined by the profit maximizing rule $VMP_L = W$ in the Barnum-Squire model).

The way Low's model allocates household labour between enterprises (on and off the farm) is no different from what microeconomic theory would predict in the given circumstances. The critical assumption employed by Low is that household workers do not have free choice regarding the enterprise in which they work. Although Low assumes the existence of a household utility function, the mechanics of his model require only that employment decisions made by individual workers be consistent with the wishes of other household members. This less stringent assumption suggests that the share of wage income remitted by off-farm workers is determined by consensus. Of 296 migrant workers sub-sampled by Stewart (1986:49) only 15 per cent did not remit cash to their families. Furthermore, many of the workers that did not remit wages were acting with their family's consent as they were saving for 'bride wealth' or other approved reasons. A

regression analysis performed on these data revealed that cash remittances (R) are not a linear function of wage earnings (W). This result contradicts the notion of a household utility function (in this case, direct commuting costs (D) would be independent of wage earnings, i.e Ri=Wi-D i=1,2,..,n migrant workers) but is compatible with the assumption of consistency in decision making. Invoking the latter assumption implies that remittance rates should be substituted for wage rates in Low's model and that household subsistence requirements would decline if off-farm workers finance some of their own subsistence needs out of 'after remittance income'. These modifications might alter the predicted farm:off-farm worker ratio within a particular household but would not change the wider implications of Low's analysis.

According to Low (1986:50-53), population growth in the less developed rural areas of Southern Africa has effectively reduced average farm size and quality because rural households have an incentive to retain their land rights. At the same time, improvements in expected off-farm wage rates, education and transport raised the opportunity cost of household labour in farm activities. As a result, the full cost of producing a unit of Z goods increased relative to its purchase price. Low concludes that the net outcome has been (a) real growth in the number of wage workers, (b) underutilization of arable land despite high population pressure, and (c) increased food importation. Although these

trends are also evident in rural KwaZulu (sections 1.2.1-1.2.4, Table 1.7 in particular) the underutilization of arable land is not fully explained by Low's analysis. His model merely draws attention to the fact that many rural households do not have an incentive to farm their arable land intensively. Arable land is underutilized because these households cannot rent land to others who would farm it (section 1.2.2).

Apart from the possibility of independent decision making by household workers, Low's model omits several other factors that could influence its predictions regarding labour allocation and crop output. Firstly, while it is assumed that household labour can be sold at different rates in off-farm wage markets, the possibility of hiring farm labour is not considered. In the presence of a competitive market for farm labour, certain of Low's deficit households might produce all of their food requirements (and a marketable surplus) if the purchase price of farm labour was sufficiently low. To preserve the model's explanatory power it could be assumed that there is no farm labour market because households have similar land and labour resources. This assumption is plausible as the land tenure system has not encouraged a class of landless labourers. Surveys conducted in Swaziland and Malawi indicate that only three per cent of total farm labour is hired (Low, 1986:183). Data gathered in rural KwaZulu also point to an inactive farm labour market. Stewart (1986:39) estimated the proportion of sample households using

hired farm labour to be seven per cent in an area of low cropping potential and 30 per cent in an area of high cropping potential where sugar-cane is grown. Predicted deficits would tend to be smaller, and surpluses larger, if farm labour is hired.

Secondly, Low's graphical analysis does not permit input substitution. Labour used in crop production has close substitutes (eg. machines, draught animals, herbicides and pesticides) and the cost of labour is high relative to the total value of output in Southern Africa. These factors make the derived input demand for labour elastic (Friedman, 1962). Consequently, an increase in wage rates that induces a transfer of household work time from farm to off-farm employment does not necessarily imply reduced farm output. An increase in off-farm income could also alleviate liquidity constraints inhibiting crop production. Positive relationships between off-farm earnings and the production of surpluses have been measured amongst sample households in rural KwaZulu using multivariate discriminant analysis (Lyster, 1987:135, Nieuwoudt and Vink, 1988). However, the apparent complementarity between remittance earnings and surplus production observed in these studies might only reflect differences in consumer:worker ratios between households.

Thirdly, household food consumption is fixed at a subsistence level and does not vary with changes in income or food prices. For low income households like those in rural

KwaZulu, changes in real income may have a significant effect on food consumption, and demand for food produced and consumed by households is expected to be more price elastic for deficit producers than for surplus producers (a price change generates a profit effect in surplus producing households). Nieuwoudt and Vink (1988) estimate the price elasticity of demand for staple foods as -0,53 and -0,14 respectively for deficit and surplus producers in KwaZulu.

Fourthly, leisure and risk are not treated explicitly. Low (1986:44) argues that the proportions of time allocated by a household to farm and wage employment are unlikely to be influenced by a reduction in work effort because leisure is shared by household members. Nevertheless, changes in leisure consumption do influence levels of output, and their anticipated causes, size and direction warrant attention in studies of farm production. A relative increase in the price of food may induce a transfer of time from non-farm to farm work in all rural households but the effect of the price change on leisure consumption will most likely differ between deficit and surplus producers. Members of deficit producing households are expected to take less leisure owing to declining real income (negative income effect) and the rising opportunity cost of leisure (substitution effect). In surplus producing households, a relative increase in product prices implies a positive income effect and members are expected to consume more leisure if the income effect exceeds the substitution effect.

Low (1986:41) recognises that wages, yields and prices are not known with certainty but maintains that risk considerations would complicate the model "without significantly changing the nature of the conclusions reached". This conclusion is acceptable when the object of the analysis is to explain trends in labour allocation, but risk and risk aversion are important if the object is to analyse farm production.

Lastly, Low's analysis ignores the effects of capital and land constraints, seasonal production, lumpy labour inputs and variations in soil fertility and bioclimate on resource allocation.

2.2 Factors influencing the utilization of grazing resources.

Whereas arable land is underutilized in KwaZulu, natural grazing is heavily utilized. One reason for this situation is that grazing land, unlike arable land, is a common resource (section 1.2.2).

Natural grazing covers 76 per cent of the land area in rural KwaZulu. From the estimates presented in Table 2.1 it is obvious that grazing is heavily utilized. The average stocking rate is almost double that in Natal where range land is privately owned and where herds are very much larger (section 1.2.4). High stocking rates have resulted in poor calving and high herd mortality rates (Table 2.1). Tapson

(1986) maintains that cattle mortalities (Table 2.2) are under-reported in KwaZulu as stock may be slaughtered prior to an impending death. In this case, net offtake (slaughterings plus exports) might be less than five per cent (Table 2.1). The object of this section is to identify factors responsible for the relatively high stocking rates and poor herd performance observed in KwaZulu.

Table 2.1 Comparison of key cattle statistics in KwaZulu and Natal.

	KwaZulu (communal grazing)	Natal (private land tenure)
Grazing land (Ha)	2,2 million	3,4 million
Herd size (1987)	1,5 million	1,2[1] million
Herd mortality	7,4 %	3,9 %
Calving rate	32,0 %	80,0 %
Slaughter + export rate (1987)	5,0 %	25,0[2] %

Notes 1 Excludes dairy cows.
2 Estimate relates to South Africa.

Source Colvin (1983); KDA (1980); KDA (1989); Lenta (1978); Lyster (1987:); Meat Board (1989).

2.2.1 The common property problem.

Gordon's (1954) classic paper analysed the common property problem under circumstances which permit unrestricted access to the common resource. This situation is illustrated in Figure 2.3.

Given the value product curves in Figure 2.3, if cows and grazing land are privately owned, five cows would be stocked as the fifth cow reduces the marginal value product of stock

(VMP_c) to Pc, the cost of keeping an additional cow on the range. Rents, indicated by the shaded area, are maximized at this point (VMP_c=Pc). Assuming stockowners discount future returns at a rate consistent with the time preferences of society as a whole, private tenure prevents degradation of grazing resources as the long term sustainable stocking rate occurs where VMP_c=0 (at approximately seven cows in the example).

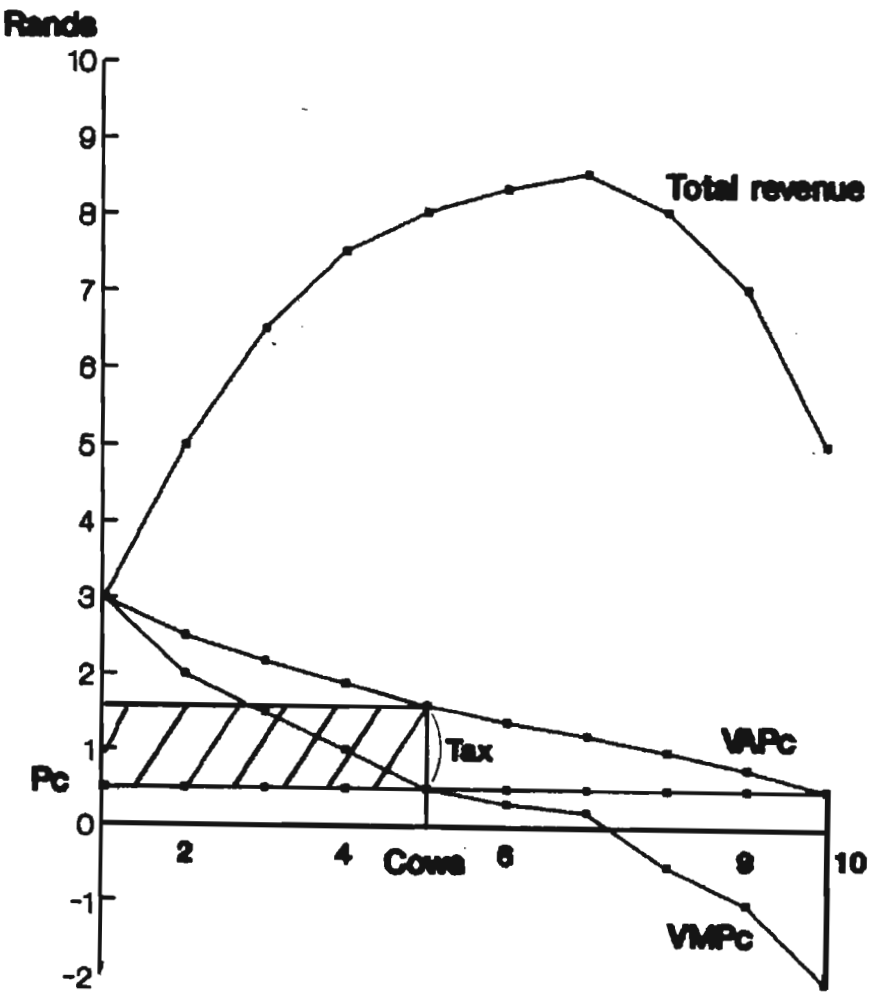

Figure 2.3 Total, average and marginal value product curves.

Conversely, if several stockowners have unrestricted access

to (communal) grazing land, the 'equilibrium' stocking rate occurs where Pc, the cost of keeping a cow on the common, equals the value of average product (VAP_e). In the example (Figure 2.3), VAP_e=Pc when 10 cows are stocked. This equilibrium arises in open access situations because stockowners only consider their own private costs and returns when deciding whether or not to make use of the common. Land is not privately owned and rents are zero. There is no incentive for a stockowner to 'stint on the common' as rents would accrue to others - the free-riders.

If Pc is sufficiently low (as in Figure 2.3), the equilibrium stocking rate (VAP_e=Pc) exceeds the maximum sustainable stocking rate. Stocking in excess of the maximum sustainable rate is therefore not a necessary outcome of unrestricted access to common grazing and will be tempered by increases in Pc caused by rising mortality rates. Even if Pc is low enough to result in stocking beyond the maximum sustainable rate, the equilibrium rate will decline systematically with the reduced quality of grazing only if the input-output price ratio (Pc/Py) remains unchanged.

Critics of Gordon's model often overlook the fact that it compares two extremes, viz. private tenure on the one hand and common property characterized by open access on the other, and that between these two extremes exists a range of stocking rates corresponding to more realistic common property situations - including tacit cooperation by individual users. Vink and Kassier (1987) claim that open

Table 2.2 Mean annual cattle populations (000), prices and rainfall in KwaZulu.

Year	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88
Cattle	1424,2	1429,3	1467,5	1357,1	1350,6	1447,3	1351,9	1343,6	1416,6	1483,1	1515,5
Deaths	98,3	110,7	97,5	154,8	72,5	67,2	145,9	63,9	70,5	67,2	77,1
Slaughterings	57,8	70,9	71,8	68,1	64,6	69,7	75,8	57,8	59,8	58,3	64,6
Exports	n/a	n/a	n/a	8,6	15,6	6,5	14,5	8,0	8,5	7,5	9,9
Imports	n/a	n/a	n/a	13,2	2,5	11,4	12,1	20,7	22,6	15,7	12,8
Nominal auction price on hook (c/kg)	93,5	96,9	119,0	202,4	212,2	211,4	222,9	228,4	257,3	353,4	451,6
Nominal interest rate	12,5	12,3	10,3	9,5	13,8	19,3	16,5	22,3	23,0	14,5	12,5
Lag rainfall (mm)	1220	960	1064	752	743	907	720	839	1130	1073	863

Note 1 Rainfall data gathered at 224 stations in and around KwaZulu.

Source CCWR (1989); Directorate Agricultural Economic Trends (1989); KDA (1978-1988); Reserve Bank (1977-1987).

access is not prevalent in Southern Africa yet their data only show that a substantial proportion of rural households do not invest in cattle. Even if access is restricted to a group of stockowners it does not necessarily follow that individual members cannot increase their stocking rates. In an attempt to strengthen their claim that Gordon's model is not appropriate in Southern Africa, Vink and Kassier (1987) argue that there is insufficient evidence of overgrazing, low productivity or increasing herd sizes on the commons. The latter argument is certainly not consistent with Gordon's analysis, nor is overgrazing (in the biological sense) a necessary outcome. The notion that cattle populations tend to gravitate toward the maximum number which the commons will bear when access is unrestricted (Lenta, 1978) is false. A positive relationship between cattle numbers and maximum

grazing capacity does not imply that price variables (Py and Pc) are unimportant determinants of herd size. To demonstrate the effects of relative price changes on herd size, the following ordinary least squares regression equation was estimated from annual observations (Table 2.2):

$$\text{Herd size}_t = 3578 + 4{,}79(Py/Pc)_t + 0{,}25(\text{Rain})_{t-1} - 1{,}25(\text{Trend})_t$$

t values (2,46)* (3,30)* (-0,25)

$R^2 = 0{,}69$ $F = 5{,}15$* DW = 2,06

where:

Herd size = cattle in thousands.

Py = auction price of cattle in cents per kg (i.e. an estimate of the value of cattle).

Pc = prime overdraft interest rate (i.e. the opportunity cost of holding cattle). This variable was used as a proxy for the cost of keeping cattle on the assumption that other private costs are relatively low.

Rain = average annual rainfall (mm) measured at more than 224 stations in Natal/KwaZulu. Rain_{t-1} was used as a proxy for maximum grazing capacity.

Trend = time (t) in years (t = 1977, . . ,1987).

The lagged rainfall and price ratio coefficients are both statistically significant at the five per cent level of probability. The trend coefficient is not significantly different from zero indicating little or no (linear) decline in veld quality over the period considered. Of relevance is

that after accounting for changes in time and rainfall (which reflect veld quality), the input:output price ratio has been an important determinant of herd size in KwaZulu. These findings are entirely consistent with Gordon's model and suggest that herd size could be reduced by increasing the cost of holding cattle relative to their perceived value.

It must be emphasised that the auction price (Py) is only a proxy for the value which stockowners attach to cattle. Data from Swaziland (Low, 1986:112) indicate that the value attached to cattle as a store of wealth that can be readily liquidated (at or near auction prices) to meet specific cash needs, constitutes an important part of their perceived value.

2.2.2 Solutions to the common property problem.

In the case of communal grazing land with open access, the following solutions have been suggested for the overstocking problem; (a) privatizing the land, (b) Introducing cattle taxes as a partial substitute for other taxes (Figure 2.3 illustrates an optimum cattle tax) and (c) quota restrictions on the number of cattle permitted on the common. Although grazing rights can be privatized by issuing saleable quota, this method of privatization should not be confused with the privatization of grazing land.

Runge (1981) contends that under conditions of open access and strict individual dominance (i.e. where individuals make stocking decisions on the basis of their own private costs

and returns) taxes and quotas do not provide a stable solution to overgrazing as there are strong incentives for users to 'break the rules'. The implication is that taxes and quotas would have to be imposed and enforced from outside and that privatization of grazing land represents the only stable solution to overstocking (assuming individual owners will conserve their private ranges at a rate consistent with the time preferences of society as a whole) if strict individual dominance prevails.

Local attitudes towards these proposals have been demonstrated in KwaZulu where; (a) stock limitation legislation introduced in 1967 is now disregarded (WGBP, 1988), (b) Crotty's attempts to introduce cattle taxes were rejected by the Legislative Assembly, and (c) a recommendation of the proposed 1988 KwaZulu Land Bill makes allowance for grazing to "remain as communal land for the common benefit of the tribe". Clearly, these 'orthodox' solutions to overgrazing are considered to be unacceptable by policy makers.

Runge (1981) views common property as a resource to which access is not open but is restricted to a particular group of users. He argues that under these conditions the assumption of strict individual dominance is not plausible as stockowners will most likely consider the expected behaviour of others in the group when deciding how many cattle to graze on the common. Accordingly, Runge rejects the principle of independent decision making and redefines the common property

problem as decision making under uncertainty - the uncertainty arising from interdependence of choice.

In this case, solutions to the overstocking problem include privatization of grazing land and institutional rules which provide assurance regarding the actions of others in the group. The rules are expected to be stable if the short term advantages of free-riding do not exceed its costs (in terms of reduced potential benefits, lost reputation, the opportunity costs of innovating new rules and pecuniary fines imposed by the group). Assuming that there is little incentive for individual group members to defect, the institutional approach would minimise the need for outside enforcement.

However, there is some doubt as to whether land tenure arrangements in rural KwaZulu facilitate restricted access. Firstly, in most areas where the tribal tenure system has not been modified by 'betterment planning' (section 4.1.3), land allocated to a household which is not used for dwellings or crop production serves as grazing and is available to other households for this purpose only. In some instances even the arable portions of allotments are opened for grazing during the winter months (section 1.2.2). Secondly, in other tribal wards and areas subject to betterment planning, land set aside specifically for grazing purposes is viewed as a common resource open to all households residing in the ward. There is no evidence of penalties imposed for overstocking (Khumalo, 1989; Keating, 1989) and grazing has been degraded

rather than rehabilitated (WGBP, 1988).

In defining strategies for communal grazing areas in Southern Africa, Vink and van Zyl (1989) highlight an 'ideal' scenario and a 'most prevalent' scenario. The former occurs where members of a group adhere to internal rules governing stocking rates and overgrazing is not a problem. In this instance, their policy recommendation is to do nothing if the situation is expected to persist. The latter scenario is closer to the open access situation and occurs where group cohesion is weak and overgrazing is evident. In this case, they suggest strategies aimed at shifting the demand for and supply of institutional rules. For example, they recommend that the quality of the veld and herd be improved (although the relationship between this strategy and the demand for and supply of institutional rules is not specified) and **herein lies the real tragedy of the commons.**

Regardless of whether overgrazing is prevented by means of internally or externally enforced restrictions on cattle numbers, cattle taxes or grazing rights, an individual would have little incentive to invest time and money improving the grazing or the quality of his herd because land remains a common resource and other stockowners (the free-riders) stand to benefit from his efforts. Whereas reductions in stocking rate are achieved by internalizing the cost of resource degradation (reduced future income), improvements in incentive are achieved by internalizing benefits. Only privatization of grazing land (even in the simplest sense of

removing free access to land that is allocated to, but not cultivated by, other households) could solve both the overstocking and low incentive problems but is likely to meet with resistance from stockowners. Since some 40 per cent of rural households in KwaZulu do not own cattle (section 1.2.4), unrestricted access to communal grazing provides, at no extra private cost, the additional ranching resources (land and watering points) needed by stockowners to maintain their herds. Rental arrangements for grazing land which would raise the private cost of keeping cattle and generate revenue for non-stockowners are seldom observed in KwaZulu. In planned areas there are no property rights to grazing land and, in unplanned areas land rental arrangements are extremely risky (section 1.2.2) and individual efforts to rent sufficient grazing for commercial beef production are usually opposed by other stockowners who stand to lose a source of communal grazing (Khumalo, 1989).

Although a cohesive group of stockowners with restricted access to grazing land might invest in better breeds and pastures, the level of investment will be constrained by members who are either unwilling or unable to contribute to the programme. Despite high levels of subsidy afforded to stock improvement, herd composition in KwaZulu is poor. A sample survey conducted in Mabedlana and Ogwini, two of the KDA's four administrative regions, revealed that only one per cent of stockowners made use of the bull breeding scheme and that bulls comprised more than 20 per cent of herds surveyed

(Tapson, 1985). Only three groups producing improved bulls have been identified, all in Ogwini (Keating, 1989; Le Roux, 1989). Khumalo (1989) cites several instances of groups purchasing improved bulls in Mabedlana but emphasised the tendency for individual group members to purchase their own bull. There is very little evidence of improved pasture or fodder crop production on common grazing land in KwaZulu despite relatively high livestock mortality and low calving rates. However, a meeting held for livestock farmers in the Umzansi administrative region during December 1988 attracted a significant number of dairy, stud and beef producers growing fodder crops on their own and hired land allotments. Of eight farmers who volunteered information about their operations, six expressed difficulties obtaining additional land. A similar situation exists in Ogwini where attempts to improve pastures are confined to stockowners' own land allotments (Keating, 1989).

These observations suggest that few productivity improvements have occured on Kwazulu's commons and that existing stockowner institutions have not been able to treat all aspects of the common property problem - possibly because group cohesion is limited by a high degree of access to grazing resources.

2.3 A summary of important economic variables influencing crop and livestock production in rural KwaZulu.

This section summarizes (a) economic variables expected to

impact significantly on household resource allocation in rural KwaZulu, and (b) anticipated directions of responses to changes in these variables.

The following economic variables are considered to be important determinants of household resource allocation in respect of cropping activities in rural KwaZulu:

(a) Off-farm wage rates. A **ceteris paribus** increase in expected net wage (remittance) rates will raise the opportunity cost of time spent in crop production and is likely to attract marginal household farm workers into wage employment. Average household welfare is expected to increase. The impact on crop production is not clearcut. On the one hand, crop output is expected to fall as farm labour is diverted to wage employment (unless the marginal product of time in crop production is close to zero). A reduction in on-farm labour could also influence the technical efficiency of household workers engaged in farm work and management in an adverse way (section 1.2.3). Lyster (1987:134) found that surplus production was negatively associated with wage employment of key decision makers in rural households sampled in the Vulindlela district of KwaZulu. Furthermore, household workers may take more leisure if the income effect of higher wage earnings is sufficiently large. On the other hand, crop production need not decline following an increase in remittance rates. Land and market inputs may be substituted for household labour in crop production,

households may adopt farming techniques that require less labour per unit output, and household liquidity will improve.

A **ceteris paribus** decrease in expected off-farm net wage rates should produce opposite effects, i.e. reduced household welfare and a probable increase in the level and intensity of labour used in crop production. Changes in expected real net wage rates could result from changes in off-farm wage rates, commuting costs (defined as all 'after remittance income'), unemployment levels or job skills.

(b) Product prices. For deficit food producers, a **ceteris paribus** increase in the farm-gate and retail price of food will reduce real household income and welfare. The price increase is expected to induce a transfer of marginal household management and labour time from non-farm to farm work, and to encourage deficit producers to substitute own production for purchased food. However, the outcome could be influenced by (1) reduced consumption of the food in question, (2) the supply of other resources (eg. land and capital), (3) substitution of market inputs (including hired farm labour) for household time, (4) the adoption of new technology (eg. high-yielding varieties), and (5) changes in the amount of leisure consumed by household workers. Leisure consumption is expected to fall as the price increase raises the opportunity cost of leisure (substitution

effect) and lowers real household income (negative income effect).

Surplus producers benefit from the price increase. A transfer of marginal household time from non-crop activities to crop production is expected but the outcome will be influenced by considerations like those listed in the previous paragraph. In this case, household liquidity will improve and food consumption could increase if the profit effect is sufficiently large. The own price elasticity of demand for agricultural commodities was estimated to be positive for households sampled in Taiwan, Malaysia, Korea and northern Nigeria (Singh, et al., 1986:26). In KwaZulu, where farm profits constitute a relatively small part of full income, the own price elasticity of demand for food staples in surplus producing households is estimated to be negative (Nieuwoudt and Vink, 1988). In the former studies, and in studies conducted in Japan, Thailand and Sierra Leone (Singh, et al., 1986:25), the profit effect also increased household leisure consumption. The implication is that, unless the market supply of hired farm labour is price elastic, farm wages will rise and dampen the price elasticity of product supply. In KwaZulu, farm wages are not likely to rise significantly following an increase in product prices because (1) derived input demand for farm labour is expected to be elastic (section 2.1.4), (2) total household labour input in farming is expected to

increase with increased agricultural earnings (section 2.1.3), (3) the market supply of farm labour is expected to be price elastic (section 2.1.3), and (4) households are not expected to consume more leisure during peak production periods. Extra leisure demanded may be consumed during slack periods (Upton, 1987:72) and the substitution effect of a product price change will most likely exceed the combined profit and real income effect as the income elasticity of demand for money savings and consumer goods (eg. clothing and durables) is very high in rural KwaZulu (Nieuwoudt and Vink, 1988).

The notion that farm wages are unresponsive to changes in product price does not imply that product supply in KwaZulu will be price elastic. On the contrary, supply is expected to be price inelastic. Farm sizes are so small that even a substantial increase in product prices is unlikely to raise farm profits (or the value of subsistence production) by an amount large enough to attract the interest of more skilled household workers engaged in wage emplomment. In Scandizzo and Bruce's (1980) survey of supply elasticity estimates for major food staples in 103 developing countries, 62 per cent of the long-run elasticities were less than 0,5 and 27 per cent were negative. Reliable econometric evidence on supply response for food staples is scant for most African countries (Weber et al., 1988), but Martin's (1988) simulation analysis shows that even a 100 per cent

increase in cereal prices would only increase the degree of (cereal) self-sufficiency by eight percentage points, from 47 to 55 per cent in Senegal.

In summary, a **ceteris paribus** increase (decrease) in the price of food is expected to lower (raise) average household welfare as most households in rural KwaZulu are deficit food producers, but is not expected to have a substantial impact on food production.

Retail and farm-gate food prices could move in different directions. For example, an increase in the South African bread subsidy would benefit both deficit and surplus wheat producers in rural KwaZulu insofar as it lowers local retail prices and raises local farm-gate prices. A reduction in transport costs could have a similar effect. Changes in market forces and market intervention in South Africa, and changes in factors contributing to real marketing costs in rural KwaZulu (eg. road infrastructure) are perhaps the most important sources of change in local food prices.

(c) Prices of market inputs used in crop production. A **ceteris paribus** decrease in market input prices would benefit all households producing crops for own consumption or market purposes. A transfer of marginal household labour and management time from non-crop activities to crop production is expected but market inputs will most likely be substituted for household

labour in crop production. Unless arable land is already fully utilized, crop deficits should diminish and quantities marketed should increase. Singh, et al. (1986:28) report empirical predictions that a decrease in fertilizer prices will increase farm output in various Asian countries. However, large supply responses are not anticipated in KwaZulu (see point b). The response estimates reported by Singh, et al.(1986:28) also suggest that household labour supply will diminish when fertilizer prices decrease. Again, this outcome is not expected in KwaZulu and it is unlikely that farm wages will increase significantly (see point b). A **ceteris paribus** increase in market input prices is expected to produce opposite effects, i.e. diminished welfare for all households, increased food deficits and reduced crop sales. Sources of change in market input prices would be similar to those influencing product prices in KwaZulu, but would include changes in local credit, tractor hire, extension, irrigation, fencing and contouring programmes.

(d) Technology. It was noted in section 2.1.4 that many rural households in the less developed regions of Southern Africa have little incentive to produce crops as they can acquire food and income at lower cost by diverting household labour into wage employment. In the absence of a land rental market, large areas of arable land lie fallow and land is seldom cropped intensively. A preference for on-farm technology that reduces the

average cost of producing subsistence goods primarily through savings in time and effort is consistent with these circumstances. It is well known that households in these regions consider the provision of domestic water and fencing for grazing lands to be important priorities in development projects (Gibbs, 1988:34 ; Low, 1986:150). Knight and Lenta (1980) provide evidence suggesting that subsistence farmers in South Africa have substituted ploughs, cultivators, planters and tractors for labour.

Households will only adopt technology if they expect it to improve their welfare. Given prevailing incentives in rural KwaZulu, households are more likely to adopt farm technology that reduces the full cost of procuring food and income than technology which only increases output per hectare. Sample surveys conducted in KwaZulu indicate that less than 13 per cent of households in rural areas close to urban employment centres plant high-yielding maize varieties (Lyne, 1981:127; Lyster, 1987:72). In rural areas more distant from job centres, the proportion of households using improved maize seed is higher. Lyster (1987:105), reports an estimate of 39 per cent for households in the Usuthu ward. Returns to household time invested in sugar-cane and timber production are relatively high and these crops have been well received by farmers in KwaZulu. The overall impact of technology adoption on crop production ought to be similar to that anticipated for a real decrease in market input prices.

Food deficits are expected to diminish and sales should increase. Unfortunately, typical time-saving farm innovations available in South Africa usually involve a scale bias and cannot be employed effectively on small farms.

(e) Land rental market. If unutilized arable land could be rented (by residents of KwaZulu) households short of land could reduce their average crop production costs by purchasing variable inputs in bulk and by spreading fixed costs associated with management, labour and information inputs over much larger volumes of output. In this case, levels of resources used in crop production and total farm output are expected to increase. Should arable land become limiting, preferences may shift from from time-saving to land-augmenting technology. The welfare of all households participating in the rental market is expected to increase as participation is voluntary (section 4.1.3). In circumstances where the economic benefits conferred by rural land rights are elsewhere more expenive or unobtainable, minimizing the risk that potential lessors bear of losing their land right is essential for an active land rental market.

Not mentioned in points a - e are the effects of lumpy labour inputs, seasonal production, multiple farm products, income risk and variations in demographic and agronomic variables on household resource allocation. Chapter 3 describes an attempt to quantify household and aggregate responses to

changes in key economic variables when some measure of these effects is taken into account.

With regard to the utilization of grazing land, an increase in the cost of keeping cattle relative to their perceived value is expected to reduce overstocking (section 2.2.1). The private costs of keeping cattle are low primarily because the opportunity cost of grazing land is low and because the cost of resource degradation (reduced future income) is largely externalized. In some parts of KwaZulu, the introduction of sugar-cane and timber has raised the opportunity cost of land used for grazing and reduced stocking rates (Tapson, 1985:Table 29; Stewart, 1989). Privatization of grazing land would improve incentives to invest in long-term improvements and would internalize the cost of resource degradation (to a greater or lesser extent depending upon the degree of privatization) on land controlled by stockowners. The private costs of keeping cattle would also increase if stockowners compete to rent grazing land controlled by non-stockowners. In this case, income would be transferred from (wealthier) stockowners to other (less fortunate) households. A reduction in the perceived value of cattle relative to the cost of keeping them will also reduce stocking rates. Doran et al. (1979:45) argue that herd sizes decreased after the Kikuyu obtained indivdual ownership rights to agricultural land because land "replaced cattle as the desired symbol and store of wealth". As noted in section 2.2.2, other methods of reducing overstocking may be appropriate depending on whether

or not access to grazing is restricted to specific groups of stockowners. Discussion of policy options and their effect on farmer incentive is deferred to section 4.2..

Chapter 3

Predicted responses to changing economic incentives in rural KwaZulu

This chapter describes an attempt to predict resource allocation, crop production and household welfare responses to changes in economic incentives using a mathematical programming model. The model aggregates enterprise levels predicted for four representative households of which two are located in areas of high cropping potential and two in areas of low cropping potential. Projected responses to changes in product and input prices, off-farm employment levels and certain institutional variables are discussed in section 3.3. Section 3.1 focuses on the representative household models and section 3.2 describes the aggregate or regional model.

3.1 The household programming models.

3.1.1 Modelling approach. Approach

In section 2.1.3 it was noted that the Barnum-Squire model of a farm household is not suited to studies where interest centres on the details of production. The empirical models presented in this chapter have more in common with Low's household economics theory and are solved using mathematical programming. This technique, like Low's model, has the allocation of resources between competing activities as its

central theme.

To some extent, the effects of risk and leisure preferences, lumpy labour inputs, resource constraints, factor substitution, seasonal production and regional differences in agronomic conditions on household profit maximizing resource allocation are accounted for in the programming models. It is assumed that employment decisions made by individual workers are consistent with the wishes of other household members (section 2.1.4). Consequently, remittances, rather than wages, are used as the criterion for allocating household workers with different wage earning potentials to off-farm employment activities (including wage work on the farm labour market). Household food consumption requirements are specified as minimum constraints, but the minimum requirements are allowed to vary with the number of workers allocated to off-farm employment. The effects of income changes on household food and leisure consumption are ignored. Although it is possible to express food and leisure consumption as functions of household income in a programming model, Hazell and Norton (1986:65-71) show that this procedure invokes the restrictive assumptions normally associated with separable models (eg. perfect substitution between household and hired farm labour, perfect substitution between farm produced and market purchased goods, and the absence of risk or risk aversion). The omission of profit effects resulting from an increase in farm product prices is not expected to have a significant influence on predicted

(aggregate) levels of leisure and food consumption as the majority of KwaZulu's rural households are deficit producers. For surplus producers, it is unlikely that real income and profit effects caused by a relative increase in product prices will significantly dampen the incentive to substitute work for leisure during peak production periods as leisure may be deferred to slack periods and the income elasticity of demand for cash savings and consumer durables is high (section 2.3, point b). Likewise, real income and profit effects resulting from a decrease in market input prices are not expected to have a significant influence on farm labour supply in surplus or deficit producing households.

3.1.2 Household data source.

Although the results of several household surveys are presented in Chapter 1, observations on all the demographic variables used in this analysis were recorded only in the study undertaken by Stewart and the author between November 1985 and February 1986 (Stewart and Lyne, 1988). A total of 193 households were sampled, 132 in an area of high cropping potential and 61 in an area of low cropping potential. Household members were sub-sampled in full at each selected household. In this way observations were recorded for 1169 individuals in the high potential area and 616 in the low potential area (a copy of the questionnaire is presented in Appendix E). Despite their agronomic differences, the study areas are contiguous and workers in each have similar access

to off-farm wage employment.

3.1.3 Household types.

Two household types (Type 1 and Type 2) were identified in the area of high cropping potential (Region 1) using cluster analysis. Sample households with a relatively large proportion of their members and workers (healthy individuals aged 16-59) capable of earning 'high' off-farm wages were classified as Type 1. Conversely, households with a relatively small proportion of their members and workers capable of earning 'high' off-farm wages were classified as Type 2. These ratios were selected as criteria for clustering as they are expected to influence household resource allocation through their effect on both the 'consumer:worker' ratio and the shape of the 'wage (or remittance) line' (Section 2.1.4). The same procedure was used to identify household types (Type 3 and Type 4) in the area of low cropping potential (Region 2). Statistical results of the cluster analyses are presented in Table 3.1.

Mean resource characteristics of the four household types are listed in Table 3.2. Although the observed mean number of off-farm wage workers does not vary between the four household types identified, it is clear that the first household type in each region (Type 1 and 3) has greater wage earning potential, fewer dependents (children), and slightly more arable land than its counterpart.

Table 3.1 Results of cluster analyses performed on household sample data recorded in two regions of KwaZulu.

Household	Region 1 Standardized cluster centres Type 1 (n = 66)	Type 2 (n = 66)	F value	Region 2 Standardized cluster centres Type 3 (n = 25)	Type 4 (n = 36)	F value
'High' income workers per household member	0,734	-0,731	150,6**	0,903	-0,621	77,9**
'High' income workers per household worker	0,772	-0,844	239,9**	0,978	-0,709	136,4**

Note ** Implies significance at the one per cent level of probability.

Table 3.2 Mean resource characteristics of four household types identified in two regions of KwaZulu.

Household	Region 1 Type 1 (n=66)	Type 2 (n=66)	Region 2 Type 3 (n=25)	Type 4 (n=36)
Children (<16 yrs)	3,92	4,7	4,2	5,0
Pensioners (>59 yrs) and disabled persons	1,2	1,1	1,4	1,5
Workers with 'low' wage earning potential[1]	1,5	3,0	2,0	3,5
Workers with 'high' wage earning potential[1]	2,0	0,5	2,0	0,5
Observed wage workers[1]	2,0	2,0	2,0	2,0
Observed arable land (m²)	10613,0	9905,0	7380,0	7131,0

Note 1 Workers rounded to nearest 0,5 as these individuals were modelled using integer activities.

In order to cluster the households, wage earning potentials ('offer' wage rates) had to be predicted for household

workers not wage employed. In offer wage models (Mincer, 1974) where some members of the workforce do not engage in wage employment, the dependent variable (wage) is observed only in a limited range (wage > 0) with the result that ordinary least squares (OLS) regression estimates of the model may not be unbiased and consistent. The model can be written as:

$$Wi = aXi + \mu i$$

where:

Wi = offer wage of the ith wage employee.

Xi = a vector of personal attributes (eg. education and work experience) of the ith wage employee.

μi = a random variable, $N.D.\approx(0,\sigma^2)$.

It is usually assumed that wage employees participate in the wage market because their offer wages exceed their reservation wages. Contrariwise, the offer wages of non-participants are assumed to fall short of their reservation wages. The reservation wage depends upon an individual's opportunity cost of engaging in wage employment and his or her preference for leisure and the type of work involved (Ryan and Wallace, 1985). That is:

$$RWi = bYi + vi$$

where:

RWi = reservation wage of the ith wage employee.

Yi = a vector of attributes affecting the opportunity cost and preferences (eg. age, education, farm size and number of dependents) of the ith individual.

vi = a random variable, $N.D.\approx(0,\sigma^2)$.

In this case the probability of engaging in wage employment is determined by the probability that Wi > RWi or:

$$Pr\ ((aXi - bYi)/\sigma > z)$$

where σ is the standard deviation of $(\mu i - vi)$ and z is a standardized normal deviate. If μi and vi are jointly normal, participation in wage employment may be analysed using a probit model with the dependent variable set to one for participants and zero otherwise, and explanatory variables drawn from both Xi and Yi (Ryan and Wallace, 1985).

To avoid sample selectivity bias which may arise when the offer wage model is estimated using OLS, Heckman (1979) recommends inclusion of the intensity ratio (Gumbel, 1958) as an additional explanatory variable. The intensity ratio (δ) is computed as:

$$\delta = \phi(Z)/\Phi(Z)$$

where ϕ and Φ are the density and cumulative distribution of a standard normal variable and Z is an index calculated from the probit function (Heckman, 1979) so that δ is a monotone decreasing function of the probability that a worker is selected into the sample of wage employees. If sample selectivity bias exists, the OLS regression coefficient estimated for δ will be statistically significant and the coefficients estimated for the other explanatory variables in the model will be consistent. If selectivity bias is not present, δ will not be statistically significant and may therefore be excluded from the model. Results of probit and semi-log offer wage equations estimated from the sample data

are presented in Tables 3.3 and 3.4 respectively. The data were pooled as no significant slope or intercept differences were detected between regions.

Variables included in the models are self explanatory with the exception of PDEP, a measure of dependency, used in the probit functions. For females, PDEP represents the number of children under 16 years of age expressed as a fraction of all household members. For males, the numerator of the ratio was increased by one to account for a housekeeper. It was expected that beyond some critical level of PDEP, reservation wages would exceed offer wages (particularly for women) owing to increasing child care needs at home. Results of the probit analysis appear to support this argument. Participation in the wage market also follows a quadratic age pattern, peaking at 36 years for women and 59 years for men. This finding is

Table 3.3 Probit analysis of the off-farm wage employment decision by male and female workers sampled in two regions of KwaZulu.

Explanatory variable	Unit	Men coefficient	Men t-statistic	Women coefficient	Women t-statistic
Intercept		-1,9199	1,82	-3,6539	3,98
EDUCATION	school years	0,0525	2,53	0,0709	3,32
AGE	years	0,0731	1,46	0,1079	2,14
(AGE)^2		-0,0006	-0,89	-0,0015	-2,08
PDEP		1,5234	0,71	4,4709	2,22
(PDEP)^2		-1,3231	-0,57	-6,0767	-2,26
ln(LAND)	hectares	-0,2885	-3,16	-0,0732	-0,85
Residual deviance		348,81		377,76	
Residual DF		322		360	
Valid cases:					
not wage employed		105		295	
wage employed		224		72	

consistent with the contention that as migrant workers age, their comparative advantage in wage employment decreases relative to that of younger household members (Low, 1986:126).

The OLS estimates (& being statistically insignificant in both Heckman equations) presented in Table 3.4 were used to predict offer wages for workers that were not wage employed and as substitutes for missing wage observations. High R^2 values were not considered essential as predicted wages were only used to assign non-wage employed workers and workers with missing wage observations to either a 'high' or 'low'

Table 3.4 Offer wage equations for employed males and females sampled in two regions of KwaZulu.

	Dependent variable = ln(monthly wage)			
Explanatory variable+	Men		Women	
	Heckman	OLS	Heckman	OLS
Intercept	3,4829	3,7975	3,5382	3,2541
	(8,65)**	(14,33)**	(4,72)**	(12,37)**
EDU	0,0934	0,0788	0,1002	0,1138
	(4,34)**	(4,82)**	(2,61)**	(6,15)**
EXPERIENCE++	0,0936	0,0849	0,0415	0,0483
	(4,50)**	(4,46)**	(1,47)	(2,13)*
(EXPERIENCE)^2	-0,0014	-0,0014	-0,0006	-0,0007
	(-3,88)**	(-3,75)**	(-1,07)	(-1,49)
&	0,2979		-0,0572	
	(1,04)		(-0,41)	
R^2	0,30	0,29	0,38	0,38
F value	9,40**	12,16**	9,41**	12,66**
Valid cases	94	94	66	66

Notes + t-statistics given in parentheses.
++ EXPERIENCE = AGE - EDUCATION - 6.
** Implies significance at the one per cent level of probability.
* Implies significance at the five per cent level of probability.

wage group. The R^2 values nevertheless compare favourably with values reported in similar studies by Rosenzwieg (1984), Chernicovsky et al. (1985) and Sumner (1982).

According to the OLS results, an extra year of schooling adds approximately eight per cent to the monthly wage of men and 11 per cent to the monthly wage of women. These 'returns to education' are similar to estimates of 9,6 and 8,7 per cent computed for a sample of men and women on farms in Saskatchewan (Furtan et al., 1985). Chernicovsky et al. (1985) measured returns of approximately 17 and 16 per cent for men and women residing in rural Botswana but their estimates may contain sample selectivity bias.

The wage rate separating 'high' and 'low' wage earners was set at the median value of predicted and observed monthly wage rates, viz. R160 in Region 1 and R165 in Region 2 (1985=100). As was hypothesized, the vast majority (more than 90 per cent) of workers not wage employed had predicted offer wage rates less than the median value in each region. In Region 1 the mean 'high' and 'low' off-farm wage rates were computed as R276 and R91 per month respectively. The corresponding estimates for Region 2 were computed as R251 and R87 respectively. It was anticipated that the mean offer wage rates in Region 2 would be lower than those in Region 1 because the opportunity cost of wage employment is lower for members of households located in areas of poor cropping potential.

For the programming models, it was assumed that (a) cash income accruing to a household derives from cropping activities, welfare payments and 'net' wage remittances (i.e., remittances net of food and travel expenses incurred by wage workers at their rural homes), and (b) off-farm wage workers provide for all of their own consumption requirements out of non-remitted wage income. A double-log OLS net remittance equation was estimated from observations on migrant workers to predict 'high' and 'low' net remittances corresponding to the mean 'high' and 'low' wage rates computed for each region. The net remittance equation is presented in Table 3.5.

Table 3.5 OLS remittance equation estimated for migrant workers sampled in two regions of KwaZulu.

Explanatory variable*	Dependent variable = ln(monthly remittance)
Intercept	0,6168
	(1,56)
ln(monthly wage)	0,6840
	(8,90)**
Adjusted R^2	0,44
F value	79,17**
Valid cases	102

Notes + t-statistics given in parentheses.
** Implies significance at the one per cent level of probability.

In Region 1 the 'high' and 'low' monthly net remittances were estimated to be R86 and R41 respectively, and in Region 2, R81 and R39.

3.1.4 Structure of the household programming models.

3.1.4.1 Representative households.

Four household programming models were formulated, one representing each household type (cluster). Households within a cluster were expected to have resource levels roughly proportional to their group mean because the criteria selected for clustering reflect human resource endowment ratios (section 3.1.3). In less developed Southern Africa, farm sizes tend to be positively correlated with household size (Low, 1986:32). Since resource proportionality reduces aggregation bias (Day, 1963), representative households were synthesized from the group means (Table 3.2). Minimization of aggregation bias also requires that households within a group (cluster) exhibit 'technical homogeneity' and 'pecunious proportionality' (Buckwell and Hazell, 1972). These requirements are best met by initially sorting farm households according to agroclimate and product type, which approach was adopted in this study (Regions 1 and 2).

3.1.4.2 Work and leisure preference activities.

Hazell and Norton (1986:65-66) suggest that leisure time sacrificed for work be costed in the objective function with the cost per unit time increasing as more leisure is sacrificed. In their linear programming example they achieve this by dividing the stock of household time available for

work and leisure into segments bearing successively higher unit charges (0,40W; 0,60W; etc. where W is the cost of hired farm labour) for time allocated to work.

A similar approach was adopted in this study except that the household's stock of on-farm work and leisure time was allowed to vary inversely with the number of migrant wage workers. Leisure preferences of migrant workers were not considered. It was assumed that the estimated wage remittances employed in the models would reflect these preferences. The planning period (one year) was separated into four production periods of equal length (Appendix B, Table B.1.3).

Workers were assumed to be equally efficient in crop production. The observed hourly hire rate (W) for farm labour in the survey area was R0,375 (buying price), of which R0,21 (selling price) was remitted to the labourer's family. On-farm time available for work and leisure (in each production period) was divided into four equal segments. Time applied to household cropping activities (or sold on the local farm labour market) was charged at an increasing rate, starting at R0,15 (0,40W) for each hour of work drawn from the first segment and rising to R0,30 (0,80W) for each hour of work drawn from the fourth segment. Work time drawn from the first two segments was charged at a rate lower than the selling price of farm labour as some households do sell labour on the local market (section 2.1.4).

Table 3.6 illustrates these issues and highlights the inclusion of integer activities (representing workers and 'half' workers) to ensure a unique choice between migrant and farm related occupations. A mixed linear and integer programming algorithm was used to solve the programming problems (FMPS 1981).

3.1.4.3 Cropping and food consumption activities.

Four crops were considered in Region 1, viz., cereals (mainly maize), legumes (mainly dry beans), roots (potato, sweetpotato and madumbi) and sugar-cane. In Region 2, only cereals and legumes were considered. Factor substitution was made possible by modelling all crops, excluding sugar-cane, at two levels of technology, 'traditional' and 'potential'. Relative to traditional crops, potential crops (high-yielding varieties) yield more output per unit land, combine labour and market inputs in different proportions and generally involve greater risk bearing. Estimated crop yields, production costs and seasonal labour requirements are presented in Appendix B, Tables B.1.1 - B.11.3. The data sources are indicated in section 3.1.4.4.

Crop rotation constraints ensured that no field would produce a root crop more than once in three consecutive years, or a legume crop in succesive years. Livestock production activities were excluded from the models as they were not expected to have a significant influence on

Table 3.6 A mini-tableau for labour activities.

	Integer activities for a worker with 'low' wages			Household farm labour supply (hrs)			Household work time segments								Total household work (hrs)				Hiring farm labour (hrs)			Selling farm labour (hrs)			Off-farm employment with 'low' wage	Cereal growing (ha)	RHS
					Period		Period 3				Period 4								Period			Period					
	On-farm	Off-farm	Child	Total	3	4	s1	s2	s3	s4	s1	s2	s3	s4	S1	S2	S3	S4	3	4	(3+4)	3	4	(3+4)			
Worker 1	1	1																									= 1
Children			1																								= 3,9
On-farm labour	-1825[1]			1																							= 0 (hrs)
Off-farm labour		-1																							1		= 0 (migrants)
Farm labour - period 3				-1	4																						= 0 (hrs)
Farm labour - period 4				-1		4																					= 0 (hrs)
Period 3 - segment 1					-1		1																				≤ 0 (hrs)
Period 3 - segment 2					-1			1																			≤ 0 (hrs)
Period 3 - segment 3					-1				1																		≤ 0 (hrs)
Period 3 - segment 4					-1					1																	≤ 0 (hrs)
Period 4 - segment 1						-1					1																≤ 0 (hrs)
Period 4 - segment 2						-1						1															≤ 0 (hrs)
Period 4 - segment 3						-1							1														≤ 0 (hrs)
Period 4 - segment 4						-1								1													≤ 0 (hrs)
Crop labour restraint-period 3							-1	-1	-1	-1									-1			1				0	= 0 (hrs)
Crop labour restraint-period 4											-1	-1	-1	-1						-1			1			105	= 0 (hrs)
Segment 1 - total work							1				1				-1												= 0 (hrs)
Segment 2 - total work								1				1				-1											= 0 (hrs)
Segment 3 - total work									1				1				-1										= 0 (hrs)
Segment 4 - total work										1				1				-1									= 0 (hrs)
Hired farm labour																			1	1	-1						= 0 (hrs)
Sold farm labour																						1	1	-1			= 0 (hrs)
Cereal requirements - summer	51,75		23,53																								
Cereal requirements - autumn	51,75		23,53																								
Cereal requirements - winter	51,75		23,53																								
Cereal requirements - spring	51,75		23,53																								
Net revenue															,15	-,19	-,24	-,30	-,375			,21			488	-200	Max! (Rands)

Note 1 Implies approximately 7,5 hours per work day for crop production and leisure (Ellis,1988:172-173).

household decisions regarding the use of labour and arable land. Observed mean herd sizes are small (ranging from 1,8 for household Type 2 to 4,8 for household Type 3), herding duties are generally performed by children and households have access to communal grazing.

Household food consumption requirements were specified as seasonal minimum constraints but the minimum subsistence requirement in each season was allowed to vary inversely with the number of off-farm wage workers. Table 3.7 lists the estimated subsistence needs of household members and the periods during which farm produced food crops are available for consumption purposes.

Table 3.7 Estimated consumption requirements and periods of home grown food availability.

Particulars	Cereals	Legumes	Roots
Requirement/person/season (Kg)[1]			
Workers	51,75	5,52	9,20
Pensioners and the disabled	37,95	5,52	8,05
Children	23,53	4,77	3,12
Season available[2]			
January-March (Summer)	Yes	No	Yes
April-June (Autumn)	Yes	Yes	Yes
July-September (Winter)	Yes	No	No
October-December (Spring)	Yes	No	No

Notes 1 Average age and sex distributions observed within Gcumisa sample households were employed in computing the food requirements.
2 According to Melis (1988). Root crops were not considered in Region 2.

Source Gopalan et al. (1985).

3.1.4.4 Risk preferences and the objective function.

Evidence suggests that farmers behave in a risk averse manner (Young, 1979). Neglect of risk in programming models can lead to considerable overstatements of the size of risky enterprises, specialized cropping patterns, biased estimates of commodity supply elasticities, overestimation of the value of resources and the incorrect prediction of technology choices (Hazell, 1982). Consequently, an attempt was made to account for the effects of income risk resulting from unstable crop yields and prices. Four measures of income risk were tested in the model representing Type 1 households; (a) a linear approximation of the expected gain-confidence limit (E,L) criterion suggested by Baumol (1963) which produces a subset of the solutions generated by MOTAD's (E,V) criterion (Hazell and Norton, 1986:86-91), (b) the Wald maximin (E,M) criterion (McInerny, 1969), (c) the Savage regret or minimax (E,R) criterion (Hazell, 1970) and (d) a linear approximation of the 'sumex' utility function criterion (Patten and Hardaker, 1987). Target MOTAD, Focus-loss and other Safety-first criteria which would have entailed imposing a subjective target or minimum income for the household were not considered.

Programming models with objective functions that include measures of farm income risk require time series revenue observations as input data. Local sugar-cane yield and price information for the ten year period 1974-1983 was obtained

from the South African Sugar Association (Bates, 1988). Unfortunately, comparable data for food crops were not available and had to be estimated.

Yields of representative crops (maize, dry beans and potatoes) were predicted from OLS regression equations expressing per hectare yield as a quadratic function of rainfall measured over the crop's growing period (Appendix C, Table C.1). The regression equations were estimated from observations recorded at crop trials conducted under commercial (i.e. potential) and traditional management practices. Rainfall amounts measured over growing periods during the years 1974-1983 at stations close to the sample survey areas were substituted into the estimated equations to predict annual per hectare food crop yields. No significant trends were detected in the estimated yield series.

Local farm gate and retail prices of food crops were computed for the years 1974-1983 from prices paid to commercial farmers in Natal (Directorate Agricultural Economic trends, 1989). It was assumed that local:Natal price ratios observed at the time of the survey (1985) reflected price relationships during the period 1974-1983. Prices were deflated using the South African consumer price index (Directorate Agricultural Economic Trends, 1989) with 1985=100. No significant trends were detected in real crop prices. Yields, prices and raw data sources are listed in Appendix B.

Maximin solutions to the household programming model were obtained by maximizing M + (A - B) subject to a paramaterized expected net income (E) constraint where:

M = largest total net crop income (excluding family labour costs) in the worst of the ten years considered.

A = off-farm income.

B = family labour costs plus other costs not accounted for in calculating net crop incomes (eg. maize milling and food purchasing costs).

Minimax solutions were obtained by maximizing (A - B) - R subject to a parameterized expected net income (E) constraint where:

R = regret (i.e. the largest deviation from deterministic linear programming solutions for farm net crop income, excluding labour costs, over the ten years), and A and B are as defined for the maximin criterion.

In contrast to these game theory approaches, Baumol's E,L criterion involves maximization of expected crop income (E) for given levels of $L = E - \sigma\theta$ where σ $(=\sqrt{V})$ is the standard deviation of E, and θ is a risk aversion parameter. A popular adaptation of the E,L criterion, and the approach used in this investigation, is to assume that the household maximizes L for given levels of θ (Hazell and Norton, 1986:92-93). Like the E,V criterion, E,L implies that household utility (U) is a quadratic function of income or that crop incomes are normally distributed.

These assumptions are not invoked if the model is solved maximizing a linear approximation of the 'sumex' utility function (Patten and Hardaker, 1987):

$$U = 1 - e^{-aE} + S(1 - e^{-bE}) \text{ with } a,b \text{ and } S > 0.$$

Where:

E = expected net crop income.

a = anticipated upper limit of household absolute risk aversion.

b = anticipated lower limit of household absolute risk aversion.

S = a non-negative parameter.

For the purpose of this investigation, solutions were generated for different values of household absolute risk aversion (r_a) by maximizing approximate U at various levels of S (when S = 0, r_a= a and when S approaches infinity, r_a approaches b).

A comparison of the predicted and actual solutions revealed that Baumol's E,L criterion provided the best results (Lyne et al., 1989) and it was decided to use this measure of risk in the other household programming models. Although quadratic utility implies positive marginal utility only within a bounded range (Hanoch and Levy, 1970) and increasing absolute risk aversion (Arrow, 1965:35), Tsiang (1972) has argued that the E,σ criterion (and hence the closely related E,V and E,L criteria) is a good approximation to more desired decision criteria if the risk taken is small relative to the total wealth of the farmer. This condition is not unreasonable in

KwaZulu where farm income usually comprises less than ten per cent of de facto household income (section 1.2.4).

The objective function employed in the household programming models can be written in full as:

$$\text{Max } L = [P'(YX-Z)]_i + [I'O]_i - [C'X]_i - [W'H]_i - [F'N]_i - \theta_i[X'\Omega X]_i^{0.5}$$

where:

$[P'(YX-Z)]$ = crop income, P being a vector of unit product prices, Y a diagonal matrix of per hectare yields, X a vector of hectares and Z a diagonal matrix of own consumption.

$[I'O]$ = off-farm income, I being a vector of welfare payments and net remittances per recipient and O a vector of off-farm workers and welfare recipients.

$[C'X]$ = total market production costs, where C is a vector of per hectare production costs excluding family labour.

$[W'H]$ = family labour costs, H being a vector of hours worked and W a vector of (rising) hourly time charges.

$[F'N]$ = purchased food costs, F being a vector of unit food prices and N a vector of food purchases.

θ_i = is an aggregate 'risk aversion' coefficient for all households in homogenous group (Type) i.

Ω = is a variance-covariance matrix of per hectare crop incomes, so that $[X'\Omega X]$ represents variance in crop income.

Variance-covariance matrices were approximated for each region using the (linear) Mean Absolute Deviation (MAD) approach described by Hazell (1971) and Hazell and Scandizzo (1974). The term $[X'\Omega X]^{0.5}$ was replaced with its MAD estimator,

$$Est(X'\Omega X)^{0.5} = \frac{\sqrt{\Pi}}{T}\left(\Sigma_t \left|\Sigma_j (g_{jt} - \bar{g}_j) X_j\right|\right)$$

where $\Pi = T\pi/2(T-1)$ is a correction factor that converts the square of the mean absolute deviation to an estimate of the population variance assuming the population is normally distributed (Simmons and Pomareda, 1975). The term T represents the number of periods considered, $(g_{jt} - \bar{g}_j)$ the deviations from mean gross revenue for crop j and time period t, and π the mathematical constant.

3.1.4.5 Market assumptions for representative households.

The (market) demand for food crops produced in excess of own consumption requirements was assumed to be perfectly price elastic at 'urban' farm-gate prices (Appendix B, Table B.12). The supply of market inputs and purchased food was also assumed to be perfectly price elastic. However, areas of sugar-cane produced by household types 1 and 2 were constrained to be less than or equal to observed levels because production is restricted by quotas known locally as small grower entitlements (Bates, 1989). Demand for off-farm labour was treated as price elastic in both the 'high' and 'low' wage markets but the supply of off-farm workers was not

permitted to exceed the mean levels presented in Table 3.2. Land rental and local sales of farm labour were not considered as these markets are inactive (sections 1.2.2 and 2.1.4).

3.1.5 Results of the household programming models.

Solutions to the household programming models were generated for a range of risk aversion (θ) values. Table 3.8 presents predicted levels of key activities. These particular solutions were selected as they provided the closest fit, measured in terms of percentage absolute deviation (PAD), between predicted and actual crop areas.

Dillon and Scandizzo (1978) measured a mean θ value of 0,9 for a sample of farmers in northeast Brazil using 'mind experiments', and Brandao et al, (1984) report θ values of 0,9 and 1,2 for landlords and tenant farmers in Brazil. It would, however, be incorrect to compare these estimates with the optimum θ, presented in Table 3.8 as the latter are simply fine-tuning devices which not only capture the effects of risk but also the effects of model misspecifications (eg. the exclusion of fixed management and information costs, and the omission of capital constraints), data errors, and risk sharing (Hazell, 1982; Young, 1979).

Hazell and Norton (1986:271) regard a PAD of below five per cent as exceptional, below ten per cent as good and below 15 per cent as acceptable. In terms of these measures, the

predicted crop mixes appear to simulate actual crop levels reasonably well.

Table 3.8 Solution levels for key activities in the household programming models.

	Region 1				Region 2			
	Household Type 1		Household Type 2		Household Type 3		Household Type 4	
Activity	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
Optimum θ		2,64		2,66		0,85		0,85
Cereals: (Ha)								
Traditional	0,30	0,30	0,30	0,28	0,37	0,37	0,42	0,42
Potential	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Legumes: (Ha)								
Traditional	0,12	0,09	0,12	0,10	0,16	0,16	0,14	0,18
Potential	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Roots: (Ha)								
Traditional	0,12	0,14	0,08	0,15				
Potential	0,00	0,00	0,00	0,00				
Sugar-cane (Ha)	0,33	0,33	0,34	0,34				
Fallow (Ha)	0,15	0,16	0,12	0,09	0,15	0,15	0,14	0,10
Total (Ha)[1]	1,02	1,02	0,96	0,96	0,68	0,68	0,70	0,70
Migrant workers[2]	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
PAD (Ha)		3,9		14,6		0,0		11,4

Notes 1 Excludes other minor crops.
2 Observed numbers rounded to nearest 0,5.

A regional model constructed from the household programming models is described and validated in section 3.2. Aggregate responses to changing economic incentives projected by the regional model are presented in section 3.3.

3.2 The regional programming model.

3.2.1 Aggregation.

It was assumed (1) that all households in parts of KwaZulu similar to the (two) areas sampled could be grouped into the household types defined in section 3.1.3 without altering mean resource levels in the original groups (Table 3.2), and (2) that within each homogeneous region, the distribution of households across household types approximated the distribution observed in the samples. The northern districts of KwaZulu (Ubombo, Simdlangentsha and Ingwavuma) were excluded from the model as they differ significantly from the areas sampled in respect of population density and access to markets (Appendix D, Map D1). Districts included in the model account for almost 90 per cent of KwaZulu's arable land (Pym Goldby, 1988) and 92 per cent of its rural households (Table 3.9).

Table 3.9 Estimated household populations in each reasonably homogeneous area and in each household type (1985).

	Area modelled				Area excluded	KwaZulu
	High crop potential (Region 1)[1]		Low crop potential (Region 2)			
Household	Type 1	Type 2	Type 3	Type 4		
Households	108700	108700	65700	94600	34844	412544
Distribution in sample (%)	50 :	50	41 :	59		

Note 1 Region 1 = bioclimatic groups 1-4. Region 2 = bioclimatic groups 6-11.

Source KDEA (1986); Table 1.2 of chapter 1, and Table 3.2.

The representative household programming models were arranged in block diagonal form in the regional model (Table 3.10). Interfarm and interregional resource trade was effected by means of transfer rows (not shown in Table 3.10). Aggregate resource levels in each household type (D_i) were computed as the product of the representative (mean) household resource levels and the estimated number of households in the group. In total, the model comprised more than 500 rows and 600 columns including 43 integer activities.

Table 3.10 A partial mini-tableau for the regional model.

	Region 1						Region 2							
	Household Type 1						Household Type 4							
	Production	Consumption					Production	Consumption					Regional	
		own	buy	sales				own	buy	sales			purchases	rural sales
	X_1		B_1	local	urban	Sum_1	X_4		B_4	local	urban	Sum_4			RHS
Restraints 1	A_1														$\leq D_1$
Commodity balances 1	$-Y_1$	1	-1	1	1										≤ 0
Objective 1	$-C_{11}$		$-F_{11}$	P_{11}	P_{21}	-1									$=0$
Restraints 4							A_4								$\leq D_4$
Commodity balances 4							$-Y_4$	1	-1	1	1				≤ 0
Objective 2							$-C_{14}$		$-F_{14}$	P_{14}	P_{24}	-1			$=0$
Purchases			1						1				-1		$=0$
Rural sales				1						1				-1	$=0$
Local marketings													1	-1	≥ 0
Objective function						a_1						a_2			Max!

Optimum θ_i values estimated for the representative households (Table 3.8) were substituted into the regional model and solutions generated by maximizing the objective function:

$$\text{Max } L = \sum_{i}^{N} a_i \{[P'(YX-Z)]_i + [I'O]_i - [C'X]_i - [W'H]_i - [F'N]_i - \theta_i[X'\Omega X]_i^{\alpha,\beta}\}$$

where:

N is the number of homogeneous household types (four in this model), a_i is a weight to neutralize size differences between populations in each household type, and the other terms are as defined for the (E,L) objective function presented in section 3.1.4.4.

3.2.2 Market assumptions for the region.

Supplies of market inputs and purchased food were assumed to be perfectly price elastic at local prices as KwaZulu is a price-taker on South African markets. Market demand for food crops that fetch higher prices on local markets than on urban markets (Appendix B, Table B.12) was treated as a single-step function. Quantities of these crops sold locally were restricted to a level less than or equal to local purchases (Table 3.10). For other crops, market demand was assumed to be perfectly price elastic. Quantities of sugar-cane produced by Type 1 and Type 2 households in Region 1 (region of high cropping potential) were constrained to levels summing to an amount less than or equal to total output as production is restricted by quotas and mill location. Demand for off-farm labour was treated as price elastic in both the 'high' and 'low' wage markets but the supply of off-farm workers from each representative household was not permitted to exceed the mean levels presented in Table 3.2. Labour transfer rows

ensured that quantities of farm labour hired locally would equal quantities sold. Any farm labour hired in excess of this level was charged at a rate equivalent to the hourly earnings of off-farm workers in the 'lowest' wage category. Land rental was not considered in the initial or 'base' model as the prevailing tenure system precludes a land market (section 1.2.2). Section 3.3.5 reports the predicted effects of a restricted land rental market.

3.2.3 Validation of the model.

To validate a model it is necessary to have a set of base data against which the predicted results can be compared. Unfortunately there is neither a complete nor a reliable set of agricultural base data for KwaZulu. Nevertheless, comparisons were drawn where possible.

The base production data presented in Tables 3.12 and 3.14 reflect mean crop areas and yields computed from annual agricultural estimates reported during the period 1982-1985 (Maduna, 1986). Mean base data were used in making the comparisons as the model employed mean yield coefficients and mean prices with 1985=100. Some of the census figures were clearly unreliable and were excluded from the calculations. Table 3.11 presents average crop areas computed from (reasonable) census estimates reported for each of KDA's four administrative regions.

Table 3.11 Mean crop areas computed from KwaZulu census estimates (Ha).

Admin. Region	Cereals	Legumes	Roots	Sugar-cane	Other	Total
Umzansi (82/83-84/85)	45198	10185	4637	11902	7420	79342
Ogwini (81/82-84/85)	64972	5719	5013	31042	1963	108709
Mpandleni (81/82-83/84)	42840	851	616	0	137	44444
Mabedlana (81/82-84/85)	61590	4752	2363	652	4005	73362
KwaZulu	214600	21507	12629	43596	13525	305857
Less: Districts excluded[1]	24636	1901	945	0	2873	30355
Area modelled	189964	19606	11684	43596	10652	275502

Notes 1 Includes the districts of Ubombo, Simdlangentsha and Ingwavuma, or approximately 40 per cent of Mabedlana's total arable area.

Source Maduna (1986).

The annual census estimates take no account of fallow land or mixed cropping. Household surveys (section 1.2.1, Table 1.4) indicate that many 'maize lands' are intercropped, particularly in areas of lower agricultural potential. Using Stewart's (1986:28) sample survey findings as a guide, the aggregate area data (Table 3.11) were adjusted to account for mixed cropping. Crop areas predicted by the model are compared with the adjusted base areas in Table 3.12. It should be noted that the crop rotation constraints employed in the model (section 3.1.4.3) were not binding in the solution.

Table 3.12 Base (adjusted for mixed cropping) and predicted crop areas in the area of KwaZulu modelled (Ha)[1].

Land use	Base area	Predicted area
Cereals (traditional)	159383	129357
Legumes (traditional)	45685	48952
Roots (traditional)	15880	25815
Sugar-cane	45000	45000
Other	10652	12865[2]
Fallow	unknown	76908
Area utilized as arable	unknown	338897

Notes 1 The percentage absolute deviation (PAD) for areas of crops included in the model is 16,3.
2 Represents area under crops excluded from the model.

Predicted fallow land (76908 Ha) constitutes some 22,6 per cent of the estimated area utilized. This estimate compares favourably with Knight and Lenta's (1980) aggregate estimate of 27 per cent. Although the PAD computed for crop areas is slightly higher than the 15 per cent acceptance level recommended by Hazell and Norton (1986:271) it should not be regarded as an accurate measure of the model's performance as the base data are unreliable (Butler et al., 1977:183; Lenta, 1978). Owing to time and staff limitations, the agricultural 'census' does not entail enumeration of rural households. Instead, extension officers are expected to make visual appraisals of crop yields and areas (on highly fragmented and often inaccessible fields) before harvesting commences.

Census yield data reported for each administrative region are presented in Table 3.13 and compared with predicted

yields in Table 3.14. The PAD computed for crop yield is 6,4.

Table 3.13 Mean production of selected crops computed from KwaZulu census estimates (tons).

Admin. Region	Cereals	Legumes	Roots	Sugar-cane
Umzansi[1] (82/83-84/85)	55659	12390	49960	324105
Ogwini (81/82-83/84)	26428	2765	21612	932987
Mpandleni (81/82-83/84)	20038	443	5898	0
Mabedlana (81/82-84/85)	46583	1307	8460	38673
KwaZulu	148708	16905	85930	1295765
Less: Districts excluded[2]	18633	523	3384	0
Area modelled	130075	16382	82546	1295765

Notes 1 Maduna does not present figures for the 1981/82 season in Umzansi region.
2 Includes the districts of Ubombo, Ingwavuma and Simdlangentsha, or approximately 40 per cent of crop yields in Mabedlana.

Source Maduna (1986).

Table 3.14 Base and predicted output levels in the area of KwaZulu modelled (tons)[1].

Crops	Base production	Predicted production
Cereals	130075	90895
Legumes	16382	14242
Roots	82546	129074
Sugar-cane	1295765	1305000

Notes 1 The PAD for crop output is 6,4.

The predicted level of off-farm employment reduced to a linear extrapolation of the input data as the upper limits imposed on the number of wage workers were binding in the

solution. Consequently, comparing the population statistics projected by the model (Table 3.15) with census estimates only serves as a check on the demographic input data and aggregation weights used in the model.

Table 3.15 'Predicted' demographic statistics for the area of KwaZulu modelled (1985).

De jure rural population:	3563638	
<16 yrs		1680078
16 - 59 yrs		1401754
>59 or disabled		481806
Wage workers:	755210	
De facto rural population (De jure population minus migrants)[1]	3251933	

Notes 1 Migrants estimated as 41,3 per cent of wage workers (DBSA, 1987).

According to population census estimates, 3137750 people resided in the area modelled during 1985 (DBSA, 1987; KDEA, 1986). This estimate falls short of the model estimate (3251933) by 3,5 per cent. The model 'predicts' that 21,2 per cent of the de jure population were wage employed and the corresponding census estimate (DBSA, 1987) is 23,9 per cent.

The Statistical Abstracts (DBSA, 1987) indicate that there were 1122645 wage employed KwaZulu citizens in 1985. Of these, 362645 are classified as 'locally employed'. Assuming that the term 'locally employed' refers to urban wage workers, the total number of (rural) migrant workers approximated 760000 in 1985. Given that the districts excluded from the model account for roughly eight per cent of

KwaZulu's rural population, this figure compares favourably with the estimate of 755210 migrant workers 'predicted' by the model.

Independent household income estimates are available but difficult to compare owing to differences in the way income is measured. In this study, cash income is defined as the sum of pension and disability payments, net wage remittances (section 3.1.3) and crop sales, less the cost of market inputs used in crop production and the cost of essential food purchases. Annual income estimates generated by the model are listed in Table 3.16.

Table 3.16 Income estimates predicted by the model (1985=100).

Particulars	Household (R)	Area modelled (R million)
Welfare payments	1071	404,7
Net remittances	1595	602,1
Crop sales	190	71,6
Total income	2856	1078,4
Less:		
Essential food purchases and milling costs	682	257,4
Market crop input costs	207	78,3
Cash income	1967	742,7

Total annual income predicted by the model for the average household (R2856) compares reasonably well with corresponding estimates of R2400, R2683 and R2638 computed from the sample data attributed to Stewart (1988) and Perkins

and May (1988) in Table 1.10. Aggregate net remittances 'predicted' for the area modelled (R602,1 million) are compatible with the 1976 estimate of R361,0 million (1985=100) for rural KwaZulu but the predicted value implies reduced growth in real aggregate remittance earnings since 1976 (Table 1.7).

Whereas the model predicts that households (excluding migrant workers) purchase 650 kilograms of cereals per annum, Lyster (1987:126-127) estimates that rural households in KwaZulu (including wage commuters) purchase approximately 900 kilograms of cereal per annum. No interhousehold farm labour transactions enter the solution. This result is consistent with the observation that the on-farm labour market is very inactive (section 2.1.4).

A summary of solution levels for key activities is presented in Table 3.17.

3.3 Predicted responses to changing economic incentives.

This section examines aggregate responses predicted by the regional model to changes in key economic and institutional variables. All outcomes reflect static equilibrium solutions (1985=100) and therefore imply complete adjustment to the change. Land transactions are excluded in all but the last scenario.

Table 3.17 Solution levels for key activities in the regional model (1985=100).

Particulars	Unit	Base solution
1 No. of households		377600
2 Household cash income : mean	R	1967
: range	R	1552 - 2524
L = E - θσ : mean[1]	R	1776
: range	R	1334 - 2274
Wage workers[2]		755210
Net wage remittances	R million	602,1
2 Food imports into rural areas:	R million	
Cereals		133,0
Legumes		109,4
Roots		8,7
Total		251,1
3 Area under crops:	Ha	
Cereals - traditional		129358
Cereals - potential		0
Legumes - traditional		48952
Legumes - potential		0
Roots - traditional		25815
Roots - potential		0
Sugar-cane		45000
Fallow land		76908
4 Sales out of rural areas:	R million	
Roots		19,6
Sugar-cane		48,8
Total		68,4
5 Sales between rural households:	R million	
Roots		3,2
6 Value of own crops consumed (at local retail prices):	R million	
Cereals		27,5
Legumes		35,2
Roots		3,2
Total		65,9
7 Total crop production costs, excluding household labour	R million	78,3
8 Net value of crop production (4+5+6-7)	R million	59,2

Notes 1 Utility is assumed to equal L.
2 High income wage workers = 450372

3.3.1 Scenario 1: Cereal price increased by ten per cent.

Changes in the price of maize are expected to have some influence on rural household welfare and resource allocation as maize is the most important food staple produced in KwaZulu. Predicted responses to a ten per cent **ceteris paribus** increase in the retail and producer prices of cereals are summarized in Table 3.18.

Mean household income declines by 1,4 per cent but mean household welfare (≈L) falls by two per cent owing to greater risk bearing and reduced leisure time.

Total area planted to cereals increases by 15 per cent, but total output only increases by 8,6 per cent as some of the expansion occurs in Region 2 where per hectare yields are low (and the model does not predict a switch to more land intensive methods of production). The long-run supply response elasticity for cereals is therefore estimated to be 0,86. Although less than unity, this estimate is still higher than comparable estimates computed for most less developed countries (section 2.3, point b). However, it must be emphasised that the estimate is not necessarily a true reflection of the predicted supply elasticity as it relates to a single point on a stepped supply function for cereals. A larger price change could generate the same solution in which case the computed elasticity would be lower than 0,86. Despite the relatively large supply response, cereal imports decline by less than three per cent (in quantity terms) and

Table 3.18 Effects of a ten per cent increase in the price of cereals (scenario 1).

Particulars	Base solution	Scenario 1
1 Household cash : mean income (R) : range	1967 1552 - 2524	1940 1522 - 2497
$L = E - \theta\sigma$: mean[1] (R) : range	1776 1334 - 2274	1741 1305 - 2247
Wage workers[2]	755210	755210
Net wage remittances (R million)	602,1	602,1
2 Food imports (R million):		
Cereals	133,0	142,1
Legumes	109,4	109,4
Roots	8,7	8,7
Total	251,1	260,2
3 Area under crops (Ha):		
Cereals - traditional	129358	148854
Cereals - potential	0	0
Legumes - traditional	48952	48952
Legumes - potential	0	0
Roots - traditional	25815	25815
Roots - potential	0	0
Sugar-cane	45000	45000
Fallow land	76908	57411
4 Sales out of rural areas (R million):		
Roots	19,6	19,6
Sugar-cane	48,8	48,8
Total	68,4	68,4
5 Sales between households (R million):		
Roots	3,2	3,2
6 Value of own crops consumed, at local retail prices (R million):		
Cereals	27,5	33,2
Legumes	35,2	35,2
Roots	3,2	3,2
Total	65,9	71,6
7 Total crop production costs, excluding household labour (R million)	78,3	79,2
8 Net value of crop production (4+5+6-7) (R million)	59,2	64,0

Notes 1 Household utility is assumed to equal L.
2 High income wage workers = 450372

the degree of self-sufficiency in cereals increases by only 2,1 percentage points. This is similar to Martin's (1988) estimate for Senegal. Experiments with the model indicated that cereals would not be produced for market purposes by any of the representative households unless producer prices increase by more than 50 per cent.

Large areas of arable land remain uncultivated and there is no change in quantities of other crops produced (sugar-cane production is restricted by quotas). Crop sales do not increase and expenditure on market inputs is virtually unchanged. This implies few additional income opportunities in agricultural service industries. To summarize, it is predicted that a ten per cent **ceteris paribus** increase in retail and producer cereal prices will reduce average household welfare in rural KwaZulu and will do little to raise the cereal ouput or self-sufficiency. Furthermore, levels of nutrition will decline if the price increase reduces total household food consumption.

3.3.2 Scenario 2: Input subsidies equal to a ten per cent reduction in non-labour crop production costs.

Subsidization of farm inputs has been proposed as an instrument to stimulate agriculture in less developed regions (eg. Feder et al., 1981). In this scenario, non-labour crop production costs are reduced by ten per cent in an attempt to simulate the effects of input subsidies. Predicted levels of key activities are presented in Table 3.19.

Table 3.19 Effects of input subsidies equal to a ten per cent reduction in non-labour crop production costs (scenario 2).

Particulars	Base solution	Scenario 2
1 Household cash : mean	1967	2000
income (R) : range	1552 - 2524	1583 - 2554
$L = E - \theta\sigma$: mean[1]	1776	1796
(R) : range	1334 - 2274	1366 - 2304
Wage workers[2]	755210	755210
Net wage remittances (R million)	602,1	602,1
2 Food imports (R million):		
Cereals	133,0	129,9
Legumes	109,4	109,4
Roots	8,7	8,7
Total	251,1	248,0
3 Area under crops (Ha):		
Cereals - traditional	129358	145509
Cereals - potential	0	0
Legumes - traditional	48952	48952
Legumes - potential	0	3346
Roots - traditional	25815	25815
Roots - potential	0	0
Sugar-cane	45000	45000
Fallow land	76908	57411
4 Sales out of rural areas (R million):		
Legumes	0	4,3
Roots	19,6	19,6
Sugar-cane	48,8	48,8
Total	68,4	72,7
5 Sales between households (R million):		
Roots	3,2	3,2
6 Value of own crops consumed, at local retail prices (R million):		
Cereals	27,5	29,5
Legumes	35,2	35,2
Roots	3,2	3,2
Total	65,9	67,9
7 Total crop production costs, excluding household labour (R million)	78,3	73,2
8 Net value of crop production (4+5+6-7) (R million)	59,2	70,6

Notes 1 Household utility is assumed to equal L.
2 High income wage workers = 450372

It is predicted that the input subsidy would cost R8,1 million. Mean household income and welfare increase by 1,7 and one per cent respectively. Estimates reported by Singh et al. (1986:31) for four Asian countries suggest that a ten per cent reduction in fertilizer prices would raise real household income by amounts ranging from 0,3 to 1,1 per cent. The increase in mean household welfare is smaller than the corresponding increase in income as the money gains are partially offset by greater risk bearing and reduced leisure.

Production of root crops is unchanged but areas planted to cereals and legumes increase by 12,5 and 6,8 per cent respectively. These area changes translate into yield increases of 7,1 per cent for cereals and 16,4 per cent for legumes (there is a partial switch to more land intensive legume production). Sugar-cane production is unaffected owing to quota restrictions. Again, the estimated supply response elasticities for roots, cereals and legumes with respect to the cost of non-labour market inputs (0,00, 0,71 and 1,64 respectively) should be interpreted with caution. Expenditure on food imports declines by 1,2 per cent and the degree of self-sufficiency in food increases by less than 1,5 percentage points.

Few income opportunities would be generated in agricultural service industries as quantities of crops and inputs marketed do not increase significantly. A large area of arable land remains uncultivated. To summarize, it is predicted that a ten per cent **ceteris paribus** reduction in

non-labour crop production costs will have very limited effects on household welfare and crop production in rural KwaZulu.

3.3.3 Scenario 3: Increased unemployment equal to a 13,5 per cent reduction in the number of wage workers.

To simulate the effects of increased off-farm unemployment (i.e. a decrease in expected net remittances), the number of on-farm workers was increased by one half person in Type 2 and Type 4 households. These households were selected as rising unemployment is expected to impact primarily on workers in the 'low' wage category. The aggregate number of wage workers is estimated to decline by 13,5 per cent (Table 3.20).

Although mean household income and welfare only decline by 8,7 and 9,8 per cent respectively, households worst affected by unemployment (approximately 30 per cent of all households considered) suffer corresponding income and welfare losses of 20,0 and 24,4 per cent. Rising unemployment is therefore expected to result in considerable hardship for a large number of households in rural KwaZulu. Welfare losses exceed income losses owing to increased risk bearing. In households affected by unemployment, the stock of on-farm labour expands, raising de facto consumption requirements and lowering the cost of family farm labour. As a result, there is a small increase in total areas planted to all food crops and fallow land declines by 5,5 per cent in aggregate.

Table 3.20 Effects of a 13,5 per cent reduction in wage workers (scenario 3).

Particulars	Base solution	Scenario 3
1 Household cash : mean	1967	1796
income (R) : range	1552 - 2524	1241 - 2524
$L = E - \theta\sigma$: mean[1]	1776	1602
(R) : range	1334 - 2274	1008 - 2274
Wage workers[2]	755210	653597
Net wage remittances (R million)	602,1	553,3
2 Food imports (R million):		
Cereals	133,0	143,0
Legumes	109,4	113,7
Roots	8,7	9,3
Total	251,1	266,0
3 Area under crops (Ha):		
Cereals - traditional	129358	131340
Cereals - potential	0	0
Legumes - traditional	48952	50879
Legumes - potential	0	0
Roots - traditional	25815	26134
Roots - potential	0	0
Sugar-cane	45000	45000
Fallow land	76908	72679
4 Sales out of rural areas (R million):		
Roots	19,6	19,5
Sugar-cane	48,8	48,8
Total	68,4	68,3
5 Sales between households (R million):		
Roots	3,2	3,4
6 Value of own crops consumed, at local retail prices (R million):		
Cereals	27,5	27,6
Legumes	35,2	36,6
Roots	3,2	3,4
Total	65,9	67,6
7 Total crop production costs, excluding household labour (R million)	78,3	79,2
8 Net value of crop production (4+5+6-7) (R million)	59,2	60,1

Notes 1 Household utility is assumed to equal L.
2 High income wage workers = 450372

Despite a one per cent increase in the quantity of food produced, the degree of food self-sufficiency declines as the volume of imported food rises by almost seven per cent. This outcome is not entirely consistent with the conclusions which Low draws from his analysis (section 2.1.4) as it suggests that food imports may also increase during periods of rising unemployment. Quantities of food marketed in urban areas diminish but sales within rural areas increase by six per cent. Levels of market inputs used in crop production are virtually unchanged.

In conclusion, it is predicted that a 13,5 per cent **ceteris paribus** reduction in the number of (low income) wage workers will have a small positive impact on crop production and is likely to have a significant adverse effect on the welfare (and possibly the nutritional status) of many households in rural KwaZulu.

3.3.4 Scenario 4: Proposed deregulation of sugar-cane production.

Recent proposals to deregulate the sugar-cane industry will increase the area available for sugar-cane production in KwaZulu by 30000 hectares (Bates, 1989; Le Roux, 1989). Deregulation is not expected to depress local cane prices owing to growth in market demand and the intended establishment of an ethanol-from-cane plant in South Africa (Bates, 1989). To test the impact of deregulation on rural households, the regional programming model was solved for an

additional 30000 hectares of sugar-cane. Predicted results are compared with the base solution in Table 3.21.

Mean household income increases by 1,7 per cent but the income benefits accrue only to households in Region 1 where sugar-cane can be produced. At household level, the increase in farm income is not large enough to attract workers from wage employment and the increase in crop production does not raise the cost of family labour by an amount sufficient to induce labour hiring. In Region 1, mean household income increases by nearly three per cent. Welfare gains are smaller owing to greater risk bearing and reduced leisure.

Although sugar-cane production expands to its limit level, food production is hardly affected as the additional sugar-cane is produced almost exclusively on land that was previously fallow. The area of fallow land decreases by 31,2 per cent in aggregate. Cereal output declines by 12,8 per cent but legume production is unaltered. Quantities of root crops produced and sold increase by 22,3 and 25,4 per cent respectively. Complementarity in the production of food crops (eg. roots) and non-food crops (eg. sugar-cane), has been observed in several African countries. Weber et al. (1988) conclude that this trend might be the result of increased access to infrastructure and inputs accompanying the adoption of cash crops while the results of this exercise suggest that risk aversion may also encourage diversification into food crops. In sum, expenditure on food imports rises by 2,3 per

Table 3.21 The effects of deregulating sugar-cane production (scenario 4).

Particulars	Base solution	Scenario 4
1 Household cash : mean	1967	2001
income (R) : range	1552 - 2524	1552 - 2618
$L = E - \theta\sigma$: mean[1]	1776	1777
(R) : range	1334 - 2274	1335 - 2277
Wage workers[2]	755210	755210
Net wage remittances (R million)	602,1	602,1
2 Food imports (R million):		
Cereals	133,0	138,7
Legumes	109,4	109,4
Roots	8,7	8,7
Total	251,1	256,8
3 Area under crops (Ha):		
Cereals - traditional	129358	117615
Cereals - potential	0	0
Legumes - traditional	48952	48952
Legumes - potential	0	0
Roots - traditional	25815	31565
Roots - potential	0	0
Sugar-cane	45000	75000
Fallow land	76908	52900
4 Sales out of rural areas (R million):		
Roots	19,6	25,3
Sugar-cane	48,8	81,3
Total	68,4	106,6
5 Sales between households (R million):		
Roots	3,2	3,2
6 Value of own crops consumed, at local retail prices (R million):		
Cereals	27,5	24,0
Legumes	35,2	35,2
Roots	3,2	3,2
Total	65,9	62,4
7 Total crop production costs, excluding household labour (R million)	78,3	98,4
8 Net value of crop production (4+5+6-7) (R million)	59,2	73,8

Notes 1 Household utility is assumed to equal L.
2 High income wage workers = 450372

cent and the degree of self-sufficiency in food falls by 2,4 percentage points.

Sugar-cane has been readily adopted by farm households in KwaZulu. It is generally recognised that owing to small farm sizes, the income benefits accruing to adopters are not sufficient to make full-time farming a viable proposition. However, few observers would doubt the success of the industry in KwaZulu as its growth has generated significant employment and income opportunities in agricultural service industries (especially transport and land preparation). The results presented in Table 3.21 suggest that deregulation would create many additional income opportunities in local agri-business as the estimated increases in crop sales and expenditure on market inputs are 53,4 and 25,7 per cent respectively.

In conclusion, it is predicted that a 30000 hectare **ceteris paribus** increase in the area available for sugar-cane production will have a positive but small direct impact on average household welfare in rural KwaZulu, a negative but small impact on food self-sufficiency, and a large positive impact on sales, input usage and employment in local service industries.

3.3.5 Scenario 5: A resticted land rental market.

The model is not suited to predicting the effects of a land market as (a) fixed costs such as those associated with

information and management inputs, and potential market economies to be gained from the bulk purchase of variable inputs are captured by the optimum θ_1, (b) potential diseconomies of size are not accounted for in the model, and (c) only two representative households are considered in each region. Furthermore, fodder crop activities that would most likely accompany farm growth in Region 2 are excluded from the model. In Region 1 the effects of a land market can be demonstrated to a limited extent if it is assumed that rental arrangements are restricted to pairs of participants. Even so, an exogenous shock is required to induce land transactions because size economies are captured by the θ_1 values. Table 3.22 summarizes activity levels predicted for Region 1, with and without a restricted market for arable land, under conditions of increased unemployment (scenario 3) and increased sugar-cane production (scenario 4).

Given these circumstances, it is predicted that Type 2 households would each rent 0,158 hectares from Type 1 households. Mean household income is similar with and without a restricted land market as the cost of renting land borne by the lessee represents income to the lessor. The average welfare of both parties improves. Although lessors experience a decline in cash income (from R2612 to R2601 per annum), their welfare increases as the reduction in income is more than offset by reduced risk bearing and lower household time inputs in farming.

The value of cereals produced for home consumption increases

Table 3.22 Effects of a restricted land rental market in Region 1 (scenario 5).

Particulars	Scenario 3 + Scenario 4	
	without market	with market
1 Household cash : income	1978	1998
income (R) : range	1344 - 2612	1395 - 2601
L = E - θσ : mean[1]	1643	1644
(R) : range	1009 - 2276	1010 - 2277
Wage workers[2]	380352	380352
Net wage remittances (R million)	335,0	335,0
2 Food imports (R million):		
Cereals	66,0	58,7
Legumes	60,8	60,8
Roots	4,9	4,9
Total	131,7	124,4
3 Area under crops (Ha):		
Cereals - traditional	68178	83265
Cereals - potential	0	0
Legumes - traditional	22157	22157
Legumes - potential	0	0
Roots - traditional	33283	34703
Roots - potential	0	0
Sugar-cane	75000	75000
Fallow land	16506	0
4 Sales out of Region 1 (R million):		
Roots	30,1	31,5
Sugar-cane	81,3	81,3
Total	111,4	112,8
5 Value of own crops consumed, at local retail prices (R million):		
Cereals	20,6	25,1
Legumes	19,5	19,5
Roots	3,4	3,4
Total	43,5	48,0
6 Total crop production costs, excluding household labour (R million)	90,8	94,7
7 Net value of crop production (4+5-6) (R million)	64,1	66,1

Notes 1 Household utility is assumed to equal L.
2 High income wage workers = 271680

by 21,8 per cent and expenditure on cereal imports declines by 11,1 per cent. All fallow land is cultivated when land transactions are permitted. The degree of food self-sufficiency in Region 1 rises by 5,6 percentage points. These changes are much larger than those predicted in previous scenarios and do not entail treasury costs (eg. input subsidies) or a reduction in household welfare (eg. food price increases and rising unemployment). Sales of root crops increase by 4,7 per cent. By restricting land transactions to pairs of participants, the possibilty of individual farming operations expanding to a level where farm labour would be hired or household labour reallocated from off-farm to on-farm work was effectively precluded. Furthermore, the results understate the beneficial effects that a land market could have on service industries.

In summary, the land market considered benefits all types of households, vastly improves efficiency in crop production and promotes food self-sufficiency.

Chapter 4

Policy recommendations to improve agricultural incentives and household incomes in rural KwaZulu

In this chapter it is contended that distorted agricultural incentives are largely responsible for low levels of farm output and income observed in KwaZulu. Factors contributing to poor agricultural incentives are summarized and certain policy measures deemed essential to improve the current situation are suggested.

4.1 Crop production.

Despite broad-based attempts by government and non-government organizations (NGO's) to increase agricultural output (through extension services and farmer training, establishing and assisting farmer cooperatives and associations, facilitating access to market inputs, supplying improved seed, mobilizing rural savings and providing cheap credit, tractor services, roads, fencing and contouring), arable land is generally underutilized in rural KwaZulu (section 1.2.1). It is evident that the mere availability of new forms of capital (roads, irrigation etc.) and superior seeds, fertilizers, pesticides, information etc. is not sufficient to achieve large increases in food production. Farmers are calculating economic agents and will only employ resources in a way that increases agricultural production if they have an

incentive to do so. Schultz (1978) defines the incentive to which farmers respond as the economic information that they use in calculating their expected costs, including risks, against the returns they expect to receive.

4.1.1 Product prices.

The question has been asked whether it is really necessary to develop agriculture in the South African homelands (Bromberger, 1988). The conventional argument holds that growth in per capita food supply is a prerequisite for economic development in less developed countries (LDC's). As industrialization and urbanization proceed, the rate of increase in urban demand for food tends to exceed the rate of urban employment because the income elasticity of demand for food is relatively high in LDC's and the real earnings of industrial workers are usually higher than those of agricultural workers. Consequently, if food supplies do not expand rapidly, food prices are expected to rise and, since expenditure on food comprises a large part of total household expenditure in LDC's, employers will be forced to concede wage increases that are not related to productivity. The net outcome is a decline in the rate of industrial development as profits and reinvestment fall (Ghatak and Ingersent, 1984). Of course, food imports could substitute for domestic production. For a typical LDC, food importation is considered unwise as the marginal opportunity costs of domestic food supplies are 'low' (because labour and land are the principal

farm inputs and agricultural workers have few alternative employment opportunities) whereas the opportunity costs of food imports are 'high' (because they are consumed and therefore do not augment limited capital stocks). However, industrial growth in Natal and the rest of South Africa has created alternative employment opportunities for workers in rural KwaZulu and, historically, per capita food production in the Republic has increased - primarily as a result of growth in the volume of food produced by commercial (White) agriculture (Nieuwoudt, 1983). Nevertheless, this does not imply that per capita consumption is necessarily increasing or that that food security will not be a problem in the future. Per capita consumption of luxury food items such as beef, mutton, pork, and fresh milk has declined since 1950 (Nieuwoudt, 1986). Sen (1985) has argued convincingly that food entitlements are not only a function of per capita output but also of affordability. Like so many first world countries, government intervention in South African food markets has resulted in the overvaluation of certain food products on domestic markets. For example supplies of red meat and sugar-cane are restricted by quotas (Nieuwoudt, 1986; Ortmann, 1985:49) and maize exports are subsidized (Brand Commission, 1988). Given the current set of circumstances prevailing in rural KwaZulu, a lowering of real food prices will benefit most households. A **ceteris paribus** reduction in the price of cereals would tend to produce effects opposite to those predicted in scenario 1 (section 3.3.1), i.e. an increase in mean household income and

welfare, a small decline in cereal production (the long-run 'frictionless' supply response elasticity for cereals is estimated to be 0,86) and a slight reduction in cereal self-sufficiency. However, quantities of cereals consumed are expected to increase (Nieuwoudt and Vink estimate the overall own price elasticity of demand for maize for deficit and surplus producers to be -0,43) thereby improving levels of nutrition. In the less developed regions of Southern Africa, observed increases in agricultural output do not necessarily imply that development efforts have been successful as the increase could reflect rising food prices or worsening unemployment. In either case, many households would be left worse off in terms of income, risk bearing and possibly nutritional status. Food self-sufficiency may well decline in the event of rising off-farm unemployment (scenario 3, section 3.3).

It has been suggested that removal of commodity price protection in South Africa might be detrimental to long term food production in the region (Pringle, 1987). Unfortunately, many of the current programmes cannot be justified on this basis. Whereas the bread subsidy encourages domestic wheat production and consumption, quotas effectively restrict production and export subsidies discourage local marketing. In South Africa, the bread subsidy can be justified on equity grounds as it involves a redistribution of income from (wealthier) taxpayers to consumers (including deficit producers), many of whom are poor. However, the latter

programmes penalize local consumers in the sense that they must pay more for less and benefit a relatively small number of commercial (White) farmers. Existing restrictions on fertilizer imports increase local production costs and therefore act as a disincentive to farmers. If future food security has motivated intervention in South Africa's agricultural markets it is hard to reconcile recent cuts in the bread subsidy with the continued application of quota schemes.

Increased agricultural output in KwaZulu and the other South African homelands could contribute to long-term food security in the country (by increasing household incomes and their food supply). To accomplish this, appropriate producer incentives are required. Higher producer prices are not expected to have a significant impact on product supply or household incomes in KwaZulu. It is estimated that producer prices for cereals would have to be increased by more than 50 per cent to induce even a modest output response (scenario 1, section 3.3). Furthermore, raising farm-gate prices in KwaZulu above current levels would require subsidization as local buyers have ready access to (cheaper) food produced in South Africa. Apart from their cost implications, product subsidies might prove to be impractical from an administrative angle as it would be extremely difficult to police rent seeking on the part of commercial (White) farmers. Instead, it might be more instructive to consider the costs of crop production in rural KwaZulu.

4.1.2 Production costs.

In section 2.1.4 it was noted that many households in rural KwaZulu have little incentive to produce crops because they are able to procure food and income at lower cost by allocating better educated workers to off-farm employment. Even for marginal wage workers, the scope for part-time farm work and management is limited by inflexible working hours in wage employment and distance from job centres. However, this alone does not explain why arable land is underutilized in KwaZulu. It is contended that arable land is underutilized because these households cannot rent land to others who would farm it. The results of scenario 5 (section 3.3) demonstrate that fallow land would be brought into production if it could be hired by households short of land, and that crop production would increase substantially. This analysis did not account for size economies that would be gained by spreading fixed costs associated with management, labour and information inputs over larger volumes of output, or by purchasing variable inputs in bulk. Consequently, a rental market for land would not only bring unutilized land into production but would also improve incentives to crop the land more intensively. Empirical studies based on sample survey data gathered in various parts of KwaZulu indicate that both the adoption of farm technology and production of surpluses are positively correlated with farm size relative to family size and the renting or borrowing of land (Kleynhans, 1983; Lyne, 1985; Nieuwoudt and Vink, 1988).

4.1.3 Reducing average production costs in KwaZulu.

Although the virtual absence of a land market has received scant attention in past years, public funds intended for agricultural development in KwaZulu (the bulk of which are obtained from South African tax payers outside the region) have invariably been directed at reducing production costs on farms. For example, a significant share of government expenditure is directed at providing information services and infrastructure. It is interesting that the construction and upgrading of access roads not only lowers the cost of transporting market inputs and products but also serves to reduce the cost of purchasing food and of commuting to job centres and may therefore discourage farming. Either way, households stand to benefit from improvements to the transportation and communication systems. Although most programmes are broad-based, irrigation schemes have been established in some areas. Users benefit from subsidized irrigation water as establishment costs are at best only partially recovered. A limited amount of subsidized credit is made available to farmers by the KFC. The usual criticism that the benefits of cheap credit accrue mainly to farmers with large land holdings may not be that relevant in KwaZulu as the range of farm sizes is small. Nieuwoudt and Vink (1988) emphasise the point that poorer households in KwaZulu often lack collateral to borrow (partly because there are no titles to land) and may underinvest in agriculture due to liquidity constraints. Their conclusion that subidized credit

is unlikely to have an adverse effect on equity is supported by the results of scenario 2 (section 3.3.2). However, these results also demonstrate that household incomes and crop production are not very responsive to changes in production costs. The long-run 'frictionless' supply response for cereals with respect to the cost of non-labour inputs is estimated to be 0,71. A one per cent change in production costs is estimated to change mean household income by only 0,10 per cent.

The obvious conclusion to be drawn from the foregoing paragraphs is that an expansion of farm sizes could improve the incentive to farm by reducing average production costs and by raising potential returns to innovation, information, infrastructure and subsidized credit (Welch, 1978). The question is whether farm sizes can be increased without detracting from equity. Although a land market would enable consolidation of farms it is argued that "the poor have a desperate and immediate need for money, and survival's urgency can drive them to sell out for cash even against their own better judgement and to their future regret" (Cross, 1987:431). In other words, a minority of elite families able to mobilize cash are likely to capture the benefits of a land market while poorer households could be forced into tenancy or urban poverty. This is a valid argument if permanent usufruct rights are traded on the land market. However, the 'landless class' problem does not arise in a rental market. In fact, a case for land rental can be

argued not only in terms of improved efficiency but also in terms of improved equity. Since rental arrangements are voluntary, all participants benefit. Lessors would gain income and households short of land for subsistence or commercial cropping purposes (particularly those with limited off-farm wage earning capacity) would be able to access additional land without diverting working capital into land purchase. Furthermore, employment opportunities would be created in agriculture and its service industries owing to increased derived demand for inputs and greater sales. Although stockowners could lose if the market raises the opportunity cost of arable land used for grazing, overstocking and its associated social cost will diminish.

A rental market for agricultural land will not require land survey and registration of title as recommended by Barnes (1988:285-287). In this regard, a sufficient condition is that households acknowledge the boundaries of existing allotments. In areas where the tribal tenure system has not been modified by betterment planning, most households can identify the boundaries of their total land allotment. This has been clearly demonstrated in areas where households have established sugar-cane and timber on land that previously constituted communal grazing. In areas that were betterment planned, households are only able to identify the boundaries of their arable land. Betterment planning involved the consolidation of tribal land allotments, and a redistribution of sites considered suitable for residential and arable

purpose with the balance of the tribal ward zoned as communal grazing. In effect betterment planning, which was implemented in 69 of KwaZulu's 246 rural tribal wards (Cunningham, 1989), removed existing property rights to grazing land. As a result, households in these wards are not in a position to establish timber on non-arable land (Stewart, 1989) and a rental market for this land would first require that the commonage be reallocated.

Where farm boundaries are acknowledged, land rental for cropping purposes could be encouraged by minimizing the risk that potential lessors bear of losing their right to land and the economic benefits conferred by this right. This would require institutional change. For example, written contracts between lessees and lessors (specifying the land to be rented and the contractual period) endorsed by the local chief and held in trust by an independent arbitrator (LIMA Rural Development Foundation) have facilitated rental transactions on irrigated land in the Umzumbe district of KwaZulu (Stewart, 1989). Contracts of this nature are supported by the KwaZulu Land Bill proposed in 1988. Existing government institutions could assume responsibility for holding and enforcing land rental contracts and should take a more active role in disseminating information about procedures. Furthermore, local authorities could be encouraged to endorse rental contracts between residents by allowing them to tax land rentals to fund public services and infrastructure required within the tribal ward. Successful applicants

granted farms 'released' to KwaZulu from Natal should be allowed to sublet portions or all of their land for farming purposes as there is no guarantee that individuals who are allocated land will always want to farm it. The same argument can be applied to plots of irrigated land allocated to successful applicants. Zoning of land for agricultural and residential purposes may be desirable regardless of whether these recommendations are accepted or not. Although the land market transactions considered in this study are confined to arrangements between households within KwaZulu, there are no economic or equity arguments to support legislation which prevents Black farmers from renting or purchasing title to agricultural land in South Africa.

4.2 Livestock production.

In section 2.2 it was emphasised that possible solutions to the overstocking problem depend upon whether or not access to communal grazing resources is open or restricted. If access is unrestricted, solutions include privatization of grazing land, a restructuring of the tax base and the imposition of fixed or transferable quotas. Where it is established that access is restricted to a specific group of graziers (the evidence provided in section 2.2.2 suggests that cases of restricted access are rare), institutional solutions may be feasible. If overgrazing is not a problem intervention may be unnecessary. Otherwise, strategies which reduce the cost of group participation (eg. administrative

assistance) and which increase the flow of information relating range quality to animal production may foster the level of group cooperation needed to induce stock reduction. However, only privatization of grazing land offers economic solutions to both the overstocking and low incentive problems (section 2.2.2). In its simplest form, privatization would merely remove free access to land allocated to, but not cultivated by, other households. To some extent this would internalize the cost of resource degradation (reduced future stocking rates) on land controlled by stockowners. The private costs of keeping cattle will also increase if stockowners compete to rent grazing land controlled by non-stockowners. In this case, income would be transferred from (wealthier) stockowners to other (less fortunate) households.

Empirical results presented in section 2.2.1 support the economic argument that an increase in the private costs of keeping livestock relative to their perceived benefits will reduce stocking rates. If privatization involved freehold titles that could be sold or inherited, the cost of resource degradation would be internalized more fully and it is possible that land might replace cattle as the desired store of wealth (i.e. a reduction in the value attached to cattle). Likewise, the introduction of profitable farm enterprises such as sugarcane and timber has not only raised the opportunity cost of land used for grazing but has also provided stockowners with alternative investment opportunities. The policy approach should be to encourage

privatization in those areas where it is more acceptable to households. There is a definite need for information about the degree of access to grazing resources and attitudes to privatization and rental arrangements. It is interesting that the concept of privatizing grazing land was favourably received by almost one half of rural households sampled in KwaZulu's Hlanganani district (Naledzani et al., 1989).

4.3 Urbanization.

Ultimately, it is desirable that willing farmers in KwaZulu should be allowed to acquire freehold title to rented land as owners tend to have longer planning horizons than tenants with short-term leases on agricultural resources. Consequently, freehold farmers have more incentive to invest in long-term improvements and are less inclined to overutilize their land and grazing than tenant farmers. A land rental market will present households with an opportunity to establish themselves as farmers or non-farmers without exposing themselves to the possible dangers of freehold title and is therefore a necessary step toward freehold title. Rental arrangements will also assist in the formalization of farm boundaries. However it is unlikely that lessors will be inclined to dispose of their rural land rights while certain benefits of ownership conferred by tribal tenure are essential to their wellbeing and are either more expensive or unobtainable elsewhere.

Rural households that are essentially displaced urban entities may be more willing to part with their allotments if they could acquire property rights in closer settlements where other (time-saving) incentives to relocate such as reticulated water, electricity and improved roads could be provided at much lower per capita cost than in rural areas. It is recommended that households should be allowed to exchange their residential rights in rural areas for freehold residential rights in closer settlements (eg. rural service centres). After relocating, these households could continue to lease their agricultural land to farmers. If entrepreneurs within and outside the region could purchase property rights in rural service centres, a major constraint to private sector investment in rural KwaZulu would be removed. Local business growth would reduce income leakages out of the region, create employment opportunities and generate revenue for public services and infrastructure. Concentrating services and infrastructure (eg. electricity, rural schools and clinics) at service centres rather than attempting to meet the needs of a widely dispersed population would not only be cheaper but would also serve to encourage rather than discourage households from relocating and ultimately surrendering their rural land rights.

A **ceteris paribus** increase in off-farm employment (or welfare transfers) is expected to produce results opposite to those predicted in scenario 3, section 3.3, i.e. improved household incomes but reduced agricultural output. However, an increase

in off-farm incomes coupled with urbanization incentives and a land market will reduce non-farmer dependence on rural land rights, facilitate farm consolidation, and improve both farmer and non-farmer incomes. Results of research conducted by Fairlamb and Nieuwoudt (1989) show that family sizes are significantly smaller in KwaZulu's urban settlements than in the rural areas. Their econometric analysis indicates that family size is inversely related to the opportunity cost of the wife's time in child rearing (which increases with her education and access to wage employment opportunities) and positively correlated with the need for child help in performing household chores such as collecting firewood and water (this need is greater in rural areas). The effect of husband's income (measured in terms of his level of education) on family size was found to be non-significant. Policy recommendations aimed at reducing rapid population growth (section 1.2.3) and its negative effects on development are therefore consistent with those required for farm consolidation; viz., increased access to employment opportunities through greater investment in human capital (eg. the inclusion of vocational training options in school curricula and skills training for adults), job creation and the provision of time-saving technologies like electricity and reticulated water.

The commercial (White) agriculture, domestic servant and informal sectors of South Africa's economy are important sources of employment for women in KwaZulu (Krige, 1988;

Nattrass and May, 1986; Stewart, 1986:44). Consequently, it is of concern that Black employment levels in commercial agriculture sector have diminished by almost one half million workers between 1971 and 1985. Van Zyl and Vink (1988) attribute part of this decline to tax concessions on farm machinery purchases and to subsidized interest rates. If commercial farmers are to be afforded tax concessions, the emphasis ought to be shifted from capital to labour (eg. larger tax deductions for housing and training farm labour). Additional employment opportunities for domestic workers would probably be created if some part of the tax cuts recently proposed in South Africa were achieved through tax concessions on servants' wages. Revision of cumbersome procedures to obtain hawkers licences and legislation controlling the sale of produce by Blacks in 'White areas' (Lyster, 1987:36 and 173) could lower transactions costs and promote employment in the informal sector. In closing, it should be noted that comprehensive financial incentives were introduced by the South African government in 1982 to stimulate industrial development in and around its homelands. However, it is estimated that until 1985 when the Environmental Planning Act of 1987 was repealed, this decentralization programme had only created some 100000 employment opportunities on the 'periphery' whereas the Act had effectively prevented the creation of approximately 220000 new jobs in metropolitan centres. Furthermore, it is claimed that the opportunity costs of this transfer of jobs were so high that the expenses for each job created

decentrally could have financed two to five times more employment opportunities in metropolitan centres (Halbach, 1988).

Conclusions

This section summarizes the (two) main conclusions drawn from the study. Policy implications and recommendations are detailed in Chapter 4.

Firstly, it is concluded that arable land would be farmed more efficiently in KwaZulu if land could be rented. Many households have little incentive to produce crops as farms are small and the opportunity cost of their labour is high. Small farm sizes limit potential returns to innovation, to higher product prices, and to programmes aimed at reducing crop production costs. Long-run food supply is estimated to be inelastic with respect to changes in product and input prices. It is anticipated that higher food prices will harm the vast majority of rural households and that lower input prices will do little to improve household welfare. Conversely, it is expected that a rental market for arable land will have a substantial impact on crop production and could generate significant income opportunities in agriculture and its service industries. A land rental market also has equity advantages and avoids the 'landless class' problem. Minor institutional changes are required to facilitate land rental arrangements.

Secondly, it is concluded that stockowners would be less inclined to overutilize grazing and more inclined to improve pasture and herd quality if grazing land were privately owned (even in the limited sense that arable land is privately

controlled). It is estimated that an increase in the private cost of keeping cattle relative to their perceived benefits would reduce stocking rates in KwaZulu. Other 'solutions' to the common property problem could reduce overstocking and its associated social cost, but are unlikely to result in improved pasture and herd quality. From an equity point of view, privatization of grazing land is expected to penalize stockowners (unless land replaces cattle as the desired store of wealth) but other (less fortunate) households stand to benefit if grazing resources are rented. Institutional changes are required to effect privatization. These changes may be more acceptable in areas where the tribal land tenure system was not modified by betterment planning.

Summary

KwaZulu is a less developed region of South Africa. The problem of widespread rural poverty is compounded by high population growth and low agricultural incomes. Despite intense population pressure on the land and sincere efforts to assist farmers, arable land is underutilized. Conversely grazing land is overutilized. It is contended that these inefficiencies reflect distorted agricultural incentives. The object of the study is to identify the distortions, to predict the effects of changing incentives on resource allocation, and to make recomendations aimed at improving household welfare in KwaZulu.

Although the KwaZulu Government has legislative powers over taxation within the territory, approximately 75 per cent of its revenue is obtained as transfers from the South African central government. Almost two thirds of KwaZulu's arable land is classified as having high cropping potential yet more than 20 per cent is left fallow. Crop yields are considerably lower than those observed on neighbouring commercial (White) farms and food staples account for the bulk of the area cultivated. Farm sizes are uniformly small. Sample survey data indicate that some 80 per cent of rural households have holdings less than two hectares in extent.

Households do not have freehold title to their farms. Tenure is secured by demonstrating some use of the land. Land rights afforded by tribal tenure are important to rural households

as they produce a stream of benefits, security in particular, that are often unobtainable or more expensive to acquire elsewhere. Households have private access to those parts of their allotment which they cultivate but uncultivated portions are regarded as common property for grazing purposes. Tribal land tenure prevents the sale of land and has also precluded an active rental market for agricultural land owing to resistance from stockowners and, more importantly, the perception that land rights may be jeopardized by leasing land.

Approximately 75 per cent of KwaZulu's de facto population reside in rural areas. It is projected that the rural population will grow at an average rate of nearly 2,5 per cent per annum during the next decade. A striking feature of rural households is the outmigration of workers, particularly better educated males, to off-farm wage employment. Sample surveys conducted in rural areas indicate that approximately 40 per cent of all household adults are engaged in off-farm wage employment and that levels of unemployment reported by households are high.

Poverty is widespread as evidenced by poor access to health services, low levels of education and very low household incomes. Farm income generally accounts for less than ten per cent of household income and, at an aggregate level, there appears to be an inverse relationship between off-farm remittance earnings and per capita food production. The vast majority of rural households are deficit food producers.

Sample estimates suggest that the average household imports one half of its staple food requirements and that food purchases account for roughly 40 per cent of its total expenditure.

It is estimated that some 40 per cent of rural households do not own cattle (often regarded as a store of wealth). The mean herd size is 3,6 head in areas better suited to cropping and 7,6 head in areas more suited to ranching. Stocking and herd mortality rates are nearly double those recorded on privately owned farms in Natal. Herd offtake in Natal is five times higher than in KwaZulu.

The underutilization of arable land in KwaZulu can be attributed largely to economic and institutional factors. From a household economics perspective it is predicted that households will allocate workers to wage employment if expected net returns in wage work exceed those in farm work. Over time, population growth has reduced farm sizes in KwaZulu because households have an incentive to retain their rural land rights. On the other hand, expected off-farm earnings have increased. As a result, the average cost of producing crops has increased relative to purchase and selling prices which are determined on much larger markets in South Africa. Since wage employment opportunities provide many households with a cheaper means of procuring food and income than farming, labour is diverted from crop production. In short, most households have little incentive to farm their arable land intensively and large areas are left fallow because land cannot be rented by those who would farm it.

This outcome is consistent with observations in KwaZulu and explains the preference which households exhibit for time-saving rather than land-augmenting technology. It is concluded that changes in wage remittances, product and input prices, and institutional factors preventing land rental will have some influence on household resource allocation and welfare. The extent (and perhaps the direction) of output responses to changes in these factors will be influenced by their effect on household leisure consumption, farm wages and household liquidity, and by risk considerations, substitution in demand and production, resource constraints, technology options and indivisible labour inputs.

An attempt was made to quantify aggregate crop production responses using a mathematical programming model. This aggregate model was constructed from four representative household programming models and captured some measure of the effects of income risk, leisure preferences, input substitution (through alternative technology options), seasonal production, and lumpy labour inputs (integer activities) on household resource allocation. Two household types were identified in a sample drawn from a region of high cropping potential (Region 1) using a clustering technique to separate sample households into groups with similar human resource proportions. A representative household was synthesized for each household type from the group means. Likewise, two representative households were identified in a region of low cropping potential (Region 2).

In order to cluster the sample households according to their relative human resource endowments, 'offer' wage rates had to be estimated for all household workers not wage employed. Sample selectivity bias which may arise when the offer wage model is estimated using OLS regression was avoided by including the 'intensity ratio' as an additional explanatory variable. Estimates of the intensity ratio were computed from the results of probit models analysing the decision to engage in off-farm employment. An interesting by-product of these procedures was the prediction that an extra year of formal schooling adds approximately eight per cent to the monthly wage of men and 11 per cent to the monthly wage of women.

Several decision criteria were tested in the household programming models (including the maximin and minimax criteria and a 'sumex' utility function) but the E,L criterion provided the best fit between predicted and observed activity levels. 'Risk aversion' coefficients were estimated independently for each representative household. These estimates were substituted into the aggregate model. Despite stringent assumptions employed in extrapolating from a limited data base to a region covering most of rural KwaZulu, enterprise levels predicted by the model compared favourably with census estimates. Responses predicted by the model complied with expectations and provided insight into other issues. The predicted 'frictionless' responses can be summarized as follows:

(a) A ten per cent increase in retail and producer cereal

prices (maize is the most important food crop produced in KwaZulu) reduces average household welfare by two per cent. Cereal output rises by 8,6 per cent implying a long-run supply response elasticity of 0,86. The volume of cereals imported declines by less than three per cent and the degree of self-sufficiency in cereals increases by only 2,1 percentage points. Large areas of arable land remain uncultivated. These estimates support findings in other developing countries.

(b) Input subsidies equivalent to a ten per cent reduction in non-labour production costs would cost R8,1 million rand but would only improve average household welfare by one per cent. This estimate is similar to those computed for several Asian countries. Cereal production increases by 7,1 per cent implying a long-run supply response elasticity of 0,71. Expenditure on food imports declines by 1,2 per cent and the degree of self-sufficiency in food increases by less than 1,5 percentage points. Large areas of arable land remain uncultivated.

(c) Increased off-farm unemployment, equal to a 13,5 per cent reduction in the number of 'low' income wage workers, reduces average household welfare by 9,8 per cent. Mean welfare falls by 24,4 per cent amongst households worst affected (30 per cent of all households) by the given increase in unemployment. Total food production increases by one per cent and the area of fallow land declines by 5,5 per cent in aggregate. The degree of food self-

sufficiency worsens as the volume of food imported rises by almost seven per cent.

(d) Proposals to relax quotas restricting the area of sugar-cane planted in KwaZulu will allow production to expand by 30000 hectares. Under these conditions, it is predicted that sugar-cane production will expand to its limit level (75000 Ha) and that mean household income will rise by three per cent in areas where the crop can be grown. Food production is hardly affected as the additional sugar-cane is produced on land that was previously fallow. Production of root crops increases as these crops offset income risk associated with sugar-cane. The area of fallow land declines by 31,2 per cent in aggregate. It is anticipated that deregulation would generate significant income opportunities in local agri-business as crop sales and expenditure on market inputs are estimated to increase by 53,4 and 25,7 per cent respectively.

(e) A rental market for arable land (restricted to pairs of participating households in Region 1) improves the welfare of all participants and arable land is fully utilized. The value of cereals produced in Region 1 increases by 21,8 per cent and cereal imports decline by 11,1 per cent. The degree of food self-sufficiency rises by 5,6 percentage points. This analysis ignores potential gains resulting from size economies. It is anticipated that a rental market for land could create significant

income opportunities in agriculture and its service industries.

The overutilization of grazing resources can also be attributed to economic and institutional factors. When access to a common grazing resource is unrestricted, stocking rates are determined largely by (a) the quality of the pasture and (b) the private cost of keeping cattle relative to their perceived benefits. The available evidence indicates that access to communal grazing is not restricted in KwaZulu and a regression analysis of variables influencing aggregate herd size supported the notion that stocking rates are sensitive to relative changes in the private cost and perceived benefits of keeping cattle. Privatization of grazing land (even in the limited sense of removing free access to land allocated to, but not cultivated by, other households) would internalize the cost of resource degradation on land controlled by stockowners. The private costs of keeping cattle would also increase if stockowners compete to rent land controlled by non-stockowners. Furthermore, privatization will reduce the perceived benefits of owning cattle if land replaces stock as the desired form of wealth. Although stock reduction could also be achieved by imposing quotas and taxes on cattle (or by means of institutional rules where access to commonage is restricted to a group of stockowners), only privatization will improve incentives to upgrade herd and pasture quality. Consequently, it is recommended that privatization of grazing land should be encouraged in areas

where it is more acceptable to households. Rental income will most likely transfer from (wealthier) stockowners to other (less fortunate) households and the social cost of overgrazing will fall.

Policy recommendations aimed at improving the efficiency of arable land utilization and rural household welfare centre on ways of reducing average crop production costs. Raising producer prices in KwaZulu would have little impact on food production (the model predicts that producer prices for cereals would have to increase by 50 per cent to induce an output response) and would require subsidization as consumers have ready access to (cheaper) food produced in South Africa. Existing programmes are generally aimed at lowering production costs but have had little impact on crop production in KwaZulu because the potential benefits of these programmes are limited by small farm sizes. The model predicts that the long-run supply response for cereals with respect to the cost of non-labour inputs is inelastic and that a one per cent change in production costs will change household income by only 0,1 per cent. A rental market for land would bring fallow land into production as some households are short of land. Furthermore, the resulting size economies would improve farmer incentives to crop the land more intensively. In this case, existing programmes would have a greater impact on farm output and farmers would be more inclined to adopt new technology. A case for land rental can also be argued in terms of equity. Trading temporary use

rights would not result in a landless class and, since renting is voluntary, must improve household welfare. A rental market would not require land survey and registration of title but it would require that households acknowledge the boundaries of their tribal land allotments. To activate the market, the risk that potential lessors bear of losing their right to land would have to be eliminated. This calls for institutional change.

In the long-term, consolidation of land in the hands of freehold farmers will improve efficiency in agriculture. A rental market will facilitate this process but the extent to which non-farming households depend upon rural land rights must be minimized. For example, households should be allowed to exchange their residential rights in rural areas for freehold residential rights in service centres. Time-saving services sought by households engaged primarily in wage employment (eg. reticulated water, electricity and improved roads) should be concentrated in service centres. This would lower the per capita cost of providing services and would also provide an incentive for non-farming households to relocate. It has been shown that families residing in KwaZulu's urban areas tend to be smaller than those residing in rural areas owing to higher levels of female participation in wage employment and a reduced need for child help. Urbanization and improved access to wage markets could dampen population growth and promote farm consolidation. It is recommended that skills training be given priority in

education programmes and that policies constraining growth in wage employment opportunities be reviewed.

The two principle conclusions drawn from this study are (a) that arable land would be farmed more efficiently in KwaZulu if land could be rented, and (b) that stockowners would be less inclined to overutilize grazing and more inclined to improve pasture and herd quality if grazing land were privately owned (even in the limited sense that arable land is privately controlled).

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Appendix A

Bioclimatic groups in KwaZulu

Table A.1 Important features of Natal's bioclimatic groups.

Group number	% of KwaZulu	Mean annual rainfall (mm)	Average mean temp. (°C)	Major dryland enterprises
1	14,8	1000	22-23	Sugar-cane
2	17,7	850-1300	18-20	Sugar-cane
3	2,2	800-1600	16-18	Maize
4	5,9	800-1500	13-15	Maize
6	5,1	800-1000	16-18	Maize Beef
7	1,4	700-800	17-18	Beef
8	12,6	715	16-18	Maize Beef
9	10,7	700-850	21-22	Beef
10	29,3	600-700	21-22	Beef
11	0,3	320-600	18-23	Beef

Source Department of Crop Science (1978); Thorrington-Smith et al. (1978).

Appendix B

Crop enterprise data

Data sources: Appendix C, Table C.3; Auerbach (1989); Bates (1988); Central Statisitical Services (1987); Directorate Agricultural Economic Trends (1974-1983 and 1989); Directorate Agricultural Production Economics (1985); Ilaco BV (1981); Frean (1988); Lyster (1987); Melis (1988); Rogers (1982); Stewart (1989); Stewart and Lyne (1988).

Table B.1.1 Region 1: Cereals (traditional) : Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	1,33	303,80	404,84	74,60
1975	1,41	281,17	395,38	65,14
1976	0,44	308,92	136,86	-193,38
1977	1,42	339,59	481,49	151,25
1978	1,10	349,52	384,69	54,45
1979	0,64	371,51	236,65	-93,59
1980	0,71	375,00	264,71	-65,52
1981	1,44	335,86	483,48	153,25
1982	0,79	349,61	275,22	-55,02
1983	0,70	342,73	239,06	-91,18
Mean	0,99	335,77	330,24	0,00
C.V.[1]	12,14	2,80	11,10	

Note 1 C.V. = Percentage coefficient of variation of mean.

Table B.1.2 Region 1: Cereals (traditional) : Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	54
Seed (18 kg)	16
Fertilizer (300 kg 2:3:2)	130
Total	200

Table B.1.3 Region 1: Cereals (traditonal): Estimated labour requirements

Season	Hours/Ha
Sept. - Nov.	260
Dec. - Feb.	35
March - May	0
June - Aug.	105

Table B.2.1 Region 1: Cereals (potential): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	5,37	303,80	1632,90	450,33
1975	5,73	281,17	1611,19	428,61
1976	0,74	308,92	228,48	-954,09
1977	5,79	339,59	1967,30	784,72
1978	4,17	349,52	1457,63	275,06
1979	1,75	371,51	651,12	-531,45
1980	2,02	375,00	756,28	-426,30
1981	5,92	335,86	1989,54	806,96
1982	2,45	349,61	855,32	-327,25
1983	1,97	342,73	676,00	-506,58
Mean	3,59	335,77	1182,58	0,00
C.V.	17,68	2,80	16,60	

Table B.2.2 Region 1: Cereals (potential): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	88
Seed (20 kg)	32
Fertilizer (600 kg 2:3:2)	260
Chemicals	70
Total	450

Table B.2.3 Region 1: Cereals (potential): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	450
Dec. - Feb.	250
March - May	0
June - Aug.	300

Table B.3.1 Region 1: Legumes (traditional): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (kg/Ha)	Price (R/kg)	Revenue (R/Ha)	Deviations (R/Ha)
1974	429	2,51	1078,29	211,94
1975	484	2,42	1170,34	303,99
1976	200	3,07	613,68	-252,66
1977	476	2,74	1304,70	438,35
1978	310	1,96	605,57	-260,78
1979	402	2,00	804,25	-62,10
1980	200	2,43	486,87	-379,48
1981	419	2,75	1152,61	286,26
1982	446	1,97	878,01	11,67
1983	200	2,85	569,17	-297,18
Mean	357	2,47	866,35	0,00
C.V.	10,47	5,03	10,74	

Table B.3.2 Region 1: Legumes (traditional): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	54
Seed (70 kg)	176
Fertilizer (360 kg 2:3:2)	160
Total	390

Table B.3.3 Region 1: Legumes (traditional): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	0
Dec. - Feb.	600
March - May	120
June - Aug.	0

Table B.4.1 Region 1: Legumes (potential): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (kg/Ha)	Price (R/kg)	Revenue (R/Ha)	Deviations (R/Ha)
1974	1710	1,88	3212,36	1048,68
1975	1986	1,81	3592,72	1429,24
1976	100	2,30	229,52	-1934,16
1977	1948	2,05	3992,82	1829,13
1978	1105	1,46	1617,10	-546,58
1979	1570	1,50	2351,47	187,79
1980	200	1,82	363,60	-1800,08
1981	1661	2,06	3418,16	1254,48
1982	1797	1,47	2645,99	482,31
1983	100	2,13	212,87	-1950,81
Mean	1218	1,85	2163,68	0,00
C.V.	20,43	5,03	21,47	

Table B.4.2 Region 1: Legumes (potential): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	88
Seed (50 kg)	110
Fertilizer	320
Chemicals	132
Total	650

Table B.4.3 Region 1: Legumes (potential): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	0
Dec. - Feb.	630
March - May	180
June - Aug.	0

Table B.5.1 Region 1: Roots (traditional): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	6,33	154,22	976,98	-22,28
1975	1,25	244,94	307,00	-692,26
1976	6,01	223,71	1344,64	345,38
1977	6,35	192,38	1222,46	223,20
1978	5,44	234,55	1276,99	277,73
1979	2,87	147,24	423,00	-576,26
1980	5,55	192,48	1067,35	68,09
1981	4,48	184,00	824,36	-174,90
1982	6,18	178,00	1100,84	101,58
1983	5,52	262,73	1448,98	449,72
Mean	5,00	201,42	999,26	0,00
C.V.	10,68	6,06	12,05	

Table B.5.2 Region 1: Roots (traditional): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	54
Seed (1500 kg)	450
Fertilizer (330 kg 2:3:4)	146
Total	650

Table B.5.3 Region 1: Roots (traditional): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	255
Dec. - Feb.	300
March - May	0
June - Aug.	75

Table B.6.1 Region 1: Roots (potential): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	19,22	154,22	2963,43	355,04
1975	0,00	244,94	0,00	-2608,39
1976	17,62	223,71	3941,10	1332,72
1977	19,33	192,38	3718,03	1109,64
1978	14,69	234,55	3445,67	837,28
1979	1,30	147,24	191,02	-2417,36
1980	14,97	192,48	2880,55	272,16
1981	9,68	184,00	1780,91	-827,48
1982	18,39	178,00	3273,57	665,18
1983	14,80	262,73	3889,59	1281,20
Mean	13,00	201,42	2608,39	0,00
C.V.	17,32	6,06	17,76	

Table B.6.2 Region 1: Roots (potential): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	88
Seed (2150 kg)	697
Fertilizer (660 kg 2:3:4)	290
Chemicals	175
Total	1250

Table B.6.3 Region 1: Roots (potential): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	375
Dec. - Feb.	600
March - May	0
June - Aug.	75

Table B.7.1 Region 1: Sugar-cane: Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	29,82	37,46	1117,04	43,35
1975	27,48	44,83	1231,88	158,19
1976	32,94	38,77	1277,07	203,38
1977	30,21	36,90	1114,61	40,92
1978	36,00	35,66	1283,59	209,90
1979	31,40	36,24	1137,90	64,21
1980	19,84	42,40	841,12	-232,57
1981	32,36	31,80	1029,05	-44,64
1982	30,99	31,59	978,94	-94,75
1983	18,98	38,24	725,70	-347,99
Mean	29,00	37,39	1073,69	0,00
C.V.	6,02	3,48	5,42	

Table B.7.2 Region 1: Sugar-cane: Estimated annual production costs, excluding labour (1985).

Particulars	R/Ha
Machinery and transport services	375
Seed	40
Fertilizer	150
Chemicals	60
Total	625

Table B.7.3 Region 1: Sugar-cane: Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	200
Dec. - Feb.	56
March - May	152
June - Aug.	152

Table B.8.1 Region 2: Cereals (traditional): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	0,04	303,80	12,53	-119,02
1975	0,70	281,17	196,67	65,12
1976	0,47	308,92	144,27	12,73
1977	0,68	339,59	231,60	100,06
1978	0,62	349,52	217,03	85,48
1979	0,14	371,51	52,84	-78,70
1980	0,00	375,00	0,00	-131,55
1981	0,67	335,86	226,27	94,72
1982	0,50	349,61	174,28	42,73
1983	0,18	342,73	59,99	-71,56
Mean	0,40	335,77	131,55	0,00
C.V.	22,25	2,80	21,99	

Table B.8.2 Region 2: Cereals (traditional): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	30
Seed (18 kg)	6
Kraal manure and fertilizer	10
Total	46

Table B.8.3 Region 2 Cereals (traditional): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	260
Dec. - Feb.	35
March - May	30
June - Aug.	25

Table B.9.1 Region 2: Cereals (potential): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (t/Ha)	Price (R/t)	Revenue (R/Ha)	Deviations (R/Ha)
1974	0,14	303,80	43,85	-613,52
1975	3,54	281,17	996,54	339,17
1976	2,36	308,92	729,98	72,61
1977	3,48	339,59	1180,50	523,13
1978	3,16	349,52	1104,95	447,58
1979	0,67	371,51	249,39	-407,98
1980	0,00	375,00	0,00	-657,37
1981	3,41	335,86	1143,85	486,48
1982	2,47	349,61	864,41	207,04
1983	0,76	342,73	260,24	-397,13
Mean	2,00	335,77	657,32	0,00
C.V.	22,97	2,80	22,71	

Table B.9.2 Region 2: Cereals (potential): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	88
Seed (20 kg)	32
Fertilizer (530 kg 2:3:2)	230
Chemicals	70
Total	420

Table B.9.3 Region 2: Cereals (potential): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	450
Dec. - Feb.	250
March - May	120
June - Aug.	100

Table B.10.1 Region 2: Legumes (traditional): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (kg/Ha)	Price (R/kg)	Revenue (R/Ha)	Deviations (R/Ha)
1974	227	2,51	570,23	-31,17
1975	339	2,42	819,29	217,89
1976	324	3,07	993,15	391,74
1977	302	2,74	828,73	227,33
1978	270	1,96	528,99	-72,41
1979	145	2,00	289,92	-311,48
1980	65	2,43	158,85	-442,56
1981	232	2,75	638,57	37,17
1982	255	1,97	502,79	-98,61
1983	240	2,85	683,51	82,11
Mean	240	2,47	601,41	0,00
C.V.	10,90	5,03	13,23	

Table B.10.2 Region 2: Legumes (traditional): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	30
Seed (70 kg)	175
Fertilizer (270 kg 2:3:2)	120
Total	325

Table B.10.3 Region 2: Legumes (traditional): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	150
Dec. - Feb.	450
March - May	100
June - Aug.	0

Table B.11.1 Region 2: Legumes (potential): Estimates of detrended yield, deflated producer price, revenue and deviations from mean revenue (1985=100).

Year	Yield (kg/Ha)	Price (R/kg)	Revenue (R/Ha)	Deviations (R/Ha)
1974	613	1,88	1150,60	-174,24
1975	1177	1,81	2129,35	804,52
1976	1101	2,30	2526,00	1201,17
1977	993	2,05	2035,71	710,87
1978	831	1,46	1216,42	-108,42
1979	197	1,50	295,35	-1029,48
1980	0	1,82	0,00	-1324,83
1981	643	2,06	1322,25	-2,58
1982	760	1,47	1118,57	-206,27
1983	683	2,13	1454,09	129,26
Mean	700	1,85	1324,83	0,00
C.V.	16,84	5,03	18,68	

Table B.11.2 Region 2: Legumes (potential): Estimated production costs, excluding labour (1985).

Particulars	R/Ha
Contract ploughing and discing	88
Seed (50 kg)	110
Fertilizer	320
Chemicals	172
Total	690

Table B.11.3 Region 2: Legumes (potential): Estimated labour requirements.

Season	Hours/Ha
Sept. - Nov.	150
Dec. - Feb.	480
March - May	150
June - Aug.	0

Table B.12 Estimated mean retail and farm-gate prices (1985 R/t).

Crop	Retail (imported)	Farm-gate local sales	Farm-gate Urban sales
Cereals	485	336	220
Legumes (traditional)	2560	2470	1850
Legumes (potential)	2490	1850	1850
Roots (summer & autumn)	224	201	201
Roots (winter & spring)	290		
Sugar-cane			37

Appendix C

Results of regression analyses

Table C.1 OLS regression equations estimated from crop trial data.

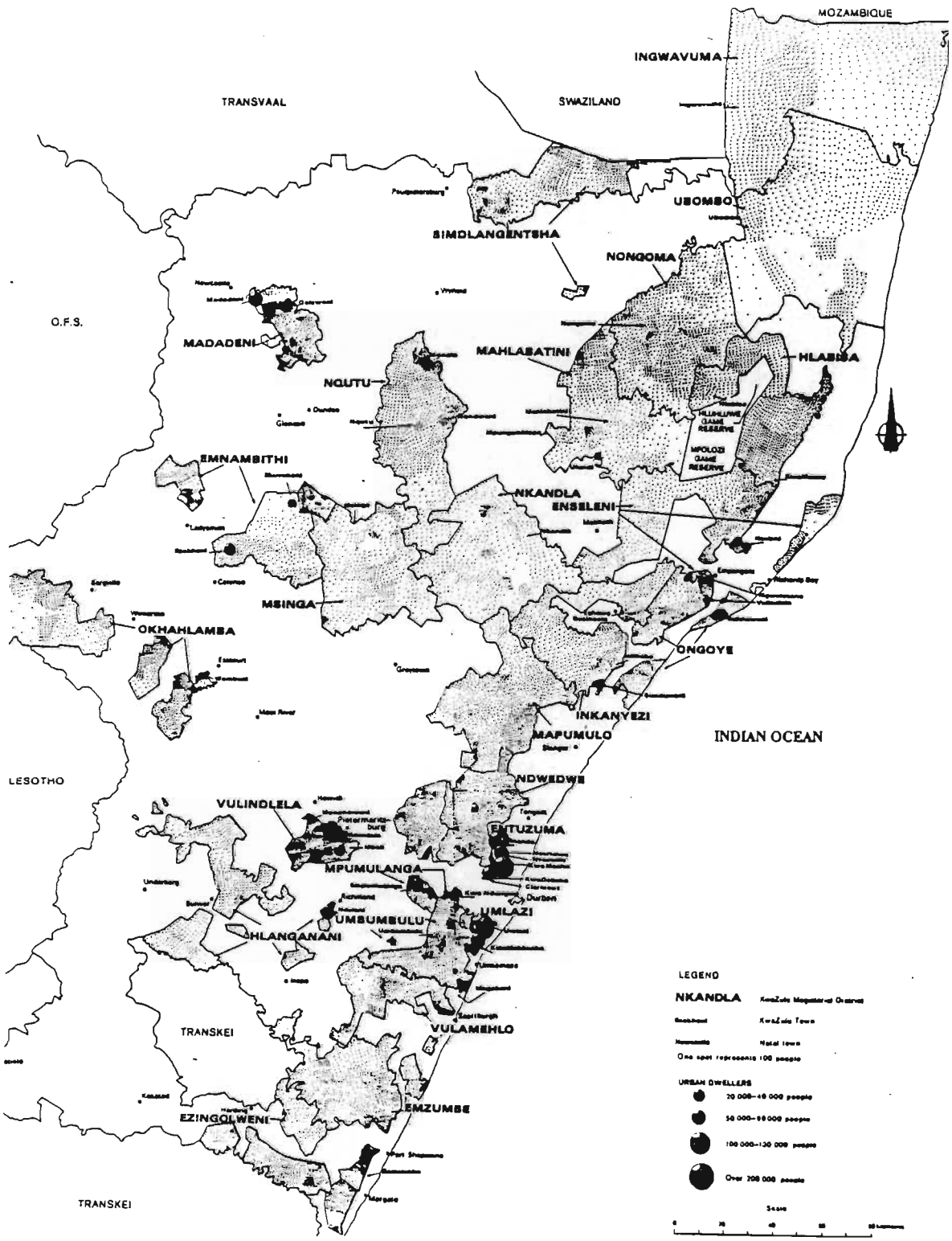
	Dependent variable = yield per Ha					
	Traditional technology			Potential technology		
Explanatory[1] variable	Maize (kg)	Beans (kg)	Potatoes (t)	Maize (kg)	Beans (kg)	Potatoes (t)
Intercept[2]	-8253,0**	-1890,9*	-40,8**	-45157,3**	-11849,4	-223,6**
Rain	30,1656*			158,6910*		
(Rain)^2	-0,0234*			-0,1231*		
Rain		9,4756*			51,3325	
(Rain)^2		-0,0094*			-0,0476	
Rain			0,2287**			1,2044**
(Rain)^2			-0,0003**			-0,0014**
Adjusted R^2	0,72	0,94	0,67	0,72	0,54	0,67
F value	9,82*	30,41*	11,11**	9,82*	3,95	11,11**

Notes 1 Rain = rainfall (mm) over the relevant growing period.
2 Intercept values were adjusted downward to estimate maize and bean yields in Region 2 where market inputs are applied at lower levels.
* Implies significance at the five per cent level of probability.
** Implies significance at the one per cent level of probability.

Source Auerbach (1989); Cairns (1989); CCWR (1989); Ilaco BV (1981); Liebenberg and Joubert (1986/87); Mallet (1988); Melis (1988); Melis and Garman (1981/82-1986/87); Nortje (1988); Rogers (1982); Stewart (1988).

Appendix D

Map D.1 Distribution of population in KwaZulu



Appendix E

Survey questionnaire

This information is confidential and is to be used for research purposes by KwaZulu Government and Natal University Staff. No names are required.

1. IDENTIFICATION

STRATNO	
BLOCKNO	
RANDNO	

2. HOUSEHOLD SIZE AND EMPLOYMENT

	Household Member	Sex	Age	Occupation	Type of commuter				Place of employment	Gross monthly cash income	Monthly remittance	Pension and disability payments	Number of years		Adults not Employed		
					Daily	Weekly	Contract	Permanent					Employed	Education	Disabled	Too busy	Searching
1	Male head	M															
2	Female head	F															
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	

3. COST OF EDUCATION

Annual cost per high school scholar	
Annual cost per junior school scholar	

4. FAMILY ORIGIN

How many years has the family head resided in this ward	
Where did the household head reside before	

5. LABOUR USED IN OWN FOOD PRODUCTION

	Household member	Hired and hommage labourers	Hours worked per day	Days worked per week	Weeks worked per year	Daily Wage	Rations	Crop Share Y/N	Time or piecemeal T/P
1	Male head								
2	Female head								
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

	Y/N	Daily wage
Is there sufficient labour for crop production		
Could labour be hired if necessary		
If not, why? Prefer employment on white farms		
Difficult to supervise		
Cannot afford to pay labour		

6. LAND

	Y/N	Rand/ Annum	Area
Is land cash leased from other farmers			
Is land cash leased to other farmers			
Is land sharecropped		%	
Is the arable area large enough			
Is more freehold land available			
Is more leasehold land available			
Is more sharecropping possible		%	

7. LIVESTOCK

No. of cattle possessed	
Females	
Bulls	
Oxen	
No. of goats	
sheep	
mules	
donkeys	
horses	
pigs	

Livestock sold during past year		animals	value
	1		
	2		
	3		
	4		
	5		

8. CROPPING

Pure crops	Grown Y / N	Freehold land					Leased land		Sharecropped		Estimated yield	Total area under crop type	Gross income in one year
		Field 1	Field 2	Field 3	Field 4	Field 5	Field 1	Field 2	Field 1	Field 2			
Maize													
Sugar													
Sorghum													
Madumbi													
Potato													
Beans													
Groundnut													
Sweetpotato													
Tomato													
Cabbage													
Onion													
Avocado													
Peach													
Wattle													
Fallow													

Alternative income sources

Source	Annual income

Total pure crop area _____

Total pure vegetable area _____

Gross crop income _____

Number of fruit trees

_____

_____

.xed crops

	Grown Y / N	Freehold land Field 1	Field 2	Field 3	Field 4	Field 5	Leased land Field 1	Field 2	Sharecropped Field 1	Field 2	Total area under crop type
.ize and beans											

Total mixed crop area _____

Total maize mix area _____

Total vegetable mix area _____

INPUTS

	Usage Y / N	Price paid			Quantity used in one year			Place obtained			Total rand in one year
rtilizer		LAN	2 3 2	2 3 1	LAN	2 3 2	2 3 1				
roved seed											
dicide, herbicide											
pesticide											
ctor ploughing											
al ploughing											
al debt to r industry											
r farm debt											
rinary services											
gement services											

Would you like to grow more maize for consumption Y / N
Would you like to grow more maize for sale Y / N
What are the major limitations on increased production.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Was there any surplus production that could not be sold :

Crop	Quantity unsold	Reason not sold

10. URBANIZATION

1. Would the household like to move to an urban area. [Y / N]

If yes :

1.1 Where ._____

1.2 Why would the family like to move.

[Y / N] Financial reasons (higher family income in urban area)

[Y / N] To be with family (eg. to join husband)

[Y / N] Improved quality of life (easier lifestyle,better facilit:

Other reasons (specify :_____

_____

1.3 Why has'nt the family moved.

[Y / N] Legal reasons (eg. no urban rights)

[Y / N] Financial reasons (specify :_____

_____

Other reasons (specify :_____

_____

If no ;

1.4 Why does'nt the family wish to move.

[Y / N] Quality of life (prefer rural lifestyle)

[Y / N] To retain land rights

[Y / N] Financial reasons (specify :_____

_____

Other reasons (specify :_____

_____

2. If the family urbanized permanently would it surrender its rural land rights willingly Y / N

grazing rights Y / N

11. ASSETS

	Quantity	Value (to be assessed by survey team)
Motor car		
L.D.V. (Bakkie)		
Tractor		
Plough		
Planter		
Cultivator		
Harrow		
Hoes		
Knapsack sprayer		
Wheeled trailer		
Storage silo / trench		
Motorcycle		

12. ALLOCATION OF TIME BY HEAD FEMALE

Task	Hours
Cooking and cleaning	
Tending children	
Fetching water	
Fetching wood	
Working in the lands	

If the female head had one extra hour of time per day, how would she spend it.

_____ Priority 1

_____ Priority 2

_____ Priority 3

Would any family member be prepared to pay for creche facilities. [Y / N] How much per infant [ ]